

# The Role of Green Server Hosting in the Digishift Era: a discussion from the theoretical point of view



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# Executive Summary

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The purpose of this study is to discuss, from the theoretical point of view, the part that Green Server Hosting is playing in the Digishift Era. More specifically what kind of benefits Green Server Hosting might provide to the Operations and Marketing & Sales activities of Google and Facebook.

A research question was established and secondary data was used in order to find results through theoretical framework, and analyzed against the activities performed by the chosen companies. The lack of collaboration to the research from private institutions conditioned this kind of analysis.

Within this paper it is expected that the reader can obtain understanding of how the effects of global warming and the increasing awareness of its effects on the planet are not only threatening companies, but offering new opportunities to develop new markets and even increasing their revenues.

From the theoretical point of view green initiatives, including Green Server Hosting can optimize environmental processes, enhancing but not alone the success for an Environmental Corporate Strategy. The findings regarding Google and Facebook activities regarding green initiatives might be a signal of trust in what some researchers have proposed, however the paper did not attempt to be conclusive as further research needs to be done and the implemented models must be tested.

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# I. Introduction

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The Digital Era arrived, almost every activity can be accomplished over the internet and the access through mobiles devices to the network has strengthened the bond between the three worlds: the material, mobile and online world. Dynamics within the system have changed and stakeholders have had to adapt in order to keep their competitiveness. To some extent material interactions seem to evaporate, just like water, and become part of a whole new system called “the Cloud”.

Despite the fast Digitalization Phenomenon, there is always a material counterpart to take into consideration; all the dynamics taking part on the Cloud need to be supported by servers, pieces of machinery physically allocated in Data Centers, some of these consuming amounts of energy larger than cities.

Companies have been on the run, trying to master the new technologies in order to improve their competitiveness, the ones who first succeeded did obtain a temporary advantage over the rest, but it will last as far as the other organizations catch up with the learning curve. Leading companies need to find next logical steps: costs optimization and marketing opportunities related to eco-friendly initiatives might be one of them.

The current document aims to open a discussion from the theoretical point of view on how Green Server Hosting could positively impact value activities such as: Operations, Outbound Logistics and Marketing & Sales within two of the biggest social network companies in the World: Google and Facebook.

## *1. Statement of the problem*

The Digital Era is full of options, the perception of time and space has radically changed. Knowledge travels at the speed of light, what appeared “impossible” seems to vanish when it comes to face the current technological advances. To sustain this Digital World, it is necessary to provide and maintain a material counterpart and as Stross (2008) said “some environmental critics see the Cloud as a gauzy euphemism for Data Centers that sit not on a diaphanous Cloud, but solidly on earth, consuming enormous amounts of scarce energy”.

The existence of an online world has a direct impact in the resources from the material world and therefore it is a compulsory to point out its effects in order to understand the need of opening a discussion on this paper.

### Economical effect

Since the middle of the 1990s, which marked the mainstream adoption of the internet and commercial enterprise software, competition within the United States' economy has accelerated to unprecedented levels. A central catalyst in this shift is the massive increase in the power of IT investments (McAfee & Brynjolfsson, 2008)

Findings show that the internet and enterprise IT are now accelerating competition within traditional industries, not because more products are becoming digital but because more processes are (McAfee & Brynjolfsson, 2008).

Existence of a direct and proportional relationship between IT investment and competitiveness might be found on three quantifiable indicators: concentration, turbulence, and performance, however under that argument it would just be a matter of time until companies figure out how to internalize the new tools and all industries return to their previous competitive patterns (McAfee & Brynjolfsson, 2008).

In plain words, some researchers pointed at those investments in IT have boosted the performance of companies. The ones who adopt and master the new technology get a source of competitive advantage that will last until the followers catch up. Companies must find initiatives to keep ahead on the race, one of them might be optimizing the costs for server's maintenance.

For some kind of industries, like computer service, the need for massive servers is a compulsory to maintain operations and sales. Clear examples are global companies such as Google and Facebook. Their profiles according to Forbes Rank for March 2013:

- Google a company from USA founded in 1998, it has value in the market for \$268,44B and sales for \$50.18 and has the 3<sup>rd</sup> position when it comes to market value.
- Facebook a company also from USA founded in 2004, it has a value in the market for \$63,47B and sales for \$5,09 B and has the 118<sup>th</sup> position when it comes to market value

After checking these numbers it should not come as a surprise that by 2006 some Data Centers already consumed more power in the United States than television sets (Randall Stross, 2008).

Searching for efficiency, Data Centers have developed a new type of natural free cooling, powered by clean renewable hydroelectric and geothermal energy sources, they offer unique value proposition for companies demanding a reliant and cost effective hosting service in a 100% green, zero Carbon footprint environment.

The former proposal might be a great innovation due the potential impact of this service on the Evolving nature of Operations: Globalization, Business Integration and Corporate Responsibility.

### Social Effect

When it comes to foreseeing the future of commercial activities and how the Internet has an effect on them, some organizations research and publish reports trying to discuss the future of commercial activities, Steen & Strøm Trendlab (2011) mentioned the Digishift a Phenomena that is shaping the commercial dynamics.

The Digishift is illustrated by the words of Paco Underhill in the Trendlab book of 2008 who says: “the convergence and the cross between the online world, the mobile world and the bricks and mortar world are going to be very, very, very much a part of our future” (Steen & Strøm, 2011).

In parallel, some researches talk about the existence of a trend called “First true native Netizens” (Steen & Strøm, 2011) defining them as a group of people born between 1982 and 2006. Netizens are digitally inclined, and stay connected online most of the time. They operate within the Digishift, mastering a mix of real world (mortal world) and virtual world date through their digital devices. People partly live through media, constantly in a digital flow of information.

This Phenomenon is changing the balance of power between companies, distributors and consumers. Now people are more and better connected, the learning curves are decreasing addressing to companies the threats of potential competitors coming directly from the members of their distribution channels or even the final user.

The existence of user driven communities has set a new scenario, where the ease to speak up about individual or collective concerns sets a challenge to companies when it comes to the way society evaluates the impact of their activity on the system.

According to some researchers, companies have done efforts to improve their performance but with no much success, there are two main reasons: First, they pit business against society, when clearly the two are interdependent. Second, they pressure companies to think of corporate social responsibility in generic ways instead of in the way most appropriate to each company's strategy (Porter & Kramer, 2006).

The same researchers have stated that members of society now are sharper pointing the social consequences from companies' activity; thus Corporate Social Responsibility has become a must for business leaders, through the publicity generated and the existence of institutions with the role of monitoring and ranking company's performance on term of their CSR commitment.

And that interest for community issues might set a subjective norm for an individual when it comes to its will reaction towards new technological services powered by green energy.

#### Environmental Effect

The increasing demand for storage, networking and computation has driven intensification of large complex Data Centers that run many of today's Internet, financial, commercial and business applications. A Data Center comprises of many thousands of servers and can use as much energy as a small city. Massive amount of computation power is required to drive and run these server farms resulting in many challenges like huge energy consumptions, emission of greenhouse gases, backups and recovery (Uddin & Rahman, 2012).

Global warming, an effect from Carbon emissions, is a common term for every member of society. There are several movements and organizations whose activities spin around that term and the IT industry is not the exception to the rule. Stockholders make a big pressure to assure that the companies' performance and even the governments are setting legislations to grant greener practices.

Researchers mentioned that global warming and rise on energy costs are posing serious challenges for the sustainability of the global economy (Molla, Cooper & Pittayachawan, 2009). Policy makers have identified IT, specifically Data Center energy use as one of the fastest rising sectors (Newcombe, 2009)

## *2. Background and Needs*

Since the very beginning of human history certain inventions had radically changed the way life is conceived, the wheel, astrolabe and currency contributed to an expansion process, gathered civilizations and somehow ruled the dynamics of the systems in the material world.

While the 20th and 21st century has been marked by technological innovation, few, if any, can rival the effect that the Internet has had. It has changed the way people live on a daily basis, the way they exchange goods, information and even how they socially interact.

On this digitalized society server hosting is the backbone to the internet flow, the cornerstone of communications in the Knowledge's Age. No activity related to computer can be performed without a server; therefore it is important to know few bullet points related to their evolution during the last 32 years; for this purpose, information easy to understand can be found in web communities like [www.iweb.com](http://www.iweb.com), where bloggers Stéphane Jose et al. (2012) points:

1981 – The IBM VM Machine, first list server: was hosted on an IBM, enabled group email collaboration, and spurred the first list spams, flame wars and online trolling

1991 – NeXTCube, first web server: the World Wide Web was born on this server when Sir Tim Berners-Lee put the first web page online on August 6.

1998 – Sun Ultra II, first Google server: It first hosted Larry Page and Sergey Brin's Backrub search engine – which, of course, eventually evolved into Google, located at Stanford University. Google now has 450,000 servers in its datacenters around the World. Web applications and Cloud computing use literally exploded. In fact, the concept of Cloud computing is not new, it is as old as the Internet itself (and its military predecessor, Arpanet), but with a significant reduction in bandwidth costs in the 90's, it has now become a reality for the general public.

As almost any other human activity, the digitalization of information and activities has consequences, some researchers point to them in a very accurate way such as: The increasing demand for storage, networking and computation has driven intensification of large complex Data Centers that run many of today's Internet, financial, commercial and business applications. A Data Center comprises of many thousands of servers and can use as much energy as small city. Massive amount of computation power is required to drive and run these server farms



resulting in many challenging like huge energy consumptions, emission of greenhouse gases, backups and recovery (Uddin & Rahman, 2012)

Dynamics of a more likely immaterial system relay on the existence of physical servers consuming big amounts of energy and polluting the atmosphere with gases; thus is necessary for companies to find eco efficient solutions to optimize their resources, reduce their operations costs and take the opportunity of improving their image towards society, what can provide accountable benefits in the short and long term.

### *3. Purpose of the Study*

This paper aims to provide a start point of discussion for the potential impact that a support activity such as “Green Server Hosting” could have on the value chain primary activities such as: Operations, Outbound Logistics, and Marketing & Sales

The main drivers to apply this study were the lack of similar information and the growing relevance for green initiatives in terms of competitiveness. The Digishift is taking over; companies and consumers are getting familiar with its dynamics and at the first stages companies can rely only on their capability to master the technology and perform; but It might not last long, two clear arguments are:

- By now consumers are paying attention to “what” they get; they are meeting the new technology and benefits, but shortly they might start pointing to “how” companies provide it, in terms of the consequences to the society including environmental effects
- Companies with resources can access better technology; this can provide an advantage over the competitors, although as soon as prices lower that strength will disappear

Facebook and Google, two of the biggest social network companies in the world were chosen to be analyzed from the theoretical point of view.

#### *4. Problem Formulation*

Global warming is a worldwide known phenomenon; human activities have rapidly modified the environment with terrible consequences; governments and particular groups within society are taking specific actions to raise awareness of the situation. Part of the main challenges has been to monitor and control the Carbon emissions due to the lack of a global accepted system, but some initiatives like the Kyoto protocol has already started.

In the Digital Era information flows faster. People are increasingly gaining awareness on the negative effects that some industries have over the environment, but the effect from others remains somehow hidden from the public attention. One of them: The Internet & Communication Technology (ICT).

Facebook and Google, both global companies within the ICT industry, hold vast amounts of physical installations over the planet where servers guarantee the dynamics of their business. Those servers consume huge amounts of energy to make possible their existence in the Cloud. It seems like that euphemism plus the characteristic innovativeness from those companies still blur the public attention from serious judgments, but eventually the situation might change.

Global warming might drive customers to prefer products based on eco-friendly processes. Therefore, companies have to develop a strategy in order to be competitive.

Competitive strategy not only demands from companies to look at their industries, but within their own structures, identifying what kind of activities might cause direct impact on the value creation of the industry benefits and even modify it to its favor (Porter, 1985).

As a response to the global warming, Data Centers have implemented a new type of natural free cooling for server's hosts, they promote it as a step forward on the run to save the planet. This initiative is known as Green Server Hosting and it might be seen as a great innovation, due to the potential impact of this service on the evolving nature of companies' strategy: Globalization, Business Integration and Corporate Responsibility.

All what has been said to this point leads to the following research topic:

- ❖ The role of Green Server Hosting in the Digishift Era: a discussion from the theoretical point of view

In order to narrow the topic and get a better insight a research question has been formulated:

- ❖ How Green Server Hosting could positively impact the primary activities of social network companies like Facebook and Google?

This question will be addressed by answering the following sub-questions:

- What benefits Green Server Hosting could provide to the Operations activities within Google and Facebook?
- What benefits Green Server Hosting could provide to the Marketing & Sales activities within Google and Facebook?

## *5. Significance of the Study*

For the participants:

The current paper has been written as the culmination for the Master of Science studies curricula. The accomplishment of this task, including an oral examination, will grant to the authors a graduate diploma on Economics and Business Administration with a concentration on International Marketing and Management.

For the field of study:

From the academic point of view the approaches and discussions from the theoretical perspective on this paper might be a start point for further analysis related to this topic and that might also imply data collection in the ICT industry, such as interviews, surveys, focus groups, among others.

The paper might raise awareness for the readers about how is possible for companies to be effective and also friendly with the environment.

## *6. Limitations*

The main limitations to conduct this study were two:

- Limited availability to information or access to studies within this field.
- Negative or no response from companies to collaborate with primary information for data collection due to time or privacy constraints.

## II. Methodology

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### *1. Introduction*

In order to maintain competitive advantage, companies not only have to be aware of their own structures and the forces within their industry, but how their actions have an effect on environment and society.

Digitalization, Global Warming and Green Strategy are not new concepts, but their relevancy is increasing; new threats/opportunities can be foreseeing on that.

The role of Green Server Hosting, from the theoretical point of view, within today's context is the core for this Master Thesis.

For the academic porpoises of this paper, the topic has been narrowed through a research question:

- ❖ How Green Server Hosting could positively impact the primary activities of social networks companies like Facebook and Google?

The Master Thesis's authors have collected evidence that is based solely on secondary data from sources such as: articles, books, reports, annual reports, and official websites among others. A detailed list of the sources can be found within this document.

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### *Authors Statement + Support to the Statement (theoretical) + Authors' Argumentation*

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Based on the collected data, the authors conducted a discussion under the following structure:

Conclusions have been drawn after the discussion as the final of this paper.

### *2. Delimitations*

The study has been conducted in Copenhagen, Denmark 2013 and, as mentioned before, it was applied to two Companies: Google and Facebook. The 5 main criteria to choose them can be found below:

- a. They are Global companies generating a huge amount of money and catching a lot of attention from media and society
- b. Both work on the Internet Communication & Technology Industry (ICT)
- c. Despite having different portfolios their business is to provide and enable free information for their users and generate revenue on paid advertisement

- d. Their operation relay on the existence of massive servers
- e. They are relevant for almost every active member of the Digital era

Above criteria allow establishing a common profile and that simplifies the analysis and discussion within the Master Thesis.

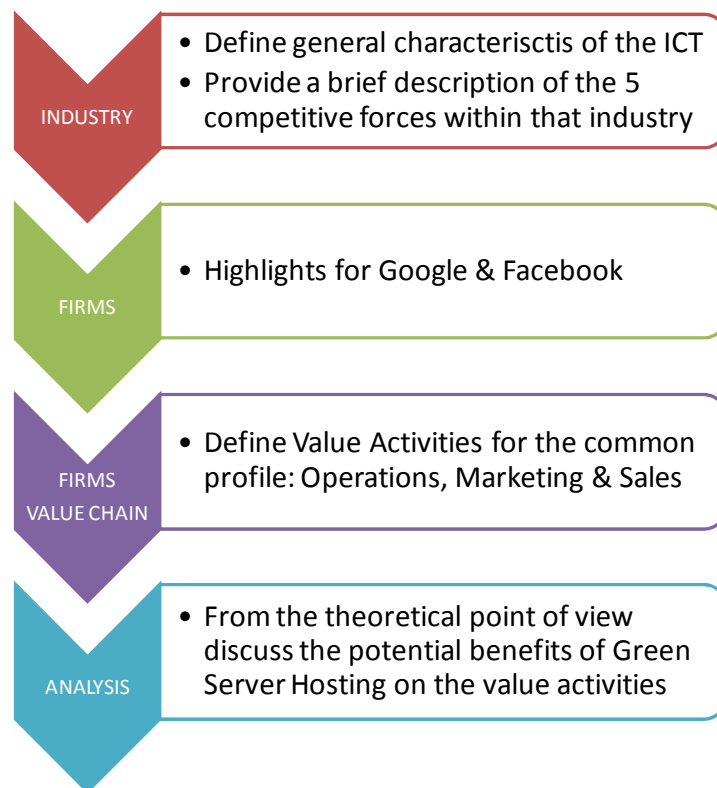
### *3. Limitations*

Initially, the authors expected to collect primary information from companies holding online interviews with their Operations Directors to test some assumptions and from there design a quantitative research using a questionnaire as a data collection tool.

The lack of cooperation from the companies' representatives eliminated the possibility to follow that path.

### *4. Structure for the Analysis*

Before entering into the following discussions, the authors have decided to use a funnel structure in order to get a better insight and sharpen the argumentation. Please see the figure 1 below:



*Figure Number 1. Structure for the Analysis*

### III. Analysis

In this chapter the authors have proceed with the analysis of the collected data. The process is made into three major sections: Foundations, Operations, Marketing & Sales. At the end of each section a conclusion will be drawn including the limitations of the theory used. This approach is taken to try to fully answer the research question, of what the role of Green Server Hosting is in the Digishift Era.

#### 1. Detailed Structure of the Analysis

Based on the collected data, the authors conducted a discussion under the following structure:

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*Statement (Authors) + Support to the Statement (Theory) + Argumentation (Authors)*

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A detailed explanation from the structure above can be found below in figure 2:

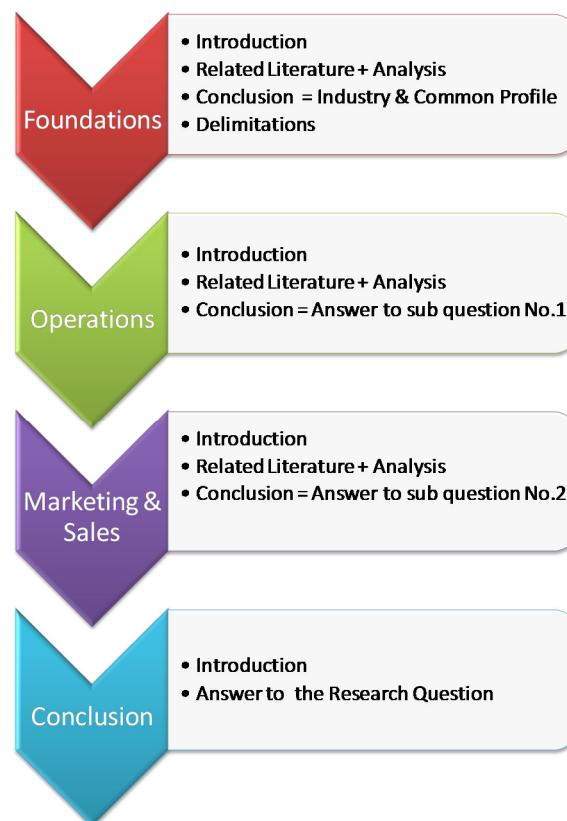


Figure 2. Structure for the Analysis in the Master Thesis

## 2. Foundations

### 2.1. Introduction

Prior to the start of the discussion, the authors have decided to use a flow chart structure in order to get a better insight of the concepts relating to strategy, digitalization, accountability, company structure and green policies. Being familiar to this kind of information will ease the understanding of the following sections. Please see figure 3 below:

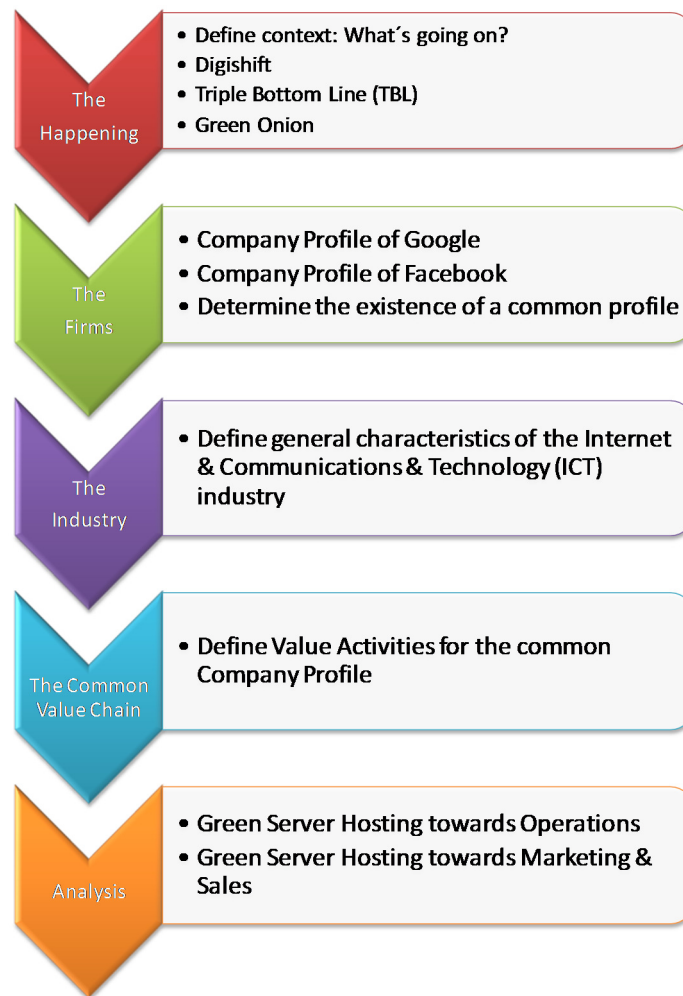


Figure 3. Structure for the Analysis in the Master Thesis

## 2.2. Context

### The Digishift

Humanity is experiencing a new technological revolution known as the Digishift, a fusion between mobile, online and material world. Negroponte (1995) referred to a belief that every object or product which can be digitized will become digitized in the future.

Steen and Strøm is a leading shopping center company in Scandinavia. Since 2007 they have been organizing Trendlab in the region inviting employees, retailers, and other experts to discuss the future of consumers, retailers and shopping centers.

In their second report, published in 2008, they covered the most important shifts that will have big impact of shopping places in the future. At that point they identified 10 major shifts, however for the purposes of this paper only one will be mentioned below:

***Environment shift*** – from Eco-luxury and Eco-Chic to Survival (Sustainability rules, Small Scale and Local Heroes, Eco-smart shopping). According to the report there will be a peek in Eco-luxury and Eco-Chic to Survival in the not so distant future. Energy, food, water and raw-materials are becoming scarcities for a growing global population. Consumers will be ever more critical of businesses and brands that behave irresponsible. Sustainability will be the driving force and focus in the efforts to create eco-smart production and consumption (Steen & Strøm, 2011).

In the 2011 report, their assumptions describe how digital channels will shape the future of shopping.

In this matter, they mention the Digishift which can be defined as the convergence and the cross between three different worlds: the online world, the mobile world and the bricks and mortar world. They argue that today people partly live through media constantly within a digital flow of information (Steen & Strøm, 2011).

The new mobility and connectivity reshapes re-form and restructures businesses, branches and societies. The new connectivity and the fact that more and more products have been transformed to bits rather than atoms, creates a new type of density in the market where everything is reachable from the palm of your hands, from your computer, your mobile, your car, your



Nintendo or Flat screen. You're closer to your co-workers or customers through Skype. You're friends and family are almost always with you via Facebook, Twitter, Go-Walla or Foursquare. Your records and every record ever produced is near you through Spotify or iTunes. Even your money and savings are in the reach every second of the day (Steen & Strøm, 2011)

The report also mentioned Richard Normann, a famous Swedish management thinker and writer that stated in his last book that because of the digitization, the carriers of value in almost every business will become de-materialized in the future.

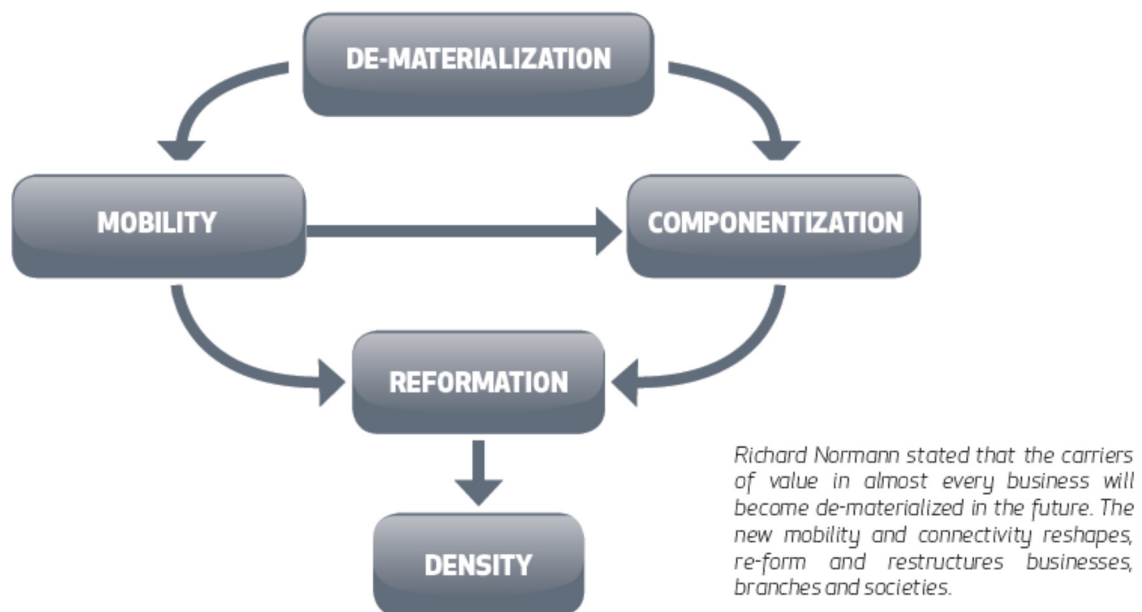


Figure 4. Steen & Strøm representation of Richard Normann statement

The report gives a very good understanding of what is going on, but it also provides a new term or identity to the people experiencing this phenomena: Those people, digitally inclined are called “Netizens”. This is one of the trends assumed by the Trendlab. “True Netizens” are individuals born between 1982 and 1996; they grew up with the network culture and global online games.

However, Netizens can also be people born before, but are considered Netizens because they are digitally inclined. They spend most of their time online and operating within the Digishift, evolving in the real world and the virtual world at the same time through the use of their mobile devices (Steen & Strøm, 2011).

Netizens consider themselves not only as consumers, but also as marketers, navigators, media producers (Steen & Strøm, 2011).

This trend underlines the fact that today people are increasingly well informed and can become “experts”. The power relationship is new since consumers realize the “commercial value of spreading the word or taking part in the buzz” (Steen & Strøm, 2011).

But all this digital phenomena that progressively de-materialize things is based on physical servers, without them storing and facilitating data exchange nothing would be possible; researchers like Stross (2008) said “some environmental critics see the Cloud as a gauzy euphemism for Data Centers that sit not on a diaphanous Cloud, but solidly on earth, consuming enormous amounts of scarce energy”; therefore the importance of Steen & Strøm 2011 report to be included on this paper.

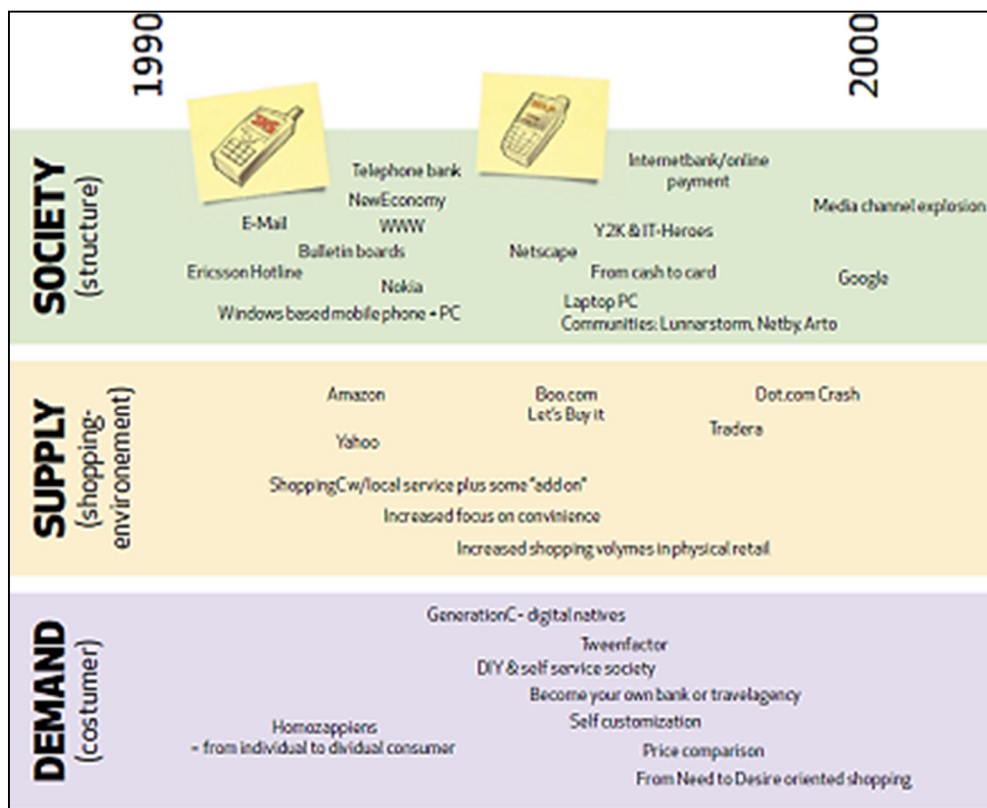


Figure 5. From past to present (Steen&Strøm

As one of the outcomes of this trend lab, they first took a glance of the 90's, a time when the virtual world was discovered and the most inspiring thoughts about what the internet will bring to the world were a problem and a blessing for many companies For the purpose of this paper on the analysis section, two happenings must be stated:

- Some of today's giants were founded during that decade including Amazon, eBay and by the end of it, Google, see figure 5.
- Today's superstars the iPhone, Facebook and the iPad were created mentally back then, see figure 6.

The report goes on to describe the beginning of the 21 century, pointing to what happened after the crash of the Hype (Dotcom bubble) and how e-commerce did not evolve much during that decade. Nevertheless innovation within the social media has been intense with the launch of new sites like Netby in Norway, Play ahead in Sweden, Twitter, LinkedIn, Facebook, Flickr etc. (Steen & Strøm, 2011).

A timeline for the Digishift was created by them.

And finally the report provides a look into the future saying that the internet economy is back; Social media, user interfaces, word of mouth, customer driven innovation, location based services, smart phones, NFC, and self-checkouts are now part of the incumbents' core strategies (Steen & Strøm). The report also mentions 7 main drivers for society in the next decade, the relevant ones for this paper are:

- Financial burden: Europe's financial difficulties will continue to drive developments in the retail sector and in society as a whole due to difficulties for countries to pay their debts, generating loss to banks and pension assets. Thus crisis Cloud will keep hanging over economy. Many people are now expecting the "turbulent teens", a decade of uncertainty and turbulence
- Technology with a human touch: As technology becomes more common in society people ask for more human touches. Technology is now moving into an era of expanding human development. Instead of technical focus there is more focus on human interaction with technology. Individuals are becoming more tech-savvy and tolerant.
- Shift in the Environment: The demand from the developing countries will put pressure on global resource use for the coming decades.

In few words, the message within the 150 pages from Steen & Strøm 2011 report is that there is a clear tendency for trade and society as a whole to become more digitalized. Companies and

consumers will become experts in the field and the optimization of resources and acknowledgement of social impact will be determinant. And given green server hosting is the skeleton of this structure; this report is relevant for the considerations and analysis within the current paper and strongly related to the article below.

### **The Triple Bottom Line (TBL)**

The TBL is an accounting framework that incorporates three dimensions of performance: social, environmental and financial.

This differs from traditional reporting frameworks as it includes ecological (or environmental) and social measures that can be difficult to assign appropriate means of measurement.

The TBL dimensions are also commonly called the three Ps: people, planet and profits. We will refer to these as the 3Ps (Slaper & Hall, 2011).

The TBL “captures the essence of sustainability by measuring the impact of an organization’s activities on the world including both its profitability and shareholder values and its social, human and environmental capital.” (Savitz, 2006)

The trick isn’t defining TBL. The trick is measuring it. The 3Ps do not have a common unit of measure. There is no universal standard method for calculating the TBL. Neither is there a universally accepted standard for the measures that comprise each of the three TBL categories. The level of the entity, type of project and the geographic scope will drive many of the decisions about what measures to include (Slaper & Hall, 2011).



*Figure 7 The Triple Bottom Line (Elkington, 1994)*

From the academic discourse Slaper & Hall (2011) provide the following measures:

- **Economic Measures:** ought to be variables that deal with the bottom line and the flow of money. It could look at income or expenditures, taxes, business climate factors, employment, and business diversity factors.

- Environmental Measures: variables should represent measurements of natural resources and reflect potential influences to its viability. It could incorporate air and water quality, energy consumption, natural resources, solid and toxic waste, and land use/land cover.
- Social Measures: variables that refer to social dimensions of a community or region and could include measurements of education, equity and access to social resources, health and well-being, quality of life, and social capital.

Businesses, nonprofits and government entities alike can all use the TBL. The TBL and its core value of sustainability have become compelling in the business world due to accumulating anecdotal evidence of greater long-term profitability.

The relevance of this concept for the current paper lies on the words of Lash & Wellington “Investors already are discounting share prices of companies poorly positioned to compete in a warming world. Many businesses face higher raw material and energy costs as governments around the globe increasingly enact policies placing a cost on emissions. Consumers are taking into account a company’s environmental record when making purchasing decisions” (2007).

### **The Green Onion: A Corporate Environmental Strategy Framework**

A framework from Scott Victor Valentine (2009); the Green Onion is a tool that can be used to analyze the potential impact of Environmental CSR on a company’s performance. Its main purpose is to allow social scientists to begin the process of orderly control and predict how CSR would affect the companies positioning.

Valentine (2009) did a long review of prior studies and he concluded that all the research performed until that moment, and related to corporate environmental strategy; were either too broad or too narrow in scope to be applied, so he developed the following model where he shows the relation between many layers of forces that affect the Environmental Strategy, that is the reason for the name of the framework, figure 8:

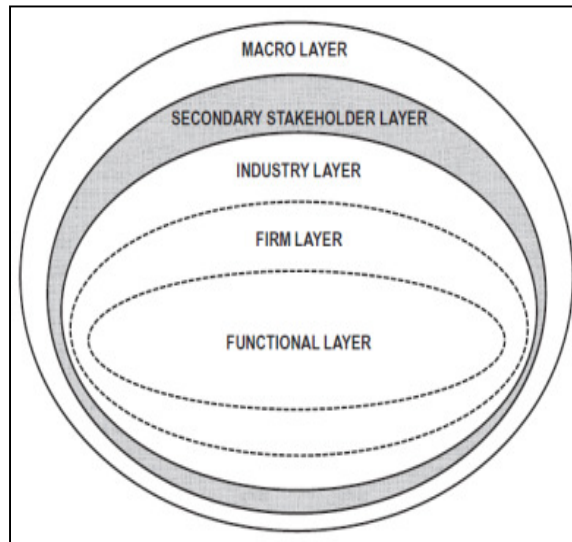


Figure 8. The Green Onion Framework: Forces influencing Environmental Strategy (Valentine, 2009)

According to Valentine (2009) The higher the layer, the less control the strategists have to control the forces, so the model shows and integral relation between what can be modify up to what requires to be proactive due to its volatility and power.

- The Macro Layer: In here the author refers that external forces like Politics, Economy, Society and Technology defined by Grant (2005) like “PEST” forces in each country influence the extent to which companies within industries approach environmental governance (Kolk, 2005)
- Secondary Stakeholder Layer: The members of this layer are Lenders/ Creditors, Government Regulation, Pressure Groups, Public Pressure, Union Pressures, Educators. Researchers like Friedman et.al. (2007) have said “Various stakeholders (consumers/purchasers, investors, bankers, NGOs, and so on) press companies to reduce their negative impact on the environment. This is now seen as companies’ social responsibility, what businesspeople often refer to as corporate social responsibility (CSR).

Companies aware of the threat and opportunities that this group represent have included into their annual reports a clear description of how they accomplished friendly actions to preserve the environment measures in order to catch their attention in a positive way. e.g.: Googlegreenblog.com.

- The industry layer: According to the author this layer is related to Porter's (1980) Five Forces' framework and in this case he acknowledges that the forces should come as no surprise that industry-specific forces related to environmental governance also influence a company's environmental strategy (Valentine, 2009). These forces are: Type of Industry, Industry Risk, Media Exposure, Customer, Buyer pressures, Supplier Pressures, Competitive Practices
- The company layer: The forces here are Ownership Characteristics, Company Size, Financial Health, Age of Assets, and Environmental Reputation. In this case it is important to state that bigger companies with broad owners are more likely to implant environmental measures
- The functional layer: The forces on this layer are: Positioning Strategy, Financial Strategy, Brand Protection Strategy, Quality Strategy, and Cost Control Strategies. It is on the last layer where the company strategy is very important and where all the benefits from the CSR implementation can be better pointed. For example:

The use of an environment friendly strategy will probably attract green investors and green customers, open chances for green funding, improve the image of the company as a green one, improve efficiency using the resources and reduce costs from the operation of support activities. Companies are facing growing pressure to become greener.

The current Master Thesis will focus, but not exclusively, on the Industry and Company layer. Therefore it is important to take a look on the ICT Industry and Google & Facebook Value Chain.

### *2.3. Company profile*

- **Google**

#### General

From its start in 1998 "Google's mission has been to organize the world's information and make it universally accessible and useful." Google also believes in focusing on the user and all else will follow. (Google, 2013)

The internet company has made a platform, a workstation away from the home computer, where the user can access online browsers, do searches, check emails, edit, save and access documents, store the most important information that the consumers could want to access anytime, anywhere.

To introduce the size of Google, they have more than 5 billion searches per day, according to their statistics done in June 2013, and has grown from 9.800 users their first year. (Google, 2013). See table 1.

Year	Annual Number of Google Searches	Average Searches Per Day
2012	1,873,910,000,000	5,134,000,000
2011	1,722,071,000,000	4,717,000,000
2010	1,324,670,000,000	3,627,000,000
2009	953,700,000,000	2,610,000,000
2008	637,200,000,000	1,745,000,000
2007	438,000,000,000	1,200,000,000
2000	22,000,000,000	60,000,000
1998	3,600,000 *Googles official first year	9,800

*Table 1, Google's Search Statistic (Statistic Brain, 2013)*

Google is innovation, their strategy is all about 80% work and 20% innovation, it relies on their employees to come up with ideas, it relies on innovative thinking, it relies on new competition as Google acquires most companies that could threaten or are seem to be valuable (Morrow, 2009).

Google's aim is to collect information, to collect information about their users and that information is used for direct marketing. Their main source of revenue is direct marketing through the user information, influencing the consumers' next purchase (Morrow, 2009).



### Source of Revenues

Direct marketing by AdSense that greatly influences the consumer with cost-per click (CPC) from advertising partners, as these ads directly markets a product or company through the consumers information, screened from Gmail, screened from Chrome, or screened from the consumers searches (Deen, 2012). All this information is stored on Servers and in Data Center all around the world.

### Operations

Due to competitive advantages Google does not publicize all their locations or their total number of servers, or Data Centers (Pearn, 2012), however Google does disclose on their website that they have 7 Data Centers in the USA, with 810 employees. They also have 3 Data Centers in Europe, no employee data and 3 Data Centers under construction in Asia, also no employee data (Google, 2013).

According to Google's financial statement 2013 the total number of employees at end of the year 2012 was 37,544, and this number has grown to 40,178 by Q2 2013 (Google, 2013).

### Power Consumption

Data Centers strive to show that energy efficiency and climate are incorporated in the company's policies. The energy efficiency of the computational power is measured by PUE or Power Usage Efficiency, this measure shows how much energy a Data Center uses. To explain, if a Data Center has PUE of 2.0 it means that for each 1 computational watt there is 1 extra watt for cool and other uses. If the PUE is closer to 1 it means that for 1 watt used, it is almost solely used for computing.

The New York Times did a research in 2012 and their findings showed that Data Centers are only using a 6-12% of power consumption for computing; however the total consumption for Data Centers is 30 billion Watts that is equivalent to the output of 30 nuclear power plants. (Glanz, 2012) With that knowledge at hand, one would think the servers could be turned off or used differently, however no one person wants to be responsible to turn off someone's information. (Glanz, 2012)

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$$PUE = \text{Total Facility Power} / \text{IT Equipment Power}$$

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For example if a Data Center manager identifies servers that are not being used, and decides to shut them off and create virtual servers, this would show a decreasing result in power consumption, however it would increase the PUE, see table 2.

	IT power Demand	Total Data Center Power Demand	PUE
Base Case	15MW	20MW	1.33
Idle Servers Down (5MW)	10MW	15MW	1.5

Table 2, "How Clean is your Cloud" 2012

Therefore using less power and being more energy efficient due to lower power consumption, does not mean full computational efficiency. There is also another limitation to this measurement; it does not measure the carbon emission of a Data Center. In Green peace's report they introduce a CUE (Carbon Usage Effectiveness) measure, where CO<sub>2</sub> is measured against Kilowatt hour, or CO<sub>2</sub>/Kwh. According to the report the largest companies, Apple, Google, and Microsoft were not sharing this information due to the competitiveness in the market. However, since the report was published in 2012 the companies have made efforts of applying transparency to their policies.

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$$\text{Total Carbon Emission} / \text{Total Power Consumption} = \text{CUE}$$


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Data Centers entering the market today are becoming more and more innovative in using renewable energy as a complementing source of power. Applying Green IT and renewable strategies to lower power consumption and counter carbon emission. By using natural elements for sustainable energy, like wind, solar, biogases even tidal to create energy has been greatly implemented. Even location matters as cooling and heating have significant costs and affects carbon emissions.

Green IT involves dissecting the Data Center into smaller function to understand every watt used, where, what, when and how. By understanding the structure inside and out is possible to implement renewable sustainable energy. Google has taken steps to implementing, wind and solar to some of their Data Centers.

Another option is Carbon Offset. Carbon offset is balancing out the carbon emission, it is a reduction in Carbon emission of Greenhouse Gases made in order to compensate for or to offset an emission made elsewhere, defined by Woodward & Kelly (2012), that is buying and selling renewable energy from another location, such as a wind farm, and saving on fuel or coal powered energy.

This implementation has risen from the global consensus of reducing the carbon emissions by 80% by 2050 to avoid climate catastrophes. Companies within the USA, Europe and Asia have all made efforts to implement Greener IT policies as a solutions for the future. Investing in the future does not go unnoticed, efforts to implement Greener more sustainable policies create and gain awareness. The consumer wants to know what they are buying and what efforts their provider offers in regards to the environment.

Google has always been much undisclosed regarding their own energy efficiency information, they started measuring their Data Center Power Usage Efficiency (PUE) in 2008 and have since then emphasized greatly on Green IT. Figure 9 below shows how efficient the total field Data Center PUE has been since the start of measurement. (Google Data Centers, 2013)

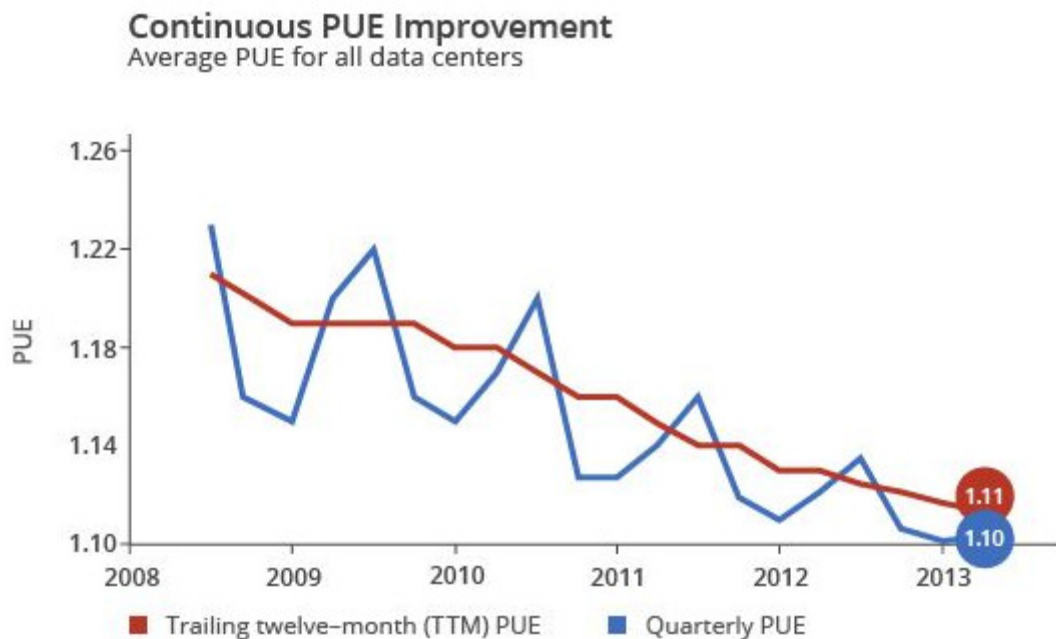


Figure 9, PUE Data for all large-scale Google Data Centers (Google)

Google's efforts to be Greener, has lead them to take responsibility of their carbon emissions and their environment, and through their Googlegreenblog with director Jolanka Nickerman they reveal that Google has been carbon neutral for the last 6 years.

Googlegreenblog continues to inform that in 2012 Google emitted 1.5 million metric tons of carbon dioxide, before purchasing high-quality carbon offsets to reduce that footprint to zero. Their total carbon emissions decreased 9% compared to the previous year because they are

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$$PUE = \text{Total Facility Power} / \text{IT Equipment Power}$$

---

deducting our green power purchases from our carbon footprint. (Nickerman, 2013)

Google has efficiently put this into perspective and says that serving an active user for one month equals driving a car 1 mile. To be more detailed they go on to say “an active Google user is someone who does 25 searches and watches 60 minutes of YouTube a day, has a Gmail account and uses our other services. To serve that user, Google emits about 8 grams of carbon per day”, see figure 10 (Nickerman, 2013)

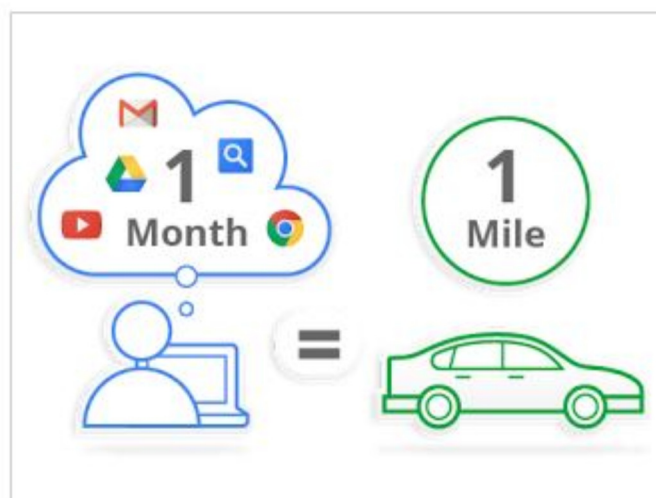


Figure 10, Google Carbon Emission per User

## ▪ Facebook

### General

Founded in 2004, Facebook's mission is to make the world more open and connected. People use Facebook to stay connected with friends and family, to discover what's going on in the world, and to share and express what matters to them (Facebook, 2012)

Facebook is all about connecting people, it is an online platform where users can look and share updates, events by the tap of a finger on a keyboard, Smartphone or a tablet. There the consumer can instantly share news, or events from their lives to their friends and family online.

The primary idea was to connect universities in the USA; however the recognition of the page and popularity has been far beyond their goals. According to the documentary “Bloomberg Game Changers” (2013), Facebook reached 3 million profiles only 15 months from launch, today more than 600 million Facebook users check in everyday, out of more than 1.110 million profiles.

These users like to log on, share updates, look at pictures, view other peoples status updates and events and all this information is on the internet for the user, however all information that is put on Facebook is stored in one of their many Data Centers.

#### Source of Revenue

Like Google, advertisement is the main source of revenue for Facebook. Revenue from advertising was \$1.33 billion, representing 84% of total revenue and a 41% increase from the same quarter last year. Excluding the impact of year-over-year changes in foreign exchange rates, advertising revenue would have increased by 43% (Facebook, 2012).

#### Operations

Facebook has four known Data Center, first large one is in Prineville, Oregon, and their new Data Center in Luleå, Sweden, as well as a Data Center in Forest city, North Carolina and Altoona, Iowa. Facebook has implemented wind and biogases to their Prineville facilities.

Facebook is the largest online network with 4,619 employees (Statistics Brain, 2013).

#### Power Consumption

The new Data Center is introduced as “Likely to be one of the most efficient and sustainable Data Centers in the world. All the equipment inside is powered by locally generated hydroelectric energy. Not only is it 100% renewable, but the supply is also so reliable that we have been able to reduce the number of backup generators required at the site by more than 70 percent. In addition to harnessing the power of water, we are using the chilly Nordic air to cool the thousands of servers that store your photos, videos, comments, and Likes. Any excess heat that is produced is used to keep our office warm.” (Facebook, 2013).

Facebook has made efforts in promoting awareness regarding their new strategies and investments into greener IT, and has incorporated promotion pages demonstrating their efficiency within carbon and energy. There is even detailed total Kilowatts per hour information reported on their page.

The Figure 11 shows Facebook total power consumption from 2012. The following Figure 12 shows the total consumption for 2011.

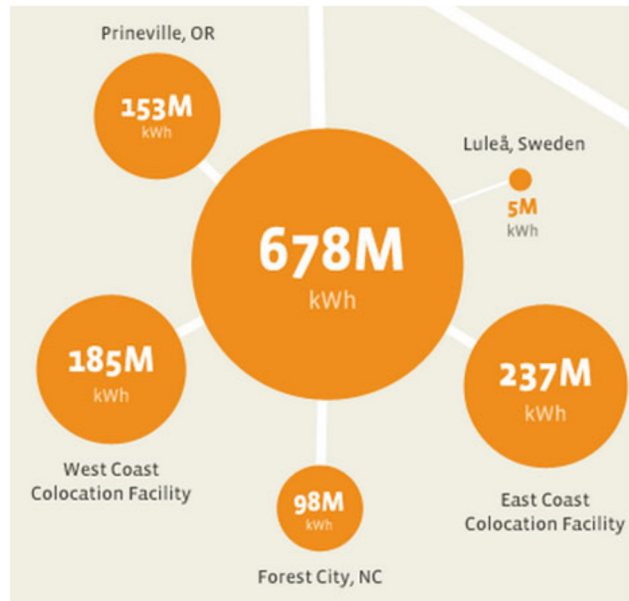


Figure 11, Facebook Data Center Energy consumption 2012



Figure 12, Facebook Data Center Energy consumption 2011

“In 2011 Facebook’s per-user carbon footprint was .000249 metric tons of CO<sub>2</sub>e, or 249 grams, per monthly active user. In 2012 the carbon intensity per user was only slightly higher at .000294 MT of CO<sub>2</sub>e, or 294 grams. Another way to think about this is that one person’s Facebook use for each of these years had about the same carbon impact as 3-4 bananas, a few glasses of wine, or a latte.” See Figure 13 (Facebook, 2013).



*Figure 13, Facebook Carbon emission per user (Facebook)*

Facebook first started releasing their sustainability report in 2011, introducing their Power consumption and carbon emission as well as their energy efficiency. They have even put up detailed Facebook pages detailing their sustainability in easy to understand pictures.

Figure 14 reveals the total PUE of Facebook’s Datacenters for 2011 and the second, figure 15, the PUE for 2012.

Facebook’s Operations manager at Rutherford DC explains „Companies like Facebook and Google are pouring millions into development of more efficient greener Data Centers. We have the cash needed to push the envelope to build the most advanced, most state-of-the-art facilities in the world (Young, 2012). So far there is no information regarding Carbon Offsets or means to apply these neutral options in Facebook’s reports.



Figure 14, Data Center PUE 2011 (Facebook)

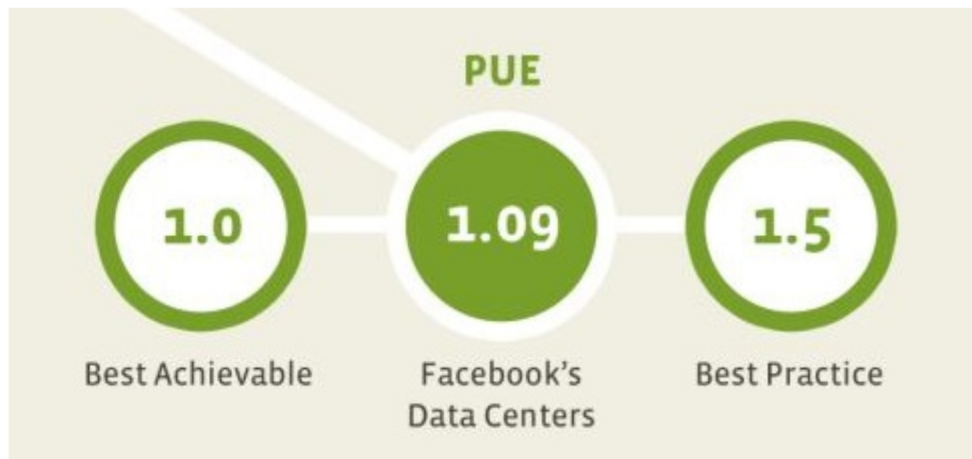


Figure 15, Data Center PUE 2012 (Facebook)

## 2.4. Common Profile

Based on the information provided by Google and Facebook it is possible to list a couple of common points for both companies:

- Relatively young in the market, but both global
- The core of their operations is information highly dependent of the users
- Due the characteristics of their activities the existence of servers and consumption of electric energy is a compulsory
- Both are within the Internet & Communication Technology Industry



- They generate impressive amounts of revenues, specially Google, and mainly from Advertisement
- They own Data Centers and include within their annual report data related to energy efficiency and CO<sub>2</sub> emissions
- Both hold a massive volume of operations on daily basis
- They have high energy consumption and volume of CO<sub>2</sub> emissions
- They are important part of life for people when it comes to search, discover and share information

Table 3 below provides an overview of their profiles:

Variables	Google	Facebook
Age	15	9
Core	Information	Information
Backbone	Servers	Servers
Industry	ICT	ICT
Revenues (2012)	43,6Bn	5,0bn
Source of Revenue	Advertisement	Advertisement
Data Centers	10	4
Employees (2012)	37554	4619
Volume of Operation	5bn Searches/day	600Mn Check-in/day
Kilowatt consumption	220M W (2010)	509M W (2011)
CO <sub>2</sub> Emmission (2012)	1,5 M MT	3,916 M MT
PUE (2012)	1,11	1,09

*Table 3, Google & Facebook Main Figures 2012 (Google, Facebook, 2012)*

For the purpose of the current study and due the similarities of both companies, a common profile will be used for further analysis.

## 2.5. *The Industry*

ICT (Internet & Communication Technology) companies are steadily growing in size and in consumers. ICT is a wide industry as it covers not only computers and software but telephones and mobile connectivity as well. It covers anything that links people or companies, banks or educational, together over an electrical grid.

The ICT industry relies heavily on computational power and by centralizing that power into Data Centers, it offers flexibility, accuracy and offers all users the power of a professional server.

A company needs a steady internet connection, cheap power and preferably a good governmental tax deal. With the introduction of The Cloud, a newer more virtual form of data keeping has risen: virtualization, which basically consists in outsourcing the server hosting activities to Data Centers in order to optimize resources. Growth in the installed base of servers in Data Centers had already begun to slow by early 2007 because of virtualization and other factors (Kooimey, 2011).

However virtual needs to be real somewhere, the Cloud touches the grounds and the effects are not unfelt. Data Center running on massive amounts of computational power to drive and run these server farms resulting in many challenging like huge energy consumptions, emission of Greenhouse Gases, backups and recovery (Uddin & Rahman, 2012), these challenges need to be addressed.

With such enormous power consumption, which leads to great carbon emissions and high costs, Data Centers have fallen under the scrutiny of the public eye. The New York Time researched how secretive large companies and Data Centers are, as the ICT sector is proving to be at odds with highly marketed and renowned image of clean its image of sleek efficiency and environmental friendliness (Glanz, 2012).

The ICT sector sees it as a competitive advantage not to share information regarding utility and server costs. Especially not if it is regarding customized Data Center giants that can keep all the new data that is stored online every second, and continually grow to location storage limit. Google doesn't publicly say how many servers they have. They keep the figure secret for competitive reasons (Pearn, 2012).

### **1.1. Porter's Five Forces**

The survival and success of companies relays on their capacity to provide significant value to their stakeholders; it does apply to any company within any industry. Researchers, such as Porter et al. (1985) have defined that capability under the term "Competitive advantage".

Given competition seems to be the key to success or failure, leaders must develop a “Competitive Strategy” in order to establish a profitable and sustainable position against the forces that determinate industry (Porter, 1985). To understand the rules of competition that determines industry's attractiveness is necessary to look at the five competitive forces.

To look at the Internet & Communication Technology industry through Porters five forces model, figure 16: buyer and supplier power, rivalry and threats of substitutes and new entrants the following is understood.

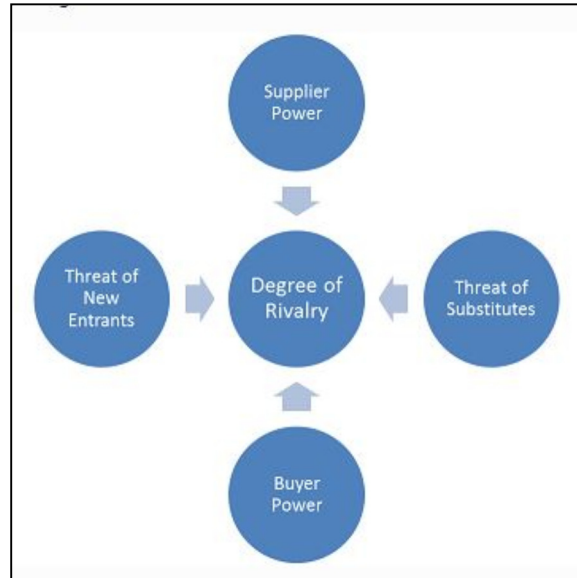


Figure 16. Michel Porter 5 Forces Model

### **Power of Supplier**

Determinates the extent to which value created for buyers will be appropriated by suppliers rather than companies in an industry (Porter, 1985). Data Centers require enormous amounts of energy to operate and cool servers, leaving them vulnerable to high electricity costs and criticism from environmental groups (Powell, 2012).

The drive of offering the cleanest energy and the best price in a preferred tempered climate all factor in the options of user.

### **Power of the buyer**

Determinates how much value companies can get in return from the products they have created for the market (Porter, 1985).

The datacenter industry is so competitive that is ruled by the buyer, with giants such as Google, Apple and Facebook leading it. e.g.:

“Since Google doesn’t produce physical products, its value chain is a bit more nuanced. Google gathers all the web users it can (the raw material) by enticing them to use its stellar search product with highly relevant results delivered promptly. Then, through assorted “signs”

(text advertisements) it directs these same web users in the form of traffic to its advertising partners who transform the traffic into “conversions” or sales on their sites: the finished good” (Morrow, 2009).

When it comes to social media is all about the user; thus power of the buyer is high and determinant.

### **Threat of New Entrants**

It determinates the likelihood of taking away the value. Lowering prices for the buyers or making the costs of competing to rise up (Porter, 1985) The global ICT marketplace is extremely competitive and diverse, with many opportunities for new entrants (IT University of Copenhagen, 2004)

### **Threat of Substitutes**

Determinate the extent to which some other product can meet the same buyer's needs, creating a ceiling for the price the buyers are willing to pay for a product within that industry (Porter, 1985) The existence of many players in the industry such as: MySpace, Hi5, etc.

### **Rivalry**

It takes place among existing competitors within the industry and acts similar to the threat of entry (Porter, 1985).

There is a lot of secrecy within the ICT sector, information regarding cost; location and storage are held under close wraps. The same happens with all ideas and possible investments. Information is seen as a competitive advantage and in the fast changing atmosphere that is the ICT sector that is very understandable. Google doesn't publicly say how many servers they have. They keep the figure secret for competitive reasons (Pearn, 2012). If a player within the industry is perceived as a threat it is usually acquired by one the larger competitors. E.g. “Facebook Buys Instagram for \$1 Billion” (New York Times, 2012).

The competitive landscape for the ICT industry, based on what was said before can be defined as:

The power of the consumers is high because the companies depend entirely on users whom are aware of the existence of many substitutes and the cost from changing from one company to other is relatively low

- The threat of new entrants is moderate, despite the fact of low investments costs, the users show a moderate consumer loyalty and it is difficult to accumulate them
- The power of suppliers is low because there is high availability of hardware and software providers with no much differentiation
- The threat of substitutes is high because the large number of similar companies that replicate to each other, losing differentiation
- Rivalry within the industry is high because there are many substitutes available, many acquisitions and companies need to be innovating to differentiate

Please see the graphic representation in the figure 17 below:

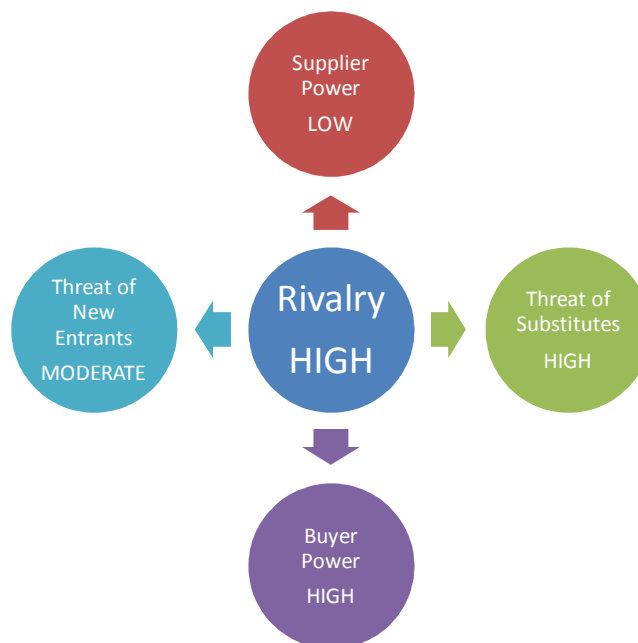


Figure 17. Michel Porter 5 Forces

## 2.6. Value Chain

The importance of value chain on competitive advantage is pointed by Porter (1985) saying that despite companies in the same industry may have similar chains, the value chain of competitors often differs and those differences are a key source of competitive advantage.

The value chain disaggregates a company into its strategically relevant activities in order to understand the behavior of costs and the existing and potential sources of differentiation. A

company gains competitive advantage by performing these strategically important activities more cheaply or better than its competitors (Porter, 1985).

Prior further analysis, it is important to define that in competitive terms “value” is the amount buyers are willing to pay for what a company provides them; it is measured by total revenue, a reflection of unitary price multiplied by the units it can sell (Porter, 1985).

A company's value chain is composed by two categories: primary activities and support activities.

### **Primary activities**

Google and Facebook primary activities in its value chain vary slightly from a traditional model where raw materials are processed into finished goods for sale to a customer, gaining value in each step of the process. Since they do not produce physical products, its value chain is a bit more nuanced.

- **Inbound Logistics:** Associated with receiving, storing and disseminating inputs to the product. The companies under study work on information uploaded by the users, collecting and analyzing. Gathers all the web users it can (the raw material) by enticing them to use its stellar search product with highly relevant results delivered promptly (Morrow 2009).
- **Operations & Outbound Logistics:** Operations activities are associated with transforming inputs into the final product form meanwhile outbound logistics are associated with collecting, storing, and physically distributing the product to buyers. Through assorted “signs” (text advertisements) it directs these same web users in the form of traffic to its advertising partners who transform the traffic into “conversions” or sales on their sites: the finished good (Morrow, 2009).
- **Marketing and Sales:** Associated with providing a means by which buyers can purchase the product and inducing them to do so. Google and Facebook's main means of revenue is advertising through a software called “AdSense” where advertisement is selected especially for a user through his/hers internet profile or presence. Both Medias offer their products for free and earn revenue from connecting advertising partners with the most likely buyers (Morrow, 2009).

- **Service:** Associated with providing service to enhance or maintain the value of the product. Google uses advanced analytics to measure the efficiency of its supply chain (the web users). This data about the history of its users is important because it helps Google improve its search algorithms and advertising interface. New technology and word-of-mouth promotion by its loyal users can bring in new customers and thereby increase the profit margin (Morrow, 2009).

### **Support activities**

- **Procurement:** Function of purchasing inputs in the company's value chain, not to the purchased inputs themselves. Purchased inputs are present in every value activity including support activities; thus the cost of procurement activities represents a small if not insignificant portion of total costs, but often has a large impact on the company's overall cost and differentiation. By shifting activities geographically, Google can also take advantage of diversity from a human resources perspective and also perhaps lower salaries in countries other than the United States (Morrow, 2009).
- **Technology Development:** Consist of a range of activities that can be broadly grouped into efforts to improve the product and the process Google has always tried to hire the most qualified and competent individuals to ensure that it excels at the research and development of its technology and systems (Morrow, 2009).
- **Human resource management:** Activities involved in the recruiting, hiring, training, development and compensation of all types of personnel. Google's primary activities in its value chain are heavily dependent on the support activities of administration and human resources (Morrow, 2009). As these companies have with the most qualified and highly skilled computer and technical engineers, working and applying changes to application or creating new entertainment or enticing (Morrow, 2009).
- **Company Infrastructure:** Activities including general management, planning, finance, accounting, legal, government affairs, and quality management. Google's servers and internal software allow it to conduct operations, distribution, sales, and service. Each activity contributes to the value chain by increasing the profit of the company, e.g. Google has locations all over the world<sup>1</sup> to localize distribution, marketing, and service which in turn ensures maximum profit on a global scale (Morrow, 2009).

The Value Chain for the common profile, based on what was for Morrow (2009) can be defined as:

- These companies work on information uploaded by the users, collecting and analyzing. As these companies have with the most qualified and highly skilled computer and technical engineers, working and applying changes to application or creating new entertainment or enticing
- Their structure relies heavily on human resource management and all areas are affected by them. As the product that they are offering is information and allocation of user information, Product development, R&D are heavily integrated with human resources throughout the value chain
- Through the information the users put out and their habits and searches online, both Google and Facebook have applied this method

Figure 18 shows Google's value chain according to Morrow (2009). Nevertheless, the authors for the current paper have considered extending the research in order to develop a value chain that might fit better for the common company profile, details can be found in the next section.

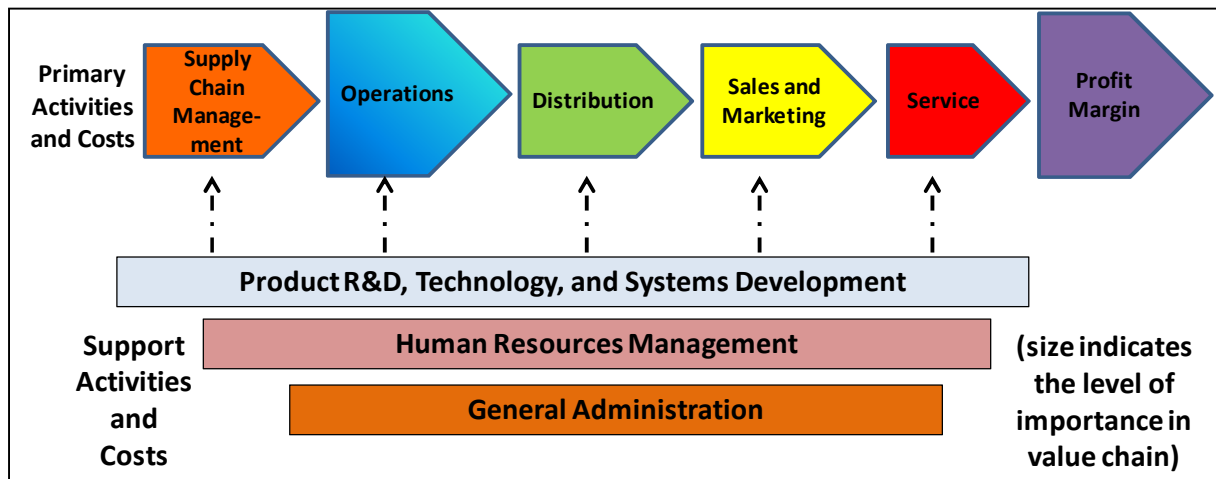


Figure 18, Google's Value Chain (Morrow, 2009)

## 2.7. From Value Chain to Value Constellation

Things do not remain the same, everything flows; therefore the importance for companies to create strategies. Porter's contributions: Industry Forcers and Value Chain (1985) have been exceptional tools to support the strategic thinking, but they might need to be refined. Our traditional thinking about value is grounded in the assumptions and the models of an industrial



economy. According to this view, strategy is primarily the art of positioning a company in the right place on the value chain. (Normann & Ramirez, 1993).

Within a competitive industry, such as ICT, where innovation and differentiation is a compulsory it seems necessary to do some adjustments. In so volatile a competitive environment, strategy is no longer a matter of positioning a fixed set of activities along a value chain. Successful companies do not just add value, they reinvent it. Their focus of strategic analysis is not the company or even the industry but the value-creating system itself, within which different economic actors—suppliers, business partners, allies, customers—work together to co-produce value (Normann & Ramirez, 1993).

In plain words, Normann & Ramirez (1993) propose that value is not the result of a linear process but an interactive one where companies interact with the constellation of different economic actors to add value and reinvent new strategies.

The Master Thesis authors (MTA) find the “Value's Constellation model”, from Normann & Ramirez (1993), to provide a better approach to the companies under study: Google & Facebook.

The main players in the value creation for the common profile are the users, company (Google or Facebook) and Companies (Advertisers) and by taking a close look at the dynamics it is possible to identify the source of value within the interactions. Some highlights below:

### **Users – Company Value Creation**

Users provide information to the company, at that stage it can be seen as “raw material” for the whole system, because the company has to take the input and process it using internal capabilities, the output is responsive information back to the user. It represents the first flow and it is illustrated in the figure with a green line. The company gains value getting information for free and user gets value having the chance to access effective information without paying a fee.

### **Company – Advertiser Value Creation**

For the company the processed information from users represents a source of revenue, due the possibility to sell it as Marketing Intelligence to advertisers in software called “Adsense”. It represents the second flow and it is illustrated in the figure with a red line. The company gets

value in the form of revenue and advertisers get access to focus their campaigns saving costs and optimizing results.

### **Advertiser – User Value Creation**

Strongly related to the second flow, advertisers provide to the company (Google or Facebook) their ads and audience request (raw material) and this last one process the request matching the message with the audience. The output is nothing else than Directed publicity for the Users. It represents the third flow and it is illustrated in the figure 19 with a blue line.

### **User – Company - Advertiser Value Creation**

Three different flows where value is created, from the understanding of the MTA, has been shown up to this point, nevertheless it is important to stress out the overlaps within the value creation within the system e.g.

Users co-create value with the company providing their information, the company then co-creates value using its internal capabilities to process this input and helping advertisers to reach right audiences. Advertisers co-create value by providing revenue to the company by making sure every last one directs these ads to the users in the form of customized advertisement. This might be seen as value adding to the user, by enabling the appropriate access to relevant products. All the players interact and affect each other in a way that one single graphic could display.

## **2.8. *Considerations***

To support the value co-creation within the MTA interpretation, shown in the figure 19, is necessary to point that no interaction would be possible without the existence of servers, a good argument for taking a look, from the theoretical point of view, to the potential benefits of green servers hosting towards operations, marketing & sales activities within the company profile.

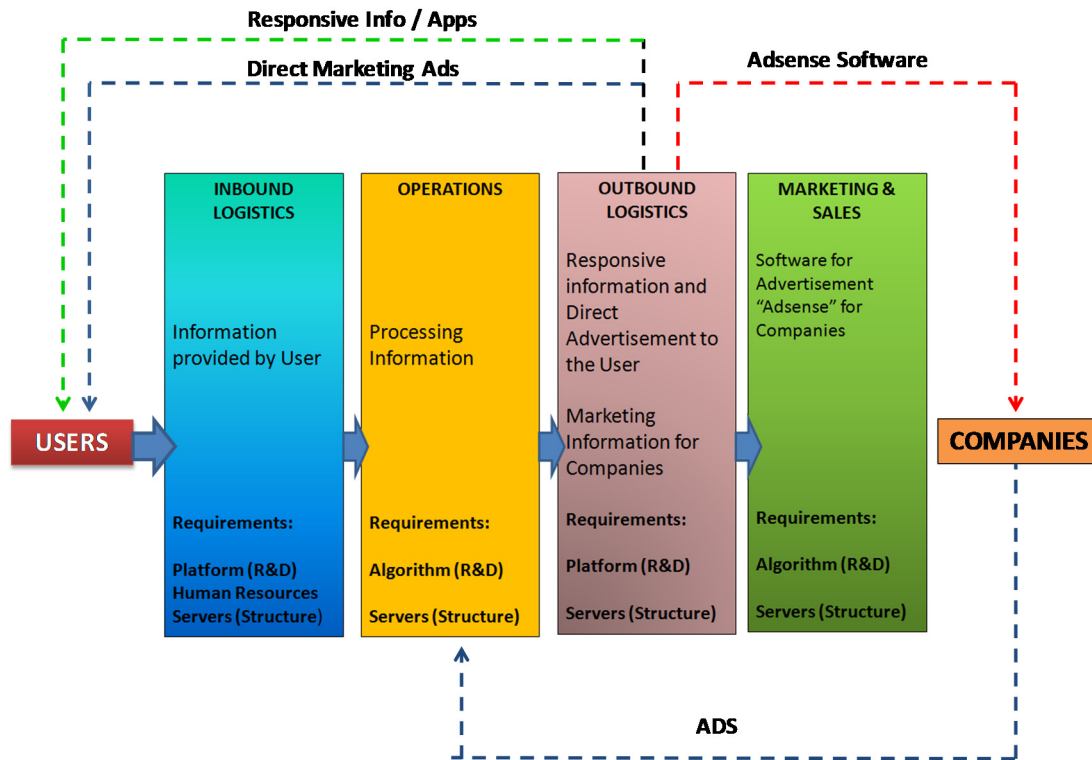


Figure 19, Master Thesis Authors' interpretation from the Value Constellation to the common profile

### *3. Benefits of Green Server Hosting towards Operations*

#### *3.1. Introduction*

Companies such as Google and Facebook will always be under much scrutiny, being such public entities as they are. This inquiry includes all companies that have high IT costs and that do not participate in environmental affairs, which rely on low cost power, or do not publicize CO<sub>2</sub> emissions. Part of this scrutiny comes from greater environmental awareness from the user who wants to know what its own presence in the ICT sector contributes to the global awareness.

With that, taking into account measures of long term efficiency and environmental impact, ICT companies need to make decisions now. InfoTech did the Smart2020 report calling attention to companies that their environmental impact is greater than originally thought, and their non-efforts are being noticed.

Following politics and policies within countries and continents and the consumer awareness of the increasing impacts of these Server hosting companies, should push them to re-evaluate their own environmental policies. These policies need to be implemented to influence global efforts of countering environmental harm, for one the CO<sub>2</sub> emissions which contributes to the global warming.

Political Global efforts, such as: the Kyoto Protocol that aims to reduce CO<sub>2</sub> emissions and is legally binding for the countries that participate. The 191 countries that have signed and are bound to reduce or neutralize their CO<sub>2</sub> emissions have the target of 20% emission reduction by 2020 compared to the emission levels in the year 1990.

Some of the participating countries have even set their own goals e.g. Norway aims to be CO<sub>2</sub> neutral by 2050 and Germany aims to cut 40% below the 1990 levels by 2020. In Sweden the government has set its goal to be a low level carbon economy in the Nordic European region. How will it be possible with an increasing ICT sector to cut or neutralize CO<sub>2</sub> emission (Smart2020, 2008)?

Figure 20, taken from Smart2020 (2008), shows how the Carbon footprint of the ICT sector is distributed by the world and by sector as well as giving an estimation of how the footprint will look in 2020 if there are no efforts put in to counter it. Since 2002 the growth is estimated to be greatly increased, from 0.53 GtCO<sub>2</sub> emissions in 2002 to alarming 1.43 GtCO<sub>2</sub> emissions in 2020.

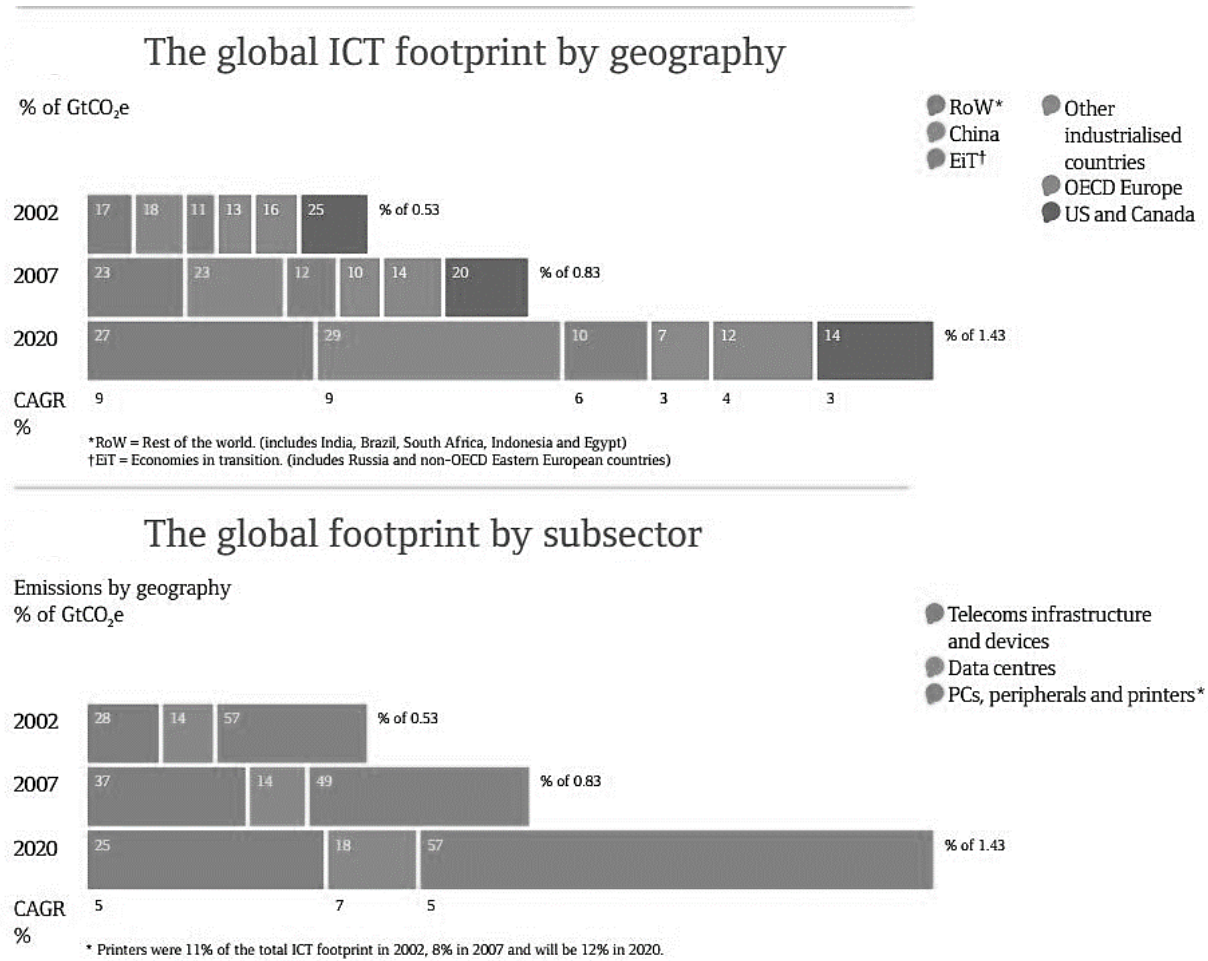


Figure 20, Global footprint Smart2020, 2008

All this focus on Data Center energy consumption, CO<sub>2</sub> emissions and non-available emission data measurements has made them easy targets for corporate environmental policy's and social responsibility, as the consumer is becoming more aware of their own footprint.

The strategic step of incorporating Green marketing is a step for the future, that green marketing objectives is for educating and making people willing to go green, because it can influence people to change their lifestyle and behavior. This is due to the fact that there is a steady movement in the public interest and concern about the environmental issues (Awan & Raza, 2012).

Companies do feel the pressure of implementing green policies and many wait “for the right time”, however according to the Smart2020 and Greenpeace the time is now. Efforts of Green IT as an umbrella term include overlapping concepts like virtualization, Cloud computing, outsourcing, recycling, procurement and power management, green because it is

environmentally friendly, it is sustainable, renewable it lowers electrical cost in the long term and it makes Data Centers energy efficient and green (Uddin & Rahman, 2012).

If Green IT is implemented correctly through green policies and frameworks they offer some key advantages:

- Green IT reduces organizations overall energy costs
- It prolongs or extends the life of existing Data Center equipment by intelligently refreshing equipment, taking advantage of energy efficiencies
- It reduces IT maintenance activities and costs and improves the overall image of the organization
- It saves money and reduces environmental stewardship by proper disposal of waste and toxic hardware, by proposing new hardware which is environment friendly; consume less energy and easy to dispose of
- It reduces overall carbon footprints there by reduces global warming effects
- It reduces the emission of CO<sub>2</sub>, thereby reducing the repertory problems faced by different species
- It reduces acid rains, smog and global climate change effects
- It reduces the strain on the electrical grid
- Frees up space on Data Center floors
- It takes advantage of pricing incentives, tax breaks and rebates offered by utilities, insurance companies and governments
- It prepares the organization for compliance with future regulations and certifications

These advantages show the importance of IT governance within a company, by setting the proper leadership, creating new structures and relationships. Tuning the process to the disposal, and defining a new culture and attitude through the right communication and training. As well as help businesses tackle their overall footprint by using IT as part of the solution to reduce business's environmental footprint (Uddin & Rahman, 2012).

Drivers for implementing Green It through IT governance:

1. Cost-reduction due to an efficient energy use.
2. Public image aligns to environmental concerns.
3. Environmental regulatory compliance.

The evolution within the IT sector is so intense, just notice how smart phones are compiled with large memory and highly energy efficient to improve lifetime. Then why is this not applied to Data Centers? If operational managers of Data Centers would implement energy efficiency, renewable energy, creating new structures of business operations and invest in green hardware the benefits are undoubtedly high, results would be seen early and the company would gain immensely in the long term.

The EPA's, Environmental Protection Agency, report from 2007 compared the purchasing dollar spent on new servers with the power and cooling cost since 1996 and projects those numbers until 2011, see figure 21.

To give an understanding how the cost of Data Center hardware is increasing as well as a forecast over the power and cooling costs. There have been advances in hardware and software technologies including low power processors, solid state drivers and energy efficient monitors have alleviated the energy consumption issue to a certain degree, a series of software approaches have significantly contributed to the improvement of efficiency (Uddin, Rahman, 2012).

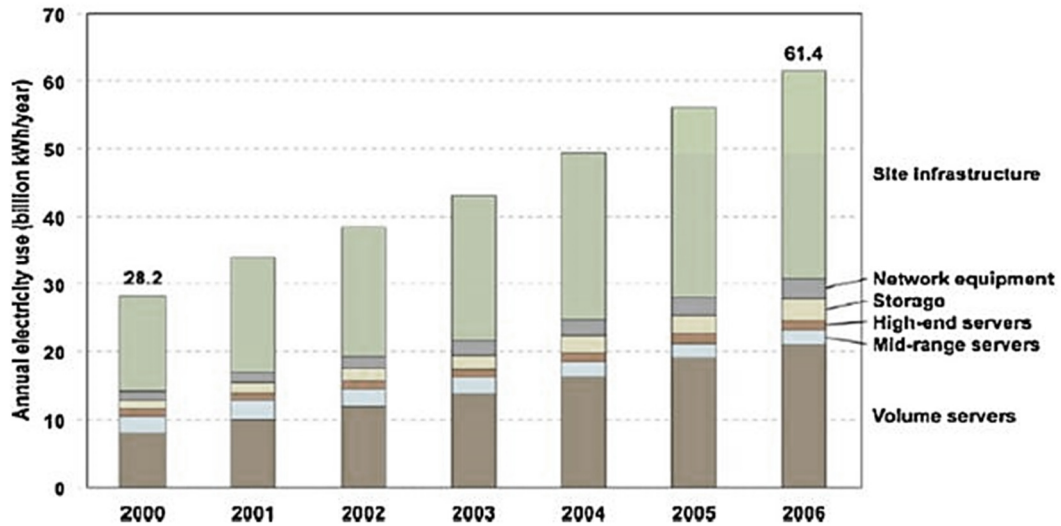


Fig. 2. Data center and server efficiency.

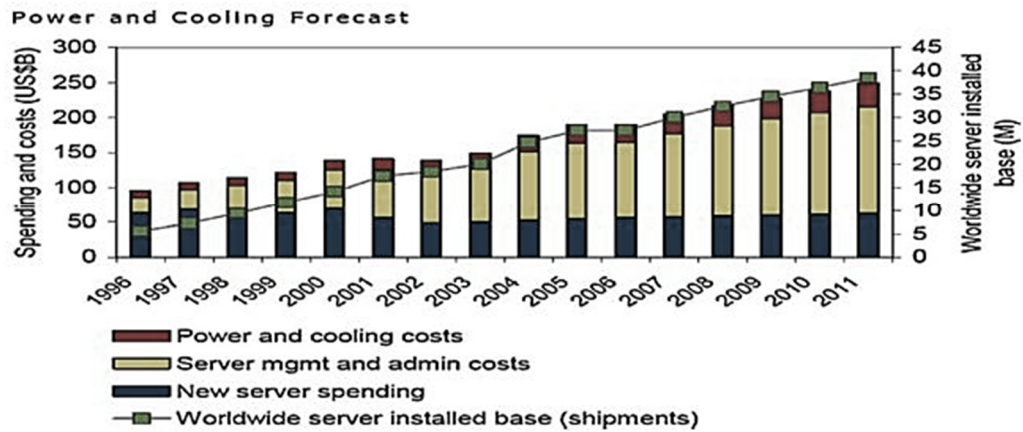


Fig. 3. Worldwide cost to power and cool server installed base, 1996–2011.

Figure 21, EPA report 2007

### 3.2. Reduce CO2 Emissions

With a competitive energy market all over the world, the increase in cost, the awareness of the pollution it makes and how consumers are becoming more demanding of the products that they purchase, company environmental efforts need to become more recognizable.



The direct Carbon footprint of the ICT sector, Table 4, is dominated by electricity consumption, so an obvious way to reduce emissions is to use as much electricity as possible from renewable sources. InfoTech's thorough research within the ICT industry showed that efforts need to be implemented at a greater rate to reach the targets set by the Kyoto protocol.

**Table 1**  
CO<sub>2</sub> emissions (carbon foot print) climate group and the global e sustainability initiative SMART 2020.

World	Emissions 2007 MtCO <sub>2</sub> e	Percentage 2007	Emissions 2020 MtCO <sub>2</sub> e	Percentage 2020
World	830	100%	1430	100%
Server farms/data centers	116	14%	257	18%
Telecom infrastructure and devices	307	37%	358	25%
PCs and peripherals	407	49%	815	57%

*Table 4, Global Footprint Smart2020, 2008*

One of the ways ICT companies can do this is by purchasing renewable electricity, by installing renewable generation on their sites and by making renewable electricity integral to their products.

The highly competitive environment that is within the power supplier sector leaves the consumer (companies) with endless possibilities of green and non-green energy (Awan & Raza, 2010). Choices regarding green energy and renewable or sustainable energys have become very attainable so the issue regarding implementation and investment should not be delayed.

Greenpeace has been publicly scoring companies regarding their actions towards environmental awareness and policies. With the "CoolIT Leaderboard" as well as their "How Clean is your Cloud?" reports, they thoroughly dissect the larger corporation's measures towards environmental issues, their efforts towards implementation of Green IT.

The scoreboard in "How Clean is your Cloud" gives companies a grade of efforts in energy transparency, infrastructure, Energy efficiency & GHG Mitigation and Renewables & Advocacy. The scoreboard also declares the percentage used of clean and dirty energy for all the largest ICT companies. See appendix 1, 2, 3.

The environmentalists look into efforts of green IT and use of sustainable or renewable power purchases, as well and efforts to minimize use of coal and nuclear power consumption.

Smart2020 showed that Asia, Europe, USA and the rest of the world, that more than 50% of the survey respondents were strongly concerned about the global warming and its effect on the climate change (InfoTech, 2008).

In Sweden the government has begun taking part in this thinking and therefore the country has set its goal to be a low level carbon economy in the Nordic European region. The power market is therefore supplying highly competitive new measures environment within the energy supplier sector giving the consumer a great variety of possibilities of applying green and non-green energy to their Corporate Social Responsibility (CSR) portfolio.

Green Energy as defined by Wenxin, 2010, is energy generated from natural and renewable resources such as sunlight, wind, biomass, tides and geothermal heat, which all fall under “renewable energy” (Awan & Raza, 2010). Green Energy contributes reduced carbon emissions, i.e. instead of coals and nuclear power that emits greatly to the carbon footprint, the option of green means less power consumption. More energy efficiency and renewable energy (not coal, not nuclear).

#### Estimated GHG Emissions of ICT Sector:

MtCO<sub>2</sub>e = Million Tonnes Carbon Dioxide Equivalent

Emissions 2007 (MtCO<sub>2</sub>e)

Data centres

Telecoms and devices

Computers and devices



iClimate Group and the Global e-Sustainability Initiative (GeSI)(2008).  
 SMART 2020: enabling the low carbon economy in the information age

Figure 22, global footprint Smart2020, 2008

To emphasize the importance of corporations choosing or applying green power and that companies switch from conventional energy to renewable energy, is that by implementing and communicating these values, as Google does, it will help build value for current employees as well as future employees.

Google proposes the Carbon Usage Effectiveness (CUE) which measures the Carbon emission per kilowatt hour. With a little searching and some calculations an estimation of information made available by Google for 2010, an assumption of total Kwh was made, as well as Facebook's earliest publication of their total Data Center power consumption for 2011. These numbers are not easily accessible due to concerns about competitive advantage. The Carbon

emission is compared for 2012 for both companies and show how the implementation of Green IT seem to have on the structure of each company, see Table 5.

	Google	Facebook
Kilowatt consumption	220M W (2010)	509M W (2011)
CO <sub>2</sub> Emission (2012)	1,5 M MT	3,916 M MT
PUE (2012)	1,11	1,09

*Table 5, comparison of Facebook and Google*

To further the comparison of sizes of these companies Google is estimated to have 900,000 servers running estimated from their power consumption in 2011 (Perry, 2011). If compared to Facebook's estimated server count at 180,900 in 2011, which has grown from 30,000 servers in 2009 to 60,000 servers in 2010.

This estimation is done from Facebook's published Power Usage Effectiveness (PUE) of 1.07 for 2011, the company conclusively sends 54.27 megawatts to its servers. At 300 watts per server, that would mean about 180,900 servers. If Facebook can achieve the generally assumed 250 watt estimate for Google, the company may run as many as 217,080 servers (Gruener, 2012).

Google has been very informant through their own measures of green initiatives and have publicly noted on their Greenblog page that all their numbers are sans Carbon credit, in order to inform their actual usage and separate Carbon emissions.

This implementation of transparency and meaningful metrics will become increasingly important as Cloud computing expands, and will allow Cloud customers to understand the true environmental performance and Carbon footprint of their IT vendors and suppliers (Cook, 2012).

Google demonstrates that the ICT sector continues to play a vital role in the growth of the global economy and international development. As the imperative to develop zero CO<sub>2</sub> growth solutions becomes stronger, society needs to lower emissions while continuing to serve the needs of people in emerging economies, to develop poverty reduction schemes and enable multiple sectors across the world (Smart2020, 2008).

Google's low power consumption in comparison with amount of servers is predominantly because of green IT within their IT governance. The implementation of renewable and sustainable Green IT measures has shown to be very beneficial as for 2012 they used a total of 34% of renewable energy, figure 23. As well as neutralizing their Carbon emission with carbon offsets.

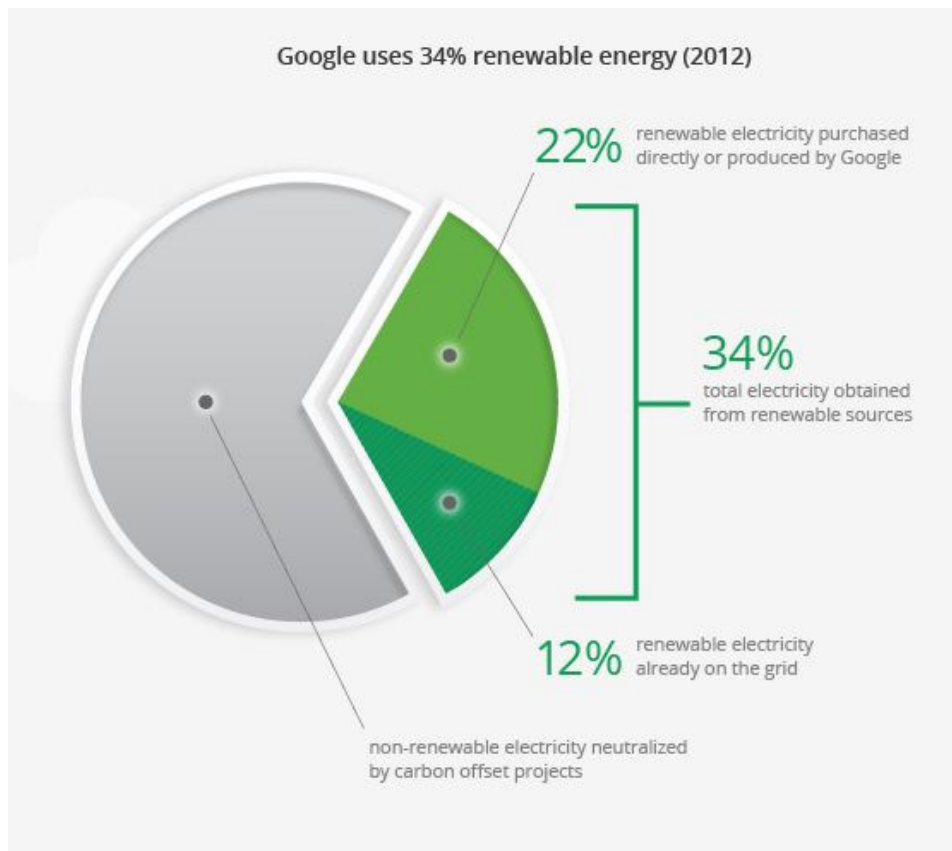


Figure 23. Renewable energy used by Google Data Centers 2012

Carbon offsets, also known as Carbon Economy, Carbon credits or Renewable Energy credit, are credits for reductions in greenhouse gas emissions made at another location, such as wind farms which create renewable energy and reduce the need for fossil-fuel powered energy.

It basically means that companies can invest in new technology that is sustainable or renewable that is not fossil-fuel powered (neither coal or nuclear).

REC represents only the property rights to the non-power qualities (environmental) associated with renewable electricity (RE) generation, not the electricity itself, and it does not cancel out the demand for dirty coal-fired power from local distributors (Cook, 2012).

The indirect approach of RECs raises concerns about whether this premium actually leads to investment in additional renewable energy, or simply increases the profit margin for energy traders

Given this is disconnected from demand, RECs alone does not suffice as a carbon mitigation strategy.

Implementations of Green IT solutions, with renewable energy or even sustainable lowers Carbon emissions drastically and by implementing CO<sub>2</sub> credits into the mix, the opportunity of becoming Carbon neutral is a possibility.

This increase in awareness regarding Green IT has even leaded the Car manufacturer Volvo to aim for a sustainable environment and sourcing energy from renewable energy. Volvo is presently replacing natural gas with renewable biogas for heating in their factories and they have also made an agreement with a Green energy company called Vattenfall AB, it is in Volvos environmental policy to use Green energy (Awan & Raza, 2010).

Ensuring a secure energy supply, preserving the environment and protecting the climate are central challenges facing today's world. Environmentally friendly technologies are the key to sustainable economic activities. In order to optimize the use of resources across the entire spectrum of global value chains, it is essential to tap the full potential of technology (Uddin, Rahman, 2012).

### *3.3. Optimize Energy*

IT companies understand the efforts and costs needed to keep computers and Data Centers running efficiently. The focus of implementing Green IT into Data Centers is to construct a more energy efficient and dense computing ecosystem where:

- Software technology control data growth and shrink capacity demands
- Managers use Service level agreement to manage energy usage
- Energy efficient computing infrastructure optimizes performance and utilization level

- Physical plant is engineered for maximum energy efficiency

The process chart, figure 24, shows how to break down the process within a Data Center to efficiently measure the consumption of each action. By breaking it down into pieces it is more comprehensible to analyze and implement.

Uddin and Rahman explain that by categorizing the Data Center into measurable units, and by identifying power consuming measuring components and then group them according to their efficiency and workloads, and thereof apply green metrics. Metrics such as efficiency, sustainability and cost of green initiative, as well as implementing virtualization.

Most Data Centers are already applying virtualization also known as “The Cloud”. Virtualization is combining two computational servers into sharing the same machine, in a Data Center each server has a specific function however are not functioning completely 100% all the time. That is servers have peak hours and bulk the capacity at that time, with virtualization servers are joined after how they are categorized and work during off hours, i.e. not at the same time.

Virtualizations is green IT as it less purchase and maintenance in hardware and equipment. Which leads also to saving on housing, powering and cooling, with a fraction of their processing power (Uddin & Rahman, 2012).

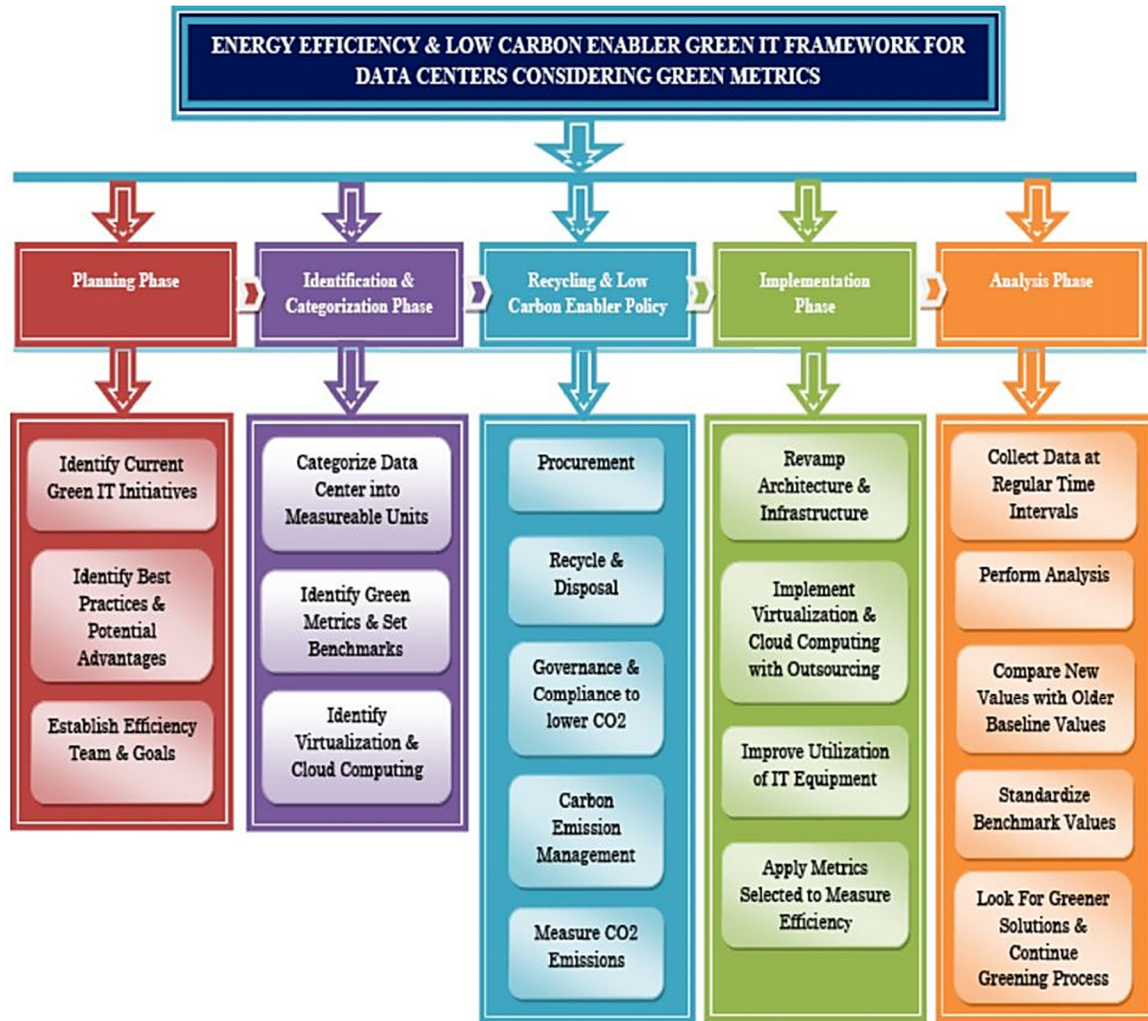


Figure 24, Green Metric Framework, (Uddin & Rahman, 2012)

Companies that have implemented Green It have achieved reductions five times greater than the growth in emissions from the IT sector itself. Continuous increases in the emissions from the IT are projected to increase from 3% of total global emissions in 2009 to a whopping 6% by 2020(Smart2020, 2008).

An affirmation made by the authors' states that with green energy companies can reap financial and social benefits in the long term because green marketing has long term impact on consumers in the energy market. They also state that true green companies have an opportunity now to take an advantage by adopting proactive strategies to pursue consumers through education the adverse effect that conventional electricity has over the environment and by promoting themselves as socially and environmentally responsible (Awan & Raza, 2010).



### *3.4. Energy Efficiency*

The Environmental Protection Agency (EPA) sent a report to the US congress in 2007 stating that from 2000 to 2006 the Data Center energy consumption had doubled, and that it would double again by 2011. This consumption was estimated to equal \$7.4 billion in annual electricity costs within the USA. This means that a Data Center has major electrical bills, which will steadily increase in the future (Uddin & Rahman, 2012).

Green IT focuses on achieving higher energy efficiency in the use of IT devices in Data Centers. However, at the same time, corporations need to deliver new IT services in shortest amount of time with considerable high reliability, performance and availability requirements as important issues in supporting the business processes (Smart2020, 2008).

To achieve these objectives IT must have a clearly defined Green IT strategy or framework tuned with business strategy and goal to be able to realize and achieve both these objectives at the same time. IT needs to quickly and transparently translate IT strategy to IT operational processes to ensure effective business IT alignment in the most efficient way (Uddin & Rahman, 2012).

Green IT is not just energy efficiency as energy efficiency will only slow the growth of the sectors Carbon footprint. Hence Green IT needs to be a combination of innovative improvements on how Data Centers can be designed and operated to reduce power consumption to a breakthrough.

An efficiency benchmark was made for Data Center operators to measure the power demanded to keeping the computers performing as designed, the consumption of the entire datacenter, lighting, chillers, air handling.

A measure of 2 on the PUE scale was considered average, now a perfect score is 1. Meaning that all electricity is consumed by computers and utilities, and most Cloud companies are promoting this info on their Webpages, as it is a straightforward metric to measure the energy and broad efficiency of a facility.



	IT power Demand	Total Data Center Power Demand	PUE
Base Case	15MW	20MW	1.33
Idle Servers Down (5MW)	10MW	15MW	1.5

*Table 6. Data Center measure of PUE*

It is however not being used properly, and does not assert how green a company is. It can be compared to how many miles per gallon (MPG) are reported for Automobiles. Even though it is a poor measure for how green a company is it is useful to for Data Center operator (Uddin, Rahman, 2012).

The above table 6 shows the limitations of the PUE, if a Data Center manager has identified servers that are not being used, and would choose to shut them down and create virtual servers, it would result in a decrease in the power consumption (10MW) which is good but it would show an increase in PUE (1.5), not good.

Not to forget PUE is completely unrelated to the CO<sub>2</sub> content of the electricity that is consumed. One example Cook mentions is that if a Data Center is largely powered by renewable energy but has a poor PUE; it will still contribute significantly less pollution than a Data Center largely powered by coal but with a much lower PUE.

Google has built their own Data Centers for years and have incorporated Green measures into their design structures. Their self-built Data Centers have been increasingly efficient even though Google has added to their Data Centers and servers. Not to mention they have a staggering number of server, i.e. an estimated more than 900,000 (Perry, 2011). Another estimation done by Gruener (2012) measures Google amount of servers to as 217,080.

These efforts are clearly showing in their PUE as well as their efforts in using renewable energy. As Table 7 shows Google's PUE has been steadily decreasing, to the point that their energy consumption is almost more than neutral.

	Variables	2008	2009	2010	2011	2012
1	Fleet-wide trailing twelve-month (TTM) PUE	1,2	1,19	1,16	1,14	1,12
	PUE TENDENCY	-	-0,8%	-2,5%	-1,7%	-1,8%
2	Google's self-build data centers	5	6	7	8	9
	Tendency	-	20,0%	16,7%	14,3%	12,5%

<sup>1</sup>PUE (Google, 2013) - <sup>2</sup>Self Build Data Centers (Pearn, J. 2012)

Table 7. Relation PUE vs. Self-build Data Centers Google 2008 – 2012

### 3.5. Conclusion

The first component for answering the Research Question demanded to discuss, from the theoretical point of view what kind of benefits that Green Server Hosting could provide to the Operations Activities.

The effects of global warming are reported in the news, in newspapers, are in discussions on blogs, and are a great concern for scientist and environmentalists all around the world. All stating the measures need to be taken to counter the effects if reversal is not an option.

The measures discussed above are showing great benefits when being implemented, in a discussion video regarding Green measures on Google's home page, the interviewee states that within 12 months of implementation Green IT is "paying off".

By implementing measurements of efficiency such as the PUE, both Google and Facebook have displayed great energy efficiency, with a power consumption of almost 1 computer, Google PUE was 1.12 and Facebook's PUE was 1.09 for 2012. This means that efforts of energy efficiency have lowered their energy consumption to a bare minimum.

Facebook has only revealed their PUE and Carbon footprint for the last 2 years, Google has only publicized this data leading back to 2008. The last information available about Google's power consumption is from 2010 which shows an estimated total consumption 220 Kwh, while Facebook first public figure is 509 Kwh for 2011.

Following these power consumption totals to get an understanding of the size of their Data Centers however there is no data available, nonetheless it is estimated that Google has over 217,080 (2011) but only had a power consumption of 220 Kwh for the year 2010.

	Google	Facebook
Power Consumption	220 kwh (2010)	509 Kwh (2011)
EST. Server Amount	217,080 (2011)	180,900 (2011)
Carbon emission (2012)	1,5 M MT	3,916 M MT
PUE (2012)	1,11	1,09

*Table 8. Comparison of Google and Facebook*

Compared to Facebook, Table 8, who are estimated to have a server total of 180,900 with a power consumption of 509 Kwh. Facebook recent implementations of Green IT has yet to show results, however Google is showing to be leaders in with their self-built Data Centers, including renewable and sustainable energy to benefit their power consumption with more than 30%.

Google publicly announces that they are Carbon Neutral; this means that for all their CO<sub>2</sub> emissions they invest in renewable energy that reduces or eliminates carbon emission from other sources.

Facebook has started their journey towards Greener Strategies by building a Data Center that relies almost 100% on sustainable renewable energy. This is obviously only the beginning for the social media giant has about 1/5 of the amount of Servers that Google has, but consumes almost 2.5x more energy per year.

All efforts of implanting Green IT and Measures within the IT Governance of a company shows a return on investment from the beginning, however this is an investment for the long term. Implementing Green IT measures shows results almost instantly, in lower cost, higher efficiency, reduced carbon footprint and happy consumers and employees, The Triple Bottom Line.

### *3.6. Implications*

This analysis sees efforts of Green IT being realized within the ICT sector however there are still companies that have yet to adopt this Greener vision. The wish is to open even more discussion regarding these operating measures available for companies.

## *4. Benefits of Green Server Hosting towards Marketing & Sales*

### *4.1. Introduction*

According to Porter (1985) Marketing and Sales activities are Associated with providing a means by which buyers can purchase the product and enticing them to do so. Morrow (2009) has adapted that concept to Google by pointing at the software “Adsense” as the main source of revenue, through direct advertisement, increasing the chances of users becoming buyers.

Nevertheless, the current analysis about what benefits Green Server Hosting could provide to the Operations Activities within the companies under study has been inspired under the logic of value co-creation from Normann & Ramirez (1993). The nature of the business for Google & Facebook, demands to consider the interaction of users, servers and advertisers in value co-creation and how the environment affects it as well.

In this section theory is relating green energy to revenue, corporate image and consumer awareness has been discussed by the MTA. As a result, a conclusion has been drawn aiming to provide some light on this issue for further researches.

### *4.2. Green Server Hosting and Revenues*

Global warming is affecting businesses in all industries. Companies have to deal with climate change risks including severe emission-reduction legislations, negative response from environmentally concerned consumers, and damage to physical assets due to natural disasters. Consumers are increasingly taking companies' environmental records into account when they make purchasing decisions. And investors are already discounting share prices of Companies poorly positioned to compete in a carbon constrained world (Lash J. & Wellington F. 2007).

But the risks of climate change also offer new sources of competitive advantage, Lash & Wellington (2007) suggest that companies reinvent their business before rivals do to mitigate those risks and seize the opportunities. A four step process for mitigating climate-related risks and seizing new opportunities for competitive advantage are given, this analysis will check how the companies that are studied here are doing regarding to these steps:

Step 1: Quantify the company's Carbon “Footprint”

Companies can utilize available reporting standards (such as the Greenhouse Gas Protocol) to prepare an inventory that provides a true and fair account of the company's greenhouse gas emissions. That differentiates direct and indirect emissions are important.

“Our efforts in efficiency, buying clean energy and purchasing carbon offsets bring our carbon footprint down to zero. We're going beyond carbon neutral by committing over \$1 billion to renewable energy projects that create far more renewable energy for the world than we consume as a company. In addition, our products enable our users to save energy themselves” (Cook 2013).

Stakeholders will receive a message that climate change is a crucial issue for the company that quantifies its carbon “footprint”; it might lead to improve the image plus getting a broad view of the risks and opportunities presented by a carbon-constrained economy (Lash & Wellington 2007).

Figure 25 shows a clear example of the message that Google wants to portrait to the Stakeholders.

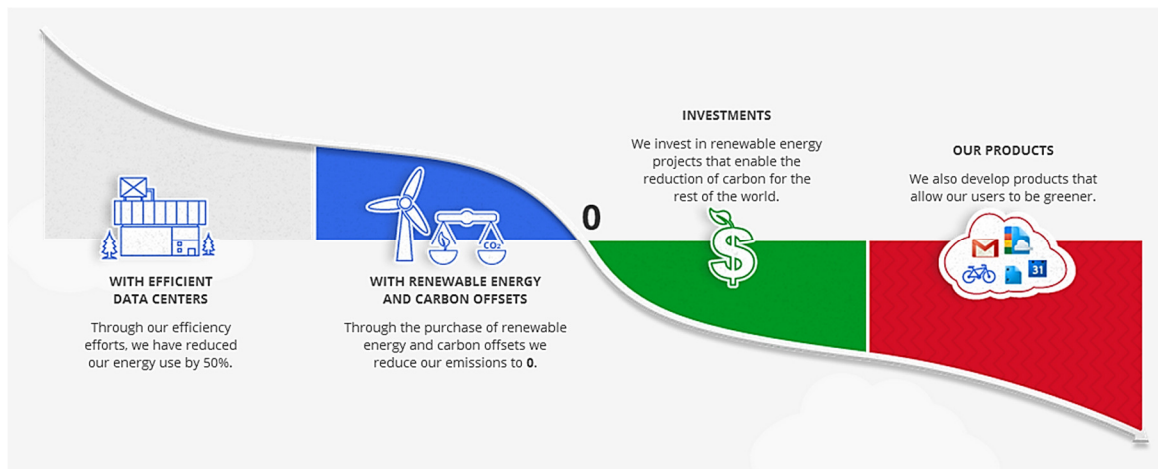


Figure 25. Google Footprint (Google Green 2013)

## Step 2: Assess the Carbon-Related Risks and Opportunities

Ignoring the financial and competitive consequences of climate change could lead a company to formulate an inaccurate profile (Lash & Wellington, 2007). Thus they propose to consider how the following six risks could hurt or present opportunities to help business:

- a. Regulatory: mandatory emissions reduction legislation

The legislation aims to regulate emissions of the products companies make or the emissions resulting of the manufacturing process to create those products.

Kyoto Protocol (Smart 2020, 2008) is an example of the initiatives to reduce carbon dioxide and other greenhouse gases. Many countries of the world are subject to it and therefore the companies operating within those countries. The regulation system is applied under the figure of allowances (European Union) that authorize the members to emit certain amounts of specified greenhouse gases.

That allowance system has opened up for a trading system for allowances, where companies with lower emissions than allotted, can sell their unneeded allowances on the market. Lash & Wellington (2007) mention that “there’s a burgeoning market in greenhouse gas emission allowances (the so called carbon market), with annual trading in these assets valued at tens of billions of dollars”. E.g.

“Google has implemented the method of “greening” the grid by Power Purchase Agreements. The company guarantees a renewable-energy developer that it will buy 100% of their future project. Google has to buy the energy from the local grid that feeds power to one of its Data Centers. Green-power purchases are only one element of Google’s strategy to run a 100% “carbon free” Data Center infrastructure. Google has been completely carbon-neutral since 2007, Joe Kava, senior director of Data Centers at Google said. The other two main elements of the strategy are energy efficiency and carbon offsets.” (Data Center Dynamics, 2012).

b. Supply chain: suppliers passing their higher carbon-related costs to the company

Given that the regulation risk applies for all companies, companies must take into consideration that their cost structure can also be affected by any cost modification based on carbon-related costs from their suppliers. On that respect Google, has taken a step forward trying to avoid this risk with strategic actions like: Purchase Agreements. The company guarantees a renewable-energy developer that it will buy 100% of their future project – such as a wind farm – for 20 years. Google has to buy the energy from the local grid that feeds power to one of its Data Centers (Data Center Dynamics, 2012).

c. Product and technology: rivals developing climate-friendly offerings before you do

Some companies will fare better than others in a carbon-constrained future, depending on their ability to identify ways to exploit new market opportunities for climate-friendly products and services. Although within the carbon markets as mentioned before, trading dynamics for allowances have created the opportunity for financial services companies to work with their trading strategies. The example provided for the point “b” matches perfectly to this statement too.

d. Litigation: lawsuits charging companies with negligence, public nuisance, or trespass

Companies that generate significant carbon emissions face the threat of lawsuits and also create personal liabilities for directors and officers. Companies under study are conducting concrete actions, to let know the public opinion, the impact from the activity on the environment and provide an image of eco-oriented. e.g.

Facebook has a page called “Green of Facebook”, making available for the stakeholders to have access to the impact from the company activities to the environment. The main message for the page says “As a follow up to the release of Facebook's 2011 carbon and energy data, we are again sharing our energy use, energy mix and carbon footprint for our operations. Tracking and sharing this kind of data – whether annually or in real-time – continues to be an important part of how we hold ourselves accountable for the efficiency of our operations and our environmental impact, and how we uncover opportunities to improve both” (Green on Facebook, 2013).

e. Reputation: destructive consumer or shareholder backlash

Companies also face judgment in the court of public opinion, where they can be found guilty of selling or using products, processes, or practices that have a negative impact on the climate; by the other hand companies can turn reputational risk into an opportunity by leveraging practices that show them to be good citizens of the planet.

f. Physical: damage to companies' assets through drought, floods, and storms

A company's exposure to this risk is highly determinate by the dependence on the physical environment and the elements.

Step 3: Adapt the Business

When a company has done an assessment of how climate change could affect it, it should be possible to develop and implement strategies for reducing energy consumption and carbon emissions. And consider how it might reinvent parts of its business to seize new opportunities. A company like Google seems that not only defined by its measures but also by how they provide resources to help others to mitigate their footprints on the environment. e.g.

“Even after our efforts in efficiency and renewable energy, we still impact the environment. To eliminate our impact on climate change, we invest in projects that reduce carbon emissions at another source outside of Google” (Nickerman, 2013).

#### Step 4: Do It Better Than Rivals

“Doing well by doing good” isn’t enough: Companies have to beat their rivals by reducing their own exposure to climate-related risk and finding business opportunities within those. Google seems to be ahead on that respect, investing in projects to produce renewable energy and at the same time closing deals with them to buy that energy, a strategic move to improve image and assure green energy supply. e.g.

“Our efforts in efficiency, buying clean energy and purchasing carbon offsets bring our carbon footprint down to zero. We're going beyond carbon neutral by committing over \$1 billion to renewable energy projects that create far more renewable energy for the world than we consume as a company. In addition, our products enable our users to save energy themselves” (Nickerman, 2013).

Based on their communication strategy, Google & Facebook seem to be oriented to Green Energies (including green server hosting) and be aware of the opportunities within carbon-constraints. Therefore they are adding their skill and other resources at hedging against physical climate risk, mitigating costs, trying to avoid legal problems and other threats to corporate reputation. In words of Lash & Wellington (2007) managing climate risk in the supply chain, investing capital in low-carbon assets, and innovating around new technology and product opportunities.

### *4.3. Green Server Hosting and Consumer Behavior*

The Second part of this section displays a discussion of articles and facts that under the MTA's consideration can provide a better understanding of how a green server hosting could influence



some of the main drivers for online consumers' behavior, helping companies to improve their image towards consumers (users and advertisers) and have impact on their TBL.

The analysis was conducted following the line set by the Digishift phenomena described for Steen & Strøm (2011). Initially, the MTA had the initiative of extrapolating some parts from Cheung et al. (2005) empirical research related to Online Consumer Behavior; nevertheless after further research of related literature a model for Environmental Marketing, developed by Suchard & Suchard, (1994) was discovered, despite being 11 years older than Cheung (2005) that model takes into consideration many key points and from the MTA's perspective it is a good tool for the discussion.

Prior further analysis it is important to point some highlights for Fishbein & Ajzen (1975); Cheung et al. (2005) and Suchard & Suchard, (1994).

### Theory of Reasoned Action

The Theory of Reasoned Action was developed by Fishbein & Ajzen, (1975); it says that intention (leads to behavior) is affected by Attitudes and Subjective Norms. In practice, two methods of impacting behavior are: to influence attitudes and exert social pressure.

The figure 26 shows the TRA Model.

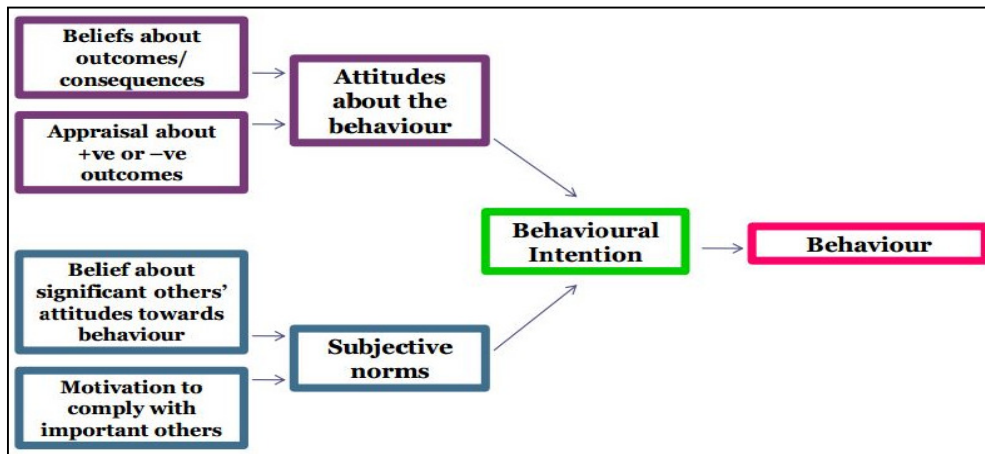


Figure 26. TRA Model (Ajzen & Fishbein, 1975)

Attitudes of the consumer are defined by the belief that consequences of taking certain action and the appraisal of that outcome. For this Master Thesis the consumers (companies' user) are defined as Netizens and consider themselves not only as consumers, but also as marketers, navigators and media producers (Steen & Strøm, 2011).

In that respect companies like Google & Facebook have enabled reports showing the carbon footprint that each person leaves when they use their services and comparing it to similar outcomes from other activities. See figure 27:



Figure 27, Google (left) & Facebook (right) Carbon emission per user (Google, 2012 & Facebook, 2012)

Subjective norms are defined by how the individual foresees others' attitudes towards a specific behavior and according to that the motivation complies with what is important to others; thus subjective norms have a strong influence on consumer's behavioral intention. Within the Steem & Strøm report (2011) it is possible to see that the existence of user-driven communities has set a new scenario, where the ease to speak up about individual or collective concerns sets a challenge for companies, when it comes to the way society evaluates the impact of their activity on the system.

Companies like Google & Facebook are conducting specific green action towards their activities –including server hosting– but using public media to present themselves as drivers for a change within the ICT industry towards eco-friendly processes. e.g.

Joe Kava, senior director of Data Centers at Google. During his keynote address at the Datacenter Dynamics conference in New York City Tuesday, Kava called on the Data Center industry to band together to make wholesale changes to the way its energy use is affecting the planet (Datacenter Dynamics, 2012).

There is no conclusive evidence in the present that TRA can provide enough tools for companies like Google and Facebook to modify consumer behavior only based on the green initiatives, at least in the short run; nevertheless further research has been done since 1975 and the MTA have included them in the next section.

Critical Review of Online Consumer Behavior (2005)

Within his article Cheung et al. (2005) mention that work from prior researchers were heavily

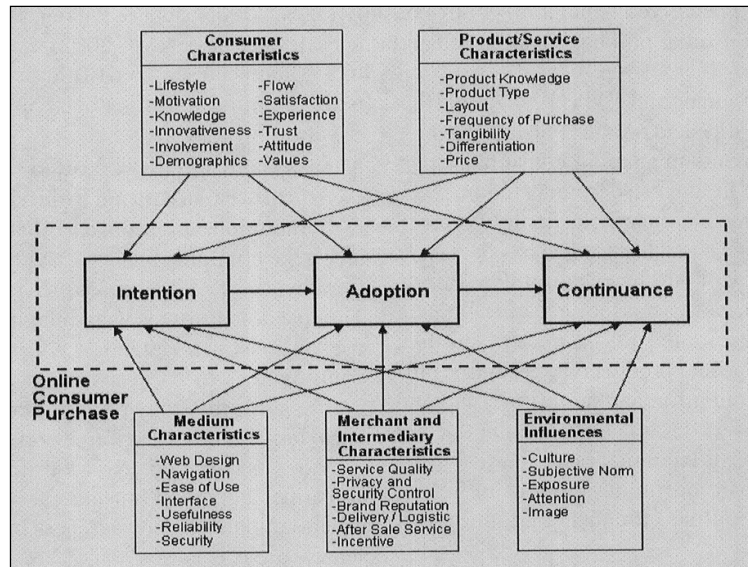


Figure 28. Framework of Online Consumer Behavior

(Cheung et al., 2008)

dependent to Theory of Reasoned Action (Fishbein & Ajzen, 1975) and its family, nevertheless TRA's model was not capturing other important factors that explain and predict a continuance behavior (repurchasing); thus there was a good chance to explore new theories, frameworks and explore online consumer behavior from another angle.

The mentioned paper is a review of 355 articles between 1994 and June 2002 providing an overview of the theoretical perspectives which have been applied to the field of online consumer behavior. At the end, the article concludes that there are five main drivers of reference regarding consumer behavior online. The graphic representation for all the factors can be seen in figure 28.

All of these determinants play a role on the framework of online consumer behavior and the consumers' intention, adoption and continuance of using a product. For the purpose of the Master Thesis, the authors have provided the following highlights:

1. Individual/Consumer characteristics: representative for intention and adoption; thus some discussion has been conducted on the TRA section
2. Environmental Factor: representative for external influences such as subjective norms; thus some discussion has also been conducted on the TRA section
3. Product/Service Characteristic: referring to the consumer's knowledge of the product, product type and price. It has been established by Steen & Strøm (2011) that Netizens not only see themselves as users but experts of technology. The companies under study

are not only providing general information related to their efforts to be green but enabling direct access from stakeholders to see a list of their initiatives over the internet e.g. Google Green (2013).

4. Medium characteristics: refer to the ease of use, convenience, information quality, usefulness and the like. E.g. Google has achieved the top market share in the search industry precisely because their product is rare. They are able to provide excellent links in the first few results. Google excels at directing a large quantity of visitors to websites using its AdSense program. Many businesses are dependent upon the traffic AdSense brings to their website to generate income. For the advertisers this increased traffic translates into increased sales and directly helps the bottom line (Morrow, 2009).
5. Merchants and Intermediate Characteristics: is representative of brand, privacy and security, Control and Service quality. E.g. For consumers (advertisers) the names Google or Facebook are synonymous for massive audiences, due the volume of traffic they do generate: 5 billion search/day (Google, 2012) and 600 million login/day (Facebook, 2012)

The Online Consumer Behavior Framework (Cheung, 2008) provides extra motivation factors for consumer behavior, but because of the nature of this Master Thesis it is necessary to find a model adapted to Environmental issues and strategy. Under the MTA criteria, the model in the following section has those characteristics:

#### Corporate Environmental Marketing: An environmental Action Model (1994)

Suchard, H. & Suchard, J. (1994) developed an Environmental Marketing action model to determinate the extent of success on this matter. They point that with the growth in importance of environmental issues, top management companies have realized that within the environmental aspects of management are part of their social responsibility to society (Porter & Kramer, 2006) and additionally present an opportunity to create new markets (Lash & Wellington, 2007).

Their paper takes a research conducted by Peattie & Ratnayaka (1992) as a start point. It is important to point out that the purpose of the paper was not to validate the model shown in the figure 29 below:

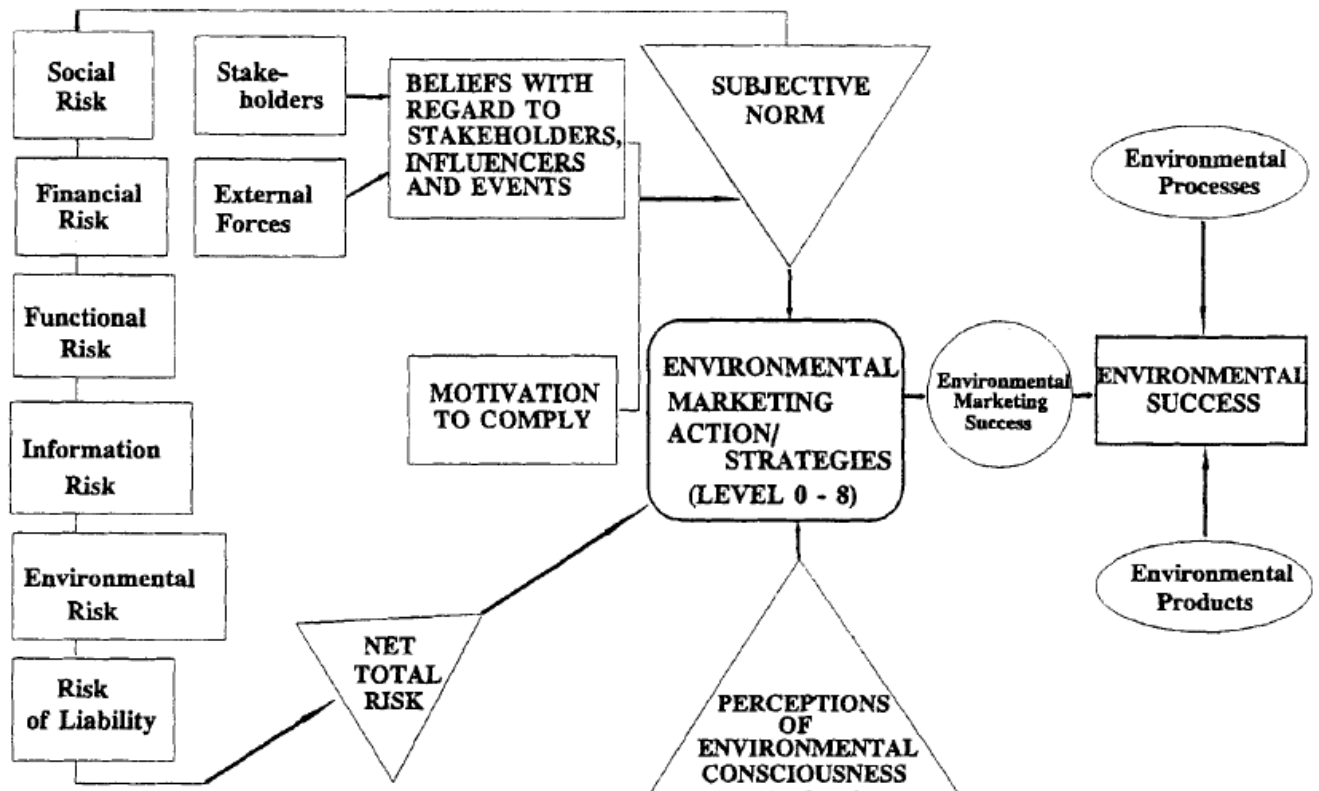


Figure 29. The Environmental Marketing Action Model by Suchard & Suchard, (1994)

The MTA have stated highlights for the model trying to apply them to the common profile as follows:

The model provides further elements that affect the perception in consumers when they make buying decisions, one of them is environmental consciousness, subjective norms and risks.

In previous sections, examples of how the companies (Google and Facebook) have been trying to cope and modify subjective norms (TRA section), and the risks related to environmental issues, have been previously established (Green Sever Hosting and Revenues section).

The interesting part that links Green Server Hosting as an important component for the Environmental Marketing Strategy is established as follows: Other factors which will influence the success rate would be, for example, the environmental processes used and the actual environmental product produced. The raw materials used, the safety, quality, reusability, recyclability, lifespan and energy efficiency of the product are all issues of concern and will affect environmental success. The actual safety of the products in terms of manufacture, use and disposal and the sustainability of the company's long term resource usage will affect the

success rate (Suchard & Suchard, 1994). The elements of energy efficiency and sustainability of the resource usage has been approached in the operation analysis above.

#### *4.4. Conclusions*

The second component to answer the Research Question was to discuss, from the theoretical point of view, the kind of benefits that Green Server Hosting could provide to the Marketing and Sales Activities.

Researchers have been talking benefits of developing a Green Marketing Strategy and related subjects since the early 90's.

It is important to point the existence of two kinds of consumers towards companies like Google and Facebook: users and advertisers and despite the fact that both are interrelated in the process of value co-creation it is possible to disaggregate theoretical benefits for each of them.

Based on the section related to GSH towards Marketing, the Master Thesis Authors have concluded:

A company can use its environmental process, where Server Hosting is allocated, to extent the environmental Marketing success towards customers. Researchers pointed that importance of environmental issues is increasing due global warming effects, media is also contributing to create awareness and connectivity due digitalization is spreading the message through social media. At the same time, big companies –including Google and Facebook- are leading a campaign showing their advance on green initiatives and even funding companies willing to produce green energy.

The theory mentions that awareness about climatic change is raisin. Users are getting more aware of the consequences of their buying decision over the clime and companies are facing opportunities to develop new markets (Carbon Economy) and improve their image within their customers through their own products and even their suppliers.

#### 4.5. *Implications*

With this paper the MTA wanted to create further discussions; therefore it would be interesting from the Marketing and Sales perspective and based on the value constellation model to conduct a quantitative study for internet users and internet advertisers within the ICT industry. In that way, primary information could be collected and applied on Environmental Marketing Models such as the one from Suchard & Suchard (1994)

## IV. CONCLUSION

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Since the early 70's researchers have been pointing to the benefits that corporate social responsibility can provide to companies from the strategic point of view; based on their work others develop further studies between the 80's and 90's including a new dimension: environment. At that point the internet was a reality and mobile phones started to be more available; nevertheless the public eye over companies' activity was focused on heavy industrialized lines, such as car production.

The 21<sup>st</sup> century brought interesting elements such as digitalization, creating new tools for people to interact, and for companies the opportunity of growth. Google and Facebook are good examples of it. Nevertheless, the increase of Global warming effects seemed to accentuate the interest of stakeholders over the environmental consequences from companies' activity and this time over almost every Industry.

Some researchers have progressively focused on subjects related to energy efficiency, Carbon emissions and mechanisms to reduce the impact on the environment and pointing the strategic benefits that a company can obtain from eco-friendly initiatives.

The final chapter aims to portrait the main findings related to "The role of Green Server Hosting in the Digishift Era". These highlights below are the output from a discussion from the theoretical point of view and have been stated as follows:

The classic assumption of Value Chain portrayed by Porter (1980) does not apply to Google and Facebook due the nature of their operations. Instead, the Value Constellation Model proposed by Normann & Ramirez (1993) provides a better understanding based of the fact of value co-creation. Within Google and Facebook activities the key players are consumers (users and advertisers) who add and modify value on every activity and the whole process is supported by the existence of servers, the company infrastructure.

The operations activity within Google and Facebook is directly related to processing the inputs from consumers (users and advertisers) and the power consumption from servers to perform is notorious, media and researchers are aware of it. To evaluate how a green server could provide benefit for an activity like processing information it would be necessary to apply measures within companies or have access to their records in case they have already started using the



initiative; both Google and Facebook are already involved in the use of eco-friendly Data Centers but detailed records are not available due to the secrecy of both companies.

From the companies' reports estimations have been made regarding their energy efficiency, carbon emission and through the theories applied in this analysis, efforts to implement Green Measures and Green IT into the companies' operations does show in the end results. All measures towards Green It can show results within 12 months of implementation and will over time lower the company costs as well as carbon emissions.

With power companies turning more towards renewable sources, i.e. wind, sun and water, companies that outsource have greater possibilities to choose their providers, to benefit themselves as well as the environment. With governmental politics applying pressure towards companies' carbon footprints, in theory companies should start investing in solutions that target their long term interest, by implementing local renewable energy sources avoiding risks and taking advantage of new marketing opportunities.

Green initiatives including the Green Server Hosting, in theory might have a positive effect on companies' access to the carbon market where companies with low carbon footprint can trade their Carbon Credits or Carbon allowances. This efficiency will also lower the companies cost a propos the governmental carbon taxes.

The Marketing and Sales Activity within Google and Facebook is far more complex, due the constant interaction with the key players; nevertheless it is interesting to observe that both companies seem to be in tune with what researches say in terms of developing communication strategies, e.g.:

To show their efforts not only to be greener but their influence over the industry with activities like funding projects to generate green energy and guaranteeing to buy that energy for their consumption. In that respect, it seems like a very strategic move: they publish how green they are and how they go the extra mile helping others to start eco-business but at the same time they secure a power supply of green energy for their Data Centers, improving image and guaranteeing energy supply.

Some models related to environmental consumer behavior have been developed but not tested. They mentioned that environmental processes, where green server hosting is included, have an influence over the success of an environmental strategy, designed to avoid the threat of poor corporate image. Those threats can lead to a drop in share prices (Google and Facebook are in

the stocks market), unhappy banks and clients, poor motivation of personnel, reductions in turnover and declining profits.

## V. CONSIDERATIONS

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The aim of the current Master Thesis was to point and discuss some benefits that companies can obtain from using Green Server Hosting. During the process the MTA have discovered a larger extend of green initiatives that already are taking place and even being lead by Google and Facebook.

The models discussed, especially on the Marketing and Sales section work under the assumption of consumers aware of their responsibility towards global warming and the subjective norm of a society highly informed and compromised with environment.

For future research, it would be interesting to apply one of these models and measure the level of Google and Facebook consumers' awareness to determinate whether these assumptions can be valid in the present.

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## VII. Appendixes

### Appendix 1

#### Company Scorecard

Company	Clean Energy Index	Coal	Nuclear	Energy Transparency	Infrastructure Siting	Energy Efficiency & GHG Mitigation	Renewables & Advocacy
	NA	NA		A	C	B	D
	13.5%	33.9%	29.9%	F	F	D	F
	15.3%	55.1%	27.8%	D	F	D	D
	56.3%	20.1%	6.4%	C	C	C	D
	36.4%	39.4%	13.2%	D	B	B	C
	39.4%	28.7%	15.3%	B	C	B	A
	19.4%	49.7%	14.1%	C	D	B	C
	12.1%	49.5%	11.5%	C	D	C	D
	13.9%	39.3%	26%	C	D	C	C
	7.1%	48.7%	17.2%	D	D	C	D
	23.6%	31.6%	22.3%	C	C	C	C
	4%	33.9%	31%	B	C	C	C
	21.3%	35.6%	12.8%	F	D	F	D
	56.4%	20.3%	14.6%	C	B	B	B

- (a) Clean Energy Index and Coal Intensity are calculated based on estimates of power demand for evaluated facilities (<http://www.greenpeace.org/cloudcomputing/facilities/>)
- (b) Akamai's global network of server is highly distributed and not possible to individually evaluate as we have done for other brands. However, Akamai is the only company that is reporting a fleet wide and regional Carbon Utilization Effectiveness (CUE), as noted in the data center facility table.
- (c) Both AWS and Apple were provided facility power demand estimates to review, both responded they were not correct, but neither provided alternative estimates. Using conservative calculations, Greenpeace has used best information available to derive power demand, and has decided to publish and invite AWS and Apple to be transparent and provide more accurate data for their facility power demands.



## Appendix 2

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Google is a multinational public cloud computing, internet search and advertising corporation; and one of the world's most recognized brands. Google has been the most open in the industry about the importance of increasing not only energy efficiency within the sector, but also the need to move our energy sources to renewable energy. Google has made significant efforts to increase the company's transparency. This is a great step forward that will enable better awareness of energy and carbon management associated with data consumption

### **Transparency: B**

In late 2011, Google increased the transparency of its environmental footprint significantly. The company finally published its energy usage<sup>53</sup> and GHG footprint for the first time. Google has also provided white papers on its energy procurement plans, and basic information to end users on the energy/carbon footprint associated with its various services.<sup>54</sup> Nonetheless, there is room for improvement. Google needs to be transparent with its emissions breakdown and reporting of facility level energy demand mix. The company should set clear goals to reduce absolute carbon emissions.

### **Infrastructure Siting: C**

Google continues to claim to choose renewable energy "where it makes sense" and applies a shadow price for carbon when calculating the power costs of potential data center sites. However, its most recent investments in Asia (Singapore, Taiwan and Hong Kong) put into question the company's prioritization for clean energy sources in the siting of its data centers.

### **Energy Efficiency and GHG Mitigation: B**

Google has a comprehensive energy reduction plan<sup>55</sup> that has resulted in its data centers using half the energy of the industry standard. Google publicizes these best practices<sup>56</sup> on its design choices in order to help improve efficiency within the sector. Nevertheless, there are some concerns over Google's plans to build three data centers in Asia<sup>57</sup> where efficiency can be a challenge due to the climate conditions in the region.

### **Renewable Energy Investment and Advocacy: A**

Google's commitment to using renewable energy<sup>58</sup> *as much as possible* has set the bar for the industry. Google has recently increased its goal of renewable energy purchasing from 25% to 35%<sup>59</sup> of total energy use and added a \$94m investment<sup>60</sup> in a portfolio of four solar photovoltaic projects in California. These actions, among a slew of other investments, are playing a useful role in the total expansion of renewable energy. Google has highlighted the benefits of clean energy innovation in a recent study<sup>61</sup> and through its involvement in the lobbying debate<sup>62</sup> to advance clean energy policies in the United States.

## Appendix 3



Facebook, the social networking site that now has 845 million users worldwide, has recently taken significant steps in putting itself on a path to being both a leader in energy efficiency, and powering its platform with renewable energy. In the past year, the company announced a new siting policy that prioritizes clean energy for its infrastructure and it has built a new data center in Sweden that will be almost exclusively powered by renewable energy.

### **Transparency: D**

Open Compute Project, launched by Facebook, provides an opportunity to be an open-source model not only in the transparent use of equipment and design of data centers, but also in the disclosure of data centers' emissions and energy sources. Facebook has yet to provide any data on its energy consumption or related GHG emissions at either a corporate or facility level. This is likely to change after the company goes public. The company, through the Open Compute Project, does disclose best practices in energy efficiency measures, which are mainly captured in that separate category.

### **Infrastructure Siting: B**

Facebook was one of the first companies to publicly announce<sup>51</sup> a preference for renewable energy supply when siting its data center infrastructure. The company stated that renewable supply was a key factor in its recent investment in Lulea, Sweden, a data center powered almost exclusively by renewable energy. This is a critical step forward for the environment as the company continues to build out infrastructure. It also signals to power producers vying for its business that they should be investing in renewable energy to enhance the likelihood of procuring Facebook's business.

### **Energy Efficiency and GHG Mitigation: B**

Through Facebook's Open Compute Project, the company published a number of designs and equipment specifications to truly enable learning in areas of data center energy efficiency. The company has showcased how the design of its data centers minimizes energy demand as well as water consumption, which is especially critical for its high desert infrastructure.

### **Renewable Energy Investment and Advocacy: C**

Facebook's announcement<sup>52</sup> that it will increase the amount of renewable energy powering its data centers will likely raise this score as the company continues implementation, which will include lobbying local utility and regulators for additional access to clean energy. At the moment, Facebook's investment in Lulea, Sweden provides the bulk of the company's overall renewable energy use, and the company has not yet set specific targets for future generation.