IT IS SMART ONLY IF IT IS SUSTAINABLE

Environmentally Friendly Business Strategies as a Source of Creating Bigger Value Pool and Reducing Negative Environmental Impacts

By

Mohammad Tashfeen Khan

July 24, 2016

A Major Paper submitted to the Faculty of Environmental Studies

in partial fulfillment of the requirements for the

Degree of Master in Environmental Studies,

York University, Toronto Ontario, Canada

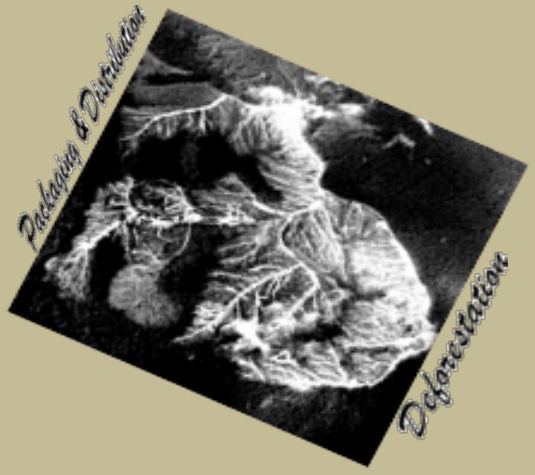
Dr. Ellie Perkins (Superviser)

_____

Mohammad Tashfeen Khan (MES Candidate)

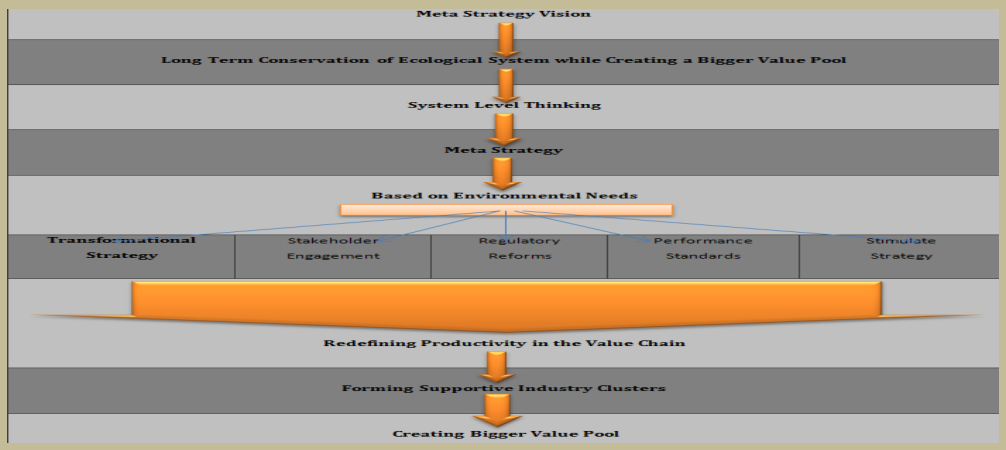
_____

IT IS SMART ONLY IF IT IS SUSTAINABLE



"We have met the enemy and he is us".
Walt Kelly

"We cannot command Nature except by obeying her."
Francis Bacon



"Modern technology owes ecology an apology."
Alan M. Eddison

"Earth provides enough to satisfy every man's needs, but not every man's greed."
Mahatma Gandhi

Contents

LIST OF FIGURES

LIST OF TABLES

CHAPTER 2

CHAPTER 3

CHAPTER 4

CHAPTER 5

CHAPTER 6

CASES

FOOD FOR THOUGHTS

THE "META STRATEGY" FIGURES

GRATITUDE

"Good thoughts are no better than good dreams, unless they be executed."
(Ralph Waldo Emerson)

BUT TO EXECUTE THEM WE NEED SUPPORT BECAUSE

"Alone we can do so little; together we can do so much".
(Helen Keller)

This paper signifies not only my work to accomplish the requirements for a graduate university degree but it is a meek effort purely based on my consciousness and willingness to create awareness among smartphone users regarding their gadget's monstrous environmental costs. My experience at the Faculty of Environmental Studies has been nothing short of amazing for it is a place where a business graduate like me developed environmental consciousness. This paper presents lessons learnt from all those teachers whom I took classes with and whom I wish to thank.

First I want to express deep gratitude to Professor Ellie Perkins who agreed to supervise my work. It was wonderful that I did not wait a single moment before starting my research proposal due to Professor Perkins' prompt response and guidance which eventually led to my major paper's topic. Professor Perkins has been supportive since the days I took research methodology classes with her, and without any doubt, that learning became a perfect guide in configuring my papers' approach. The intense reading Professor Perkins provided plus her strategy of engaging students to explore research methodologies and understand their applicability, in itself, provided a guiding logic for how to go about my paper.

And, how can I forget to mention Professor Liette Gilbert, my advisor and mentor, whose support and research related guidance throughout my terms, and provision of freedom I needed to move on in my own way, served as tools for my accomplishments. It was Professor Gilbert's constructive criticism and continuous guidance in choosing my courses and in designing my plan of study which provided me with a lens to see clearly what needed to be achieved academically during my two years stay at the Faculty of Environmental Studies. There was not a single time I did not get an email response from Professor Gilbert

within thirty minutes. My life was a lot easier at FES because of Professor Gilbert's support and professional approach.

I would also like to thank Professor Mike Valente (Schulich Business School) whose intense course on sustainable strategies enabled me to employ some concepts in my major paper. His vision, unique thinking and concepts motivated me to confidently incorporate innovative ideas in my paper. Moreover, I am thankful to Professor Mark Winfield, Professor Brian Milani, Professor Stepan Wood (Osgoode Hall Law School) and Mr. Eric Miller, all of whom are remarkable individuals with immense knowledge in their fields. What I enjoyed most with these nice people was the appealing hidden 'activism element' related to environmental issues. What I will not forget is the amount of work they made us do just in one term, and "unfortunately" some of us were lucky enough to have them all as instructors in one term. We did not sleep in that term.

Last but not the least, I am lucky to have my mother (Shamim) who prays for me all the time, memories of my late father (Mohammad Zaman Khan) whose charismatic personality still inspires me and my uncle (Dost Mohammad Khan) who supports me financially whenever I am in need. There is one other person who cooks for me, washes my clothes, forcefully gives me vitamin pills, wakes me up sometimes for no reason, points out mistakes in my writings and supports me in every step I take except when she is angry. I am talking about my wife, Wenny Bee, and without her, it would have been difficult to finish my paper on time. In short, it was everyone's support, and therefore I must say, alone can we do so little but together we can do so much.

FOREWORD

My plan of study revolves around “corporate social responsibility” towards “environmental sustainability” whereas my area of concentration is comprised of three main components: 1) corporate social responsibility towards environmental sustainability, 2) management practices and business strategies, and 3) policy making for environmental sustainability and creating a shared value. The interdisciplinary approach of MES program enabled me to merge economics, management practices and environmental studies to achieve my goal. A growing literature highlights corporate social responsibility (CSR) and ‘environmental sustainability’ as an important business practice and for many organizations, environmentally focused CSR appears to provide benefits that are not reflected in conventional balance sheets. The role of CSR is not all about ‘a triple bottom line’ but practices that can positively impact social, economic and ecological elements in a way that could bring a change in systems, contributing to the sustainable development and preservation of our ecological system. In order to grasp enough knowledge to conduct my research on the above mentioned topic, I have been enrolling in courses containing the elements of sustainable management practices, policy making and evaluation, environmental law, ecological economics, business strategies and quantitative and qualitative research methods. Moreover, one of the essential parts of my plan of study was to dig out the ground reality of sustainable business practices. To serve this purpose, attending seminars and enrolling in certification programs along with my mandatory courses have enlightened me with how to conduct my research and what to focus on to achieve the anticipated goals of my research. My major paper is therefore a mirror reflection of my plan of study.

My research design and questions helped me in achieving my learning objectives mentioned in my plan of study because my research questions are based on the components of my plan of study. First objective of gaining a solid knowledge about the environmental impact of businesses and assessing the role of businesses in contributing to our social and environmental problems is achieved by answering the first and second questions of my research. Whereas gaining an in-depth knowledge of management practices and business strategies for ‘environmental sustainability’ in order to analyse how the environment is externalized by conventional management practices, and how to form a constructive strategy to cope with the issue, is achieved in the second question of the research. The third question of research relates to the objective of developing a good knowledge of how companies create shared value and increase their business benefits while reducing negative environmental impacts. In addition, to narrow down my research area, I chose to stick with the electronic industry while emphasizing on the smartphones. Following is the abstract of my research.

ABSTRACT

In today's world, we thrashed about with intensive resource exploitation, increased productivity and increasing returns to scale to make abnormal profits and to form a system that favours the survival and growth of the corporate sector at the cost of environmental degradation. It is only now that the expression, 'environmental sustainability', which is to sustain or prolong the environment, became a focal point in today's corporate social responsibility agendas and reports. But this vagary of the corporate sector to decipher the environmental degradation enigma has not worked due to existing system and outdated strategies. Therefore, this paper calls for reinventing the system by unleashing wave of innovations, crafting new strategies, and having a vision based on transformation. To illustrate my points, I focus on the smartphone industry to unveil its environmental impact at every phase of its life cycle and throughout the supply chain. The environmental impact of the smartphone is evident at the extraction of raw material, manufacturing, distribution and packaging, use, and end of life phases. The key challenge for understanding these impacts is the complexity of the smartphone and its value chain. Smartphone, throughout its life cycle, also plays a huge part in perilous climate change. Deforestation, inefficient mining of metals and 'rare earths', air, water and land pollution, use of toxic chemicals, enormous e-waste generation, harmful smelting processes, ineffective companies' policies and government regulations and irrational consumer behaviours – all are evils associated with smartphones' entire life cycle. Also, the CO_2 emissions for all the phases of the life cycle of the smartphones for the year 2020 are forecasted to be around 390.4 megatons. I think environmental sustainability objectives require complex systems thinking for which we need collaborative effort. In this regard, I have designed what I call a "meta strategy" for "environmental sustainability". The "meta strategy" not just provides a guiding lens to mitigate smartphones' environmental impact but it can result in minimizing expenses of the smartphones' entire life cycle phase by phase, by taking advantage from others' competencies and creating clusters or partnerships, which in turn creates a larger value pool for every single actor involved. Around 6.1 billion smartphones are expected to be in use by 2020, thus creating an awareness regarding its environmental impact and providing a strategy to mitigate its environmental impact will have a tremendous multiplier effect among users, and a system changing and influential behaviour among manufacturers respectively.

Keywords: smartphone, environmental sustainability, environmental impact of the smartphone, supply chain, value pool, transformational strategy, stakeholder engagement, life cycle assessment, stimulate strategy, corporate social responsibility, complex system thinking, sustainable business strategy

Chapter 1: Introduction: Starting with a Concluding Point

1.1 Environmental Sustainability

For almost two years now, I have been eagerly waiting to write my major paper encompassing 'environmental sustainability'. The phrase is obviously self-explanatory, which is to sustain the environment and often clichéd as 'so that future generations may enjoy it, too'. I know there should be a much deeper meaning to it since universities have dedicated graduate courses based on this issue. I sit on my battered reclining chair in a corner of my tiny rented room every single day trying to understand the overwhelming number of articles all related to this subject matter and think of how a previous economics major like me can contribute to this broad aim. 'Environmental sustainability', these are just but two simple words that together are vast in its meaning and significance. I have still more to learn…

The hype to 'go green' is evident all over the place. Organic food is definitely 'in', though it is generally dearer. Governments have entered our homes for the purpose of influencing us to sort out our rubbish the right way. Tiffany and Company, a luxury jewellery retailer where my wife works, prides itself for being 'green' and besides giving her free tumblers, they offset their electrical and gas usage to reduce their carbon footprint. Interior designers slowly swap bathroom tiles to wood planks stressing that they are 'from renewable sources'. Simple paper towels are turning from eye-blinding white to guiltless brown. Even cleaning solutions, infamous for being carcinogenic, have gone biodegradable! We have come a long way from not caring to somewhat caring.

And so, every day I take an hour-long walk and see the lush greens of summer slowly change first into a burst of scarlet as if flowers took over the trees, then transform to a smooth but steady palette of tangerine, and finally turn to listless leaves or dark trunks and twigs that will eventually be covered in the overpowering pallor of snow precipitation. From eternal beauty, the vegetation just fades as if barren and then as if death hovered over. Yet we know nature has just fallen into a deep sleep because the moment the world revolves around the sun again, tiny buds of life would say hello as everything bursts and grows back again to lush greens then greets us back again with a rainbow of summer flowers, the buzzing of bees and the scurrying of our small friends, the squirrels too!

So, for all my burning-the-night-candles and painstaking efforts to learn individual subject matter pertinent to environmental sustainability, I know that its sole purpose is as meek as to preserve this simple splendour or pure spectacle of what we call nature, and knowing that it's all worth it. But one must have a great vision to preserve nature and I want to take a small step to be a part of that vision by highlighting the smartphone dilemma. It is a drop in the ocean but drops are what make the ocean. The revolutionary smartphone industry and its multibillion dollar marketing/hypnotism strategies have dragged the so-called *'homo economicus'* into neurotic communicating and irrational buying behaviour and we are apparently incapable of considering it as a threat to the environment on a global scale.

Considering it as a complex situation, I looked at it with the lens of complexity theory, according to which individuals, groups, and organizations form systems of highly inter-reliant actors that interact in nonlinear ways (Byrne 1998). As these actors acclimatize to their local environment, they influence how other actors of the system behave, creating a perpetual cycle of feedback loops (Valente 2011). According to Valente (2011: 1), "the positive feedback loops created from these interactions intensify and crowd out other behaviour resulting in a pattern that defines the system and once a pattern is established, systems become locked into self-reinforcing cycles of highly predictable collective behaviour". Therefore, systems influence actors and the actors unknowingly influence the broader system, thus creating a self-reinforcing loop.

There are two points of consideration here. First, we are victims of the same strong system created by the smartphone industry, influencing our work and social environment where goals cannot be accomplished without being dependent on the smartphone. Second, there is a need for system level thinking to combat this system. Being enslaved to the system, we are telling our children that nature is in the past and it probably doesn't count anymore, the future is in electronics, the boogeymen is in the woods, and playing outside is prohibited and possibly illegal (Louv 2008). Therefore, it is insurmountable for future generations to comprehend the moral intricacies of being alive if they

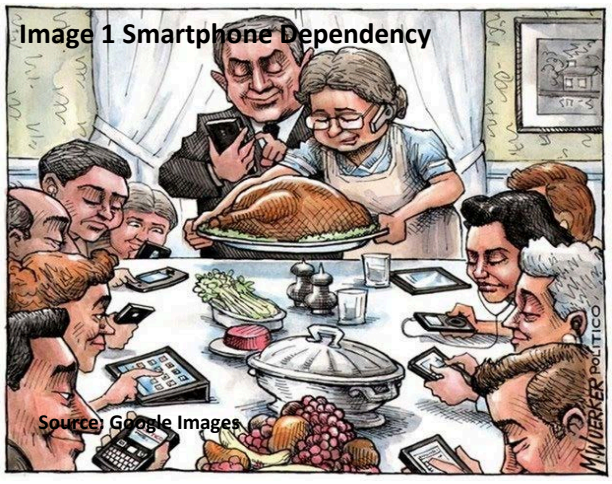


Image 1 Smartphone Dependency

Source: Google Images

are not allowed to engage in those intricacies outdoors due to their anomalous dependency on electronics and smartphones in particular. This brings us to the smartphone dilemma.

1.2 The Smartphone Dilemma

The boogeymen story should not be taken for granted because for the first time ever there are more gadgets in the world than there are people (Boren 2015). Active mobile devices in 2015 were 7.22 billion (GSMA Intelligence Report 2015) whereas human beings crossed over the 7.19 billion mark (US Census Bureau 2015). Smartphones and not-so-smart phones are burgeoning five times faster than we are (ITU 2015) with our population mounting at a rate of about two people per second (US Census Bureau 2015). No other technology has impacted us like the mobile phone (Lunden 2015) because it is the fastest growing social phenomenon ever, increasing from zero to 7.22 billion in three decades (Mamiit 2015).

Mitchell (1999), a novelist, once said when these things first appeared, they were so cool, only when it was too late did people realize they are as cool as electronic tags on remand prisoners. I wonder why they are called cell phones. If Thomas R. Malthus (1809), an English clergyman and economist, was still alive, his theory of exponential growth would not just urge moral restraint like practicing asceticism, and have castigations for those who have more children than they can support, but also extreme fines, extraordinary taxes and chastisements for those who own more cell phones and are subscribed to more connections than they need.

The term smartphone is used to refer to the state-of-the-art cellular phone devices (Theoharidou et al. 2012). Cellular phone is a telephone with access to a radio system to cover a wide area, without a physical connection to a network (Theoharidou et al. 2012). “Smartphones are distinguished from ordinary mobile/cellular phones for their sophisticated hardware, multiple and fast connectivity capabilities, and also advanced processing and computing capabilities which execute an operating system allowing users to extend its functionality with third party applications that are available from an application repository” (Theoharidou et al. 2012: 430). Smartphones came onto the consumer market in the late 1990s, but only gained popularity with the introduction of Apple’s iPhone in 2007 (Statista Report 2015b). The iPhone transformed the industry by offering customer friendly features such as a touch screen interface and a virtual keyboard (Statista Report 2015b). The first smartphone running on Android (operating system

used for smartphones) was introduced to the consumer market in late 2008 (Cecere et al 2015). The smartphone industry has been evolving and growing since then, both in market size, as well as in models and suppliers (Cecere et al 2015).

As far as all the mobile phones are concerned, by the end of 2015, there were more than 7 billion mobile cellular subscriptions worldwide, corresponding to a penetration rate of 97%, up from 738 million in 2000 (Boren 2015, GSMA Intelligence 2015). On the other hand, mobile broadband, the most vibrant market segment globally, penetrated worldwide at 47% rate in 2015, a value that augmented 12 times since 2007 (ITU Report 2015). This enormous increase in overall cellular phone subscriptions and internet usage is due to the introduction of our companion, the smartphone. The phenomenon of smartphones is a monster with one heartbeat and two heads. Today there are 2.6 billion smartphone subscriptions globally (Lunden 2015). By 2020, there will be 6.1 billion smartphone users, surpassing the number of active fixed line subscriptions worldwide (Ericsson Mobility Report 2015) where 80 percent of mobile data traffic will be from smartphones (Lunden 2015). When you take into account all sorts of phones and gadgets, there will be 26 billion connected devices by 2020 (Lunden 2015).

Moreover, according to the Statista Report (2015b), the global revenue from smartphones in 2009 amounted to 56.92 billion dollars and 272 billion by 2015. These unusual profits smartphone industry is making might even result in overrunning the forecast shown above by Boren (2015), GSMA Intelligence (2015), ITU Report (2015) and Lunden (2015) but it is highly unlikely that the industry will counter its adverse environmental effects like deforestation, water and air pollution, toxicity of farmlands and rivers, endangered animal species extinction, biodiversity loss and an overall climate change, at the same rate. Klein (2007) rightly points to the fact that the parties with the most gain never show up on the battlefield. And here arises a dilemma: they say it is smart. I think it is smart only if it is sustainable and that is my conclusion. Therefore, let me open the Pandora's Box carefully and find a way to tackle this dilemma. The following chapter is about my research approach. The idea is to provide a platform for smartphone manufacturers where they can begin to improvise their operations based on environmental needs, resulting in economic benefits for all the actors and a clean environment.

Chapter 2: Methodological Approach

I believe we live our lives with our own thinking and feeling patterns which are part of our beliefs. I think we are all born with a canvas and some instruments in front of us and we choose to use these instruments and canvas to come up with our own opus. But this is just my imagination. We are bound by systems. Even education, which is supposed to give us wisdom, is simultaneously confined by systems. I tried to jump over the edge but found myself landing somewhere in that system again. Therefore, my research approach for this paper is restrained by the analytic contents of research techniques and appropriate academic language. But I will try my best to be simple in my approach and will try to keep my readers safe from the mystification of the arcane language I tried to understand during the review of literature for this paper. I want to write this paper for those 7 billion common people who will all use smartphones by 2020 and I am sure they are not interested in the gory details of the methods I used. On the other hand, experts already know the framework but still want to know how I am going to do it. As Richard Feynman, a physicist and Nobel Prize winner, said, “if I could explain it to the average person, I wouldn't have been worth the Nobel Prize”. I am not interested in any prize, but in creating awareness about the environmental degradation due to the smartphone throughout its life cycle and in finding ways to mitigate this impact.

I will not go into the details of explaining epistemologies and ontologies (Mack 2010) and interdisciplinarities (Klein 1990). I will rather simply put my basic set of beliefs or philosophical ideas that guide this research as my “worldview”. Creswell (2013) sees worldviews as a general philosophical orientation about the world and the nature of research that a researcher brings to a study, and they are based on discipline orientations, students’ feelings and beliefs, advisors' inclinations, students’ academic institutions and past research experiences, etc. Creswell (2013) states that the types of beliefs held by individual researchers based on these factors will often lead to embracing a strategy and methods.

I am not an advocate of postpositivism, “for it is reductionistic in that the intent is to reduce the ideas into a small and discrete set to test” (Creswell 2013: 7). Therefore, my “worldview” is a combination of transformative and pragmatic approaches. Well, I might be labelled as a Marxist since I have a transformative approach, which I will take as a compliment, because I believe that to bring reforms and address environmental issues, collaborative efforts are needed from

political, business and non-for-profit entities. The transformative worldview holds that research inquiry needs to be intertwined with politics and a political change agenda to confront social oppression at whatever levels it occurs (Mertens, 2008).

Thus, I begin my paper with the focal point of how important it is to preserve our ecological system and then discus the role smartphone manufactures play in its degradation, and how they can overcome these problems with the help of other stakeholders, which can result in business benefits and creating a bigger value pool for all the actors in a system. On the other hand, a pragmatic worldview arises out of consequences (Creswell 2013), and there is a concern with applications which means there is doubt regarding what works and what does not, and also towards the solutions to problems (Morgan 2007). For instance, the more companies have tried to mitigate environmental degradation through their corporate social responsibility activities, the more criticism they have faced because the situation is in fact getting worse (Porter and Cramer 2014). Therefore, I will emphasize the research problem, and use of several approaches available to understand the problem and to provide evidence related to the issue. According to Creswell (2013), pragmatic individual researchers have a freedom of choice and can choose the methods, techniques, and procedures of research that best meet their needs and purposes. Tashakkori and Teddlie (2010) consider pragmatic worldviews important for focusing attention on the research problem in social science research and then using pluralistic approaches to derive knowledge about the problem.

The context of the research, the research problem, and its importance, are discussed in the first chapter by highlighting the importance of preserving our ecological system and the smartphone dilemma. The statistics shown in the first chapter and the evidence provided in chapter 3 regarding environmental degradation due to smartphones justifies the importance of the study. The purpose of this paper is to explore the environmental impact of smartphone and ways in which the environmental performance of the smartphones can be improved, hence resulting in more business benefits and creating a larger value pool. In this context my research will look into the following questions:

1. What is the environmental impact of the smartphone throughout its life cycle?

2. How can the environmental impact of the smartphone be reduced?

3. How can smart practices result in business benefits and create a bigger value pool?

To answer these questions, I have conducted qualitative and quantitative research based on secondary data collected through literature review to develop a complex picture of the problem which involves identifying the many factors involved in the situation, and generally sketches the larger picture that emerges. A large part of the paper is qualitative but some concurrent collection of both qualitative and quantitative data is accumulated due to the nature of inquiry. The idea behind qualitative research was to purposefully select the literature, documents, case studies, theories and visual material to elucidate the issues and efforts to tackle the issues. Quantitative data is included to compliment qualitative statements and also to forecast the smartphone's environmental impact in future in regards to CO_2 emissions. To make it understandable, I made simple calculations based on data avoiding complicated econometric formulas to prove my points. Moreover, at the end of each section, I have provided "food for thoughts" on some of the most important issues related to the smartphone dilemma but which are not a focus of this research, and hence needs due attention. "Food for thoughts" vignettes are about other horrors brought on societies and individuals by electronic monarchs to quench their thirst for ever-growing markets and greed. .

In the context of my approach, chapter 3 answers the first research question about the environmental impacts of smartphone life cycles. The first part relies on journal articles, news from magazines, NGOs, government and companies' websites and reports published by companies, governments and NGOs. This literature review provides the overall picture of environmental horrors bestowed upon us by the smartphone industry while news and reports provide further evidences related to the literature.

Since there are several smartphone manufacturers, and their supply chain is enormous (comprising tier 1, 2, 3 and other lower level suppliers) and prevailing around the entire world, I have selected Apple Inc.'s iPhone and the Fairphone as case studies. In the context of supply chain, original equipment manufacturers (OEM) are the companies that make the final product for sale to the consumers whereas tier 1 suppliers provide components directly to the OEM, fulfilling the outlined specifications required for the making of the product (Ross 2016). Tier two suppliers deliver their goods and provide their services to tier one suppliers, and not directly to the OEM, whereas tier three outputs are directed to tier two suppliers (Ross 2016). Other lower level suppliers deal with tier three suppliers.

This research has focused on smartphone manufacturers for few reasons. Firstly, smartphone supply chain is extremely complex whereas few studies have been conducted on its life cycle due to its youth as a product. There is therefore a need for more research in this regard in the light of increasing environmental impacts of smartphones. Secondly, I wanted to research something that could result in influencing large amounts of actors and individuals. Therefore, what could serve as better example than the smartphone. This helps to convey the inconceivable environmental impact of the entire electronics industry and corporate sector as a whole because smartphones will be one of the necessities by the year 2020 to be chained to 6.1 billion people living on the planet earth. Moreover, the iPhone is selected to explore its supply chain and environmental impact throughout its life cycle, notably on China, Peru, Ghana and Indonesia whereas the Fairphone is a good example to be followed in various aspects related to addressing environmental issues and redefining its supply chain. Table 2.1 provides a brief history about Apple Inc. whereas the sequence of chapter 3 is shown in Table 2.2 below.

Table 2.1 Apple Inc.

Apple was established on April 1st, 1976 by Steve Jobs, Steve Wozniak, and Ronald Wayne (Myers 2014). They manufactured the Apple I computer kit, a motherboard that merely acted as a single component of what we would today consider a complete personal computer (Myers 2014). Over the years, Apple grew through the manufacture and distribution of its own line of personal desktop computers and went on to become the world leader in the design, distribution, and manufacturing of high tech personal computing devices. After experiencing a period of decline in the 1980's, their entire strategy was changed while shutting down Apple's manufacturing branch by closing factories and warehouses around the world, reducing inventory to reach greater efficiency and product margins (Myers 2014). Manufacturing was then diverted to subcontractors around the world to ensure high turnarounds for products while keeping costs at a minimum. The new strategy brought success. According to IDC (2013), after the success of the first iMac, Apple expanded its brand and introduced the iPhone, which generated a tremendous amount of demand and revenue for Apple. It is estimated that the iPhone alone accounts for nearly two-thirds of Apple's net income, which was $41 billion over $156.5 billion in revenues in 2012 (Apple Press Info 2013) and around $233 billion in 2015 (Apple Press Info 2015). According to a report released by Apple in 2015, Apple's products are currently manufactured in 748 different locations. This strategy of outsourcing manufacturing overseas has also raised issues regarding environmental sustainability which need to be addressed. It is very important to look into the entire supply chain of the iPhone and find solutions to mitigate them.

Table 2.2 Chapter 3 Outline

Environmental Impact of Smartphone				
Environmental Impact of Smartphone Life Cycle	CO_2 Emissions for each Stage of Smartphone	Areas of Reference for Evidence	Materials of Reference	IPhone Case at each stage
Extraction and Manufacturing Stage	CO_2 Emissions	Peru	Gold	IPhone Environmental Impact and CO_2 Emissions
		Indonesia	Tin	
		China	REMS, Cadmium, BFR, PVC	
Packaging and Distribution Stage	CO_2 Emissions	Indonesia	Paper	IPhone Environmental Impact and CO_2 Emissions
		China	Paper and Aluminum	
Use Stage	CO_2 Emissions	Global	Direct and Indirect Energy	IPhone Environmental Impact and CO_2 Emissions
End of Life Stage	CO_2 Emissions	Ghana	e-waste	IPhone Environmental Impact and CO_2 Emissions
		China	e-waste	
Overview of the Chapter				

Chapter 4 answers the second research question on how to mitigate the environmental impact of the smartphone. I introduce the reader to some theories and strategies and provide them with a theoretical and strategic guidance which gives an overall orienting lens for how different authors and experts have approached environmental issues related to businesses. Theoretical guidance provides a transformative angle that shapes the types of data collected and it also provides a call for action or change (Creswell 2013). These theories and strategies provide broad themes which can be generalized and presented as one model. I call it a "meta strategy". I gathered data from the literature and then arranged it in a sequence suited for this research as shown in Table 2.4 below. I evidence each theory with a practical example from companies employing principles from these theories and forming strategies based on them. I also introduce the Fairphone (Table 2.3), the first of its kind social enterprise in the electronics industry, which bases its business model on social and environmental needs.

Table 2.3 Fairphone

Fairphone is a social enterprise, based in Amsterdam, Netherlands, that is building a movement for fairer electronics by producing smartphones while addressing social and environmental values. They believe in transparency to help consumers make informed buying decisions. Fairphone started as a campaign, to increase consciousness for the use of conflict minerals in consumer electronics campaign, with Waag Society (Waag Society institute for art, science and technology is a pioneer in the field of digital media in Netherlands) in 2010 and got registered as an independent social enterprise in 2013. According to Fairphone Fact Sheet (2014), the successful production and sales of the first Fairphone gave them financial foundation they needed to take their ambitions for fairness even further. In 2014, they decided to invest in a completely original design for new smartphone, with a specific focus on increasing product longevity and supply chain transparency. According to Fairphone, a fair economy means: extracting raw materials which come from conflict free mines; paying fair wages to workers along the life cycle; and running an open source operating system that anyone can modify. Fairphone has defined five action areas in order to generate a positive impact in the life cycle of the Fairphone. These areas are: 1) Precious Materials: responsible and transparent sourcing of minerals and metals. 2) Made with Care: workers' empowerment and improved working conditions. 3) Smart Design: open, responsible design. 4) Clear Deals: fair pricing and financial transparency. 5) Lasting Value: address the full life span, including use, reuse and recycling. Fairphone has sold more than 100,000 smartphones in Europe till date.

Source: Summarised from Fairphone Factsheet (2013-2015), Fairphone Blog (2016) and Fairphone Press Release (2013-2015)

Moreover, I develop a scenario for iPhone to mitigate its environmental impact with the strategy developed on the basis of theories reviewed, as shown in Table 2.4.

Table 2.4 Chapter 4 Outline

<table>
<tr><td colspan="2">"Meta Strategy" to Mitigate the Environmental Impact of Smartphone</td></tr>
<tr><td>Understanding complexity theory</td><td rowspan="10">Examples from companies with innovations for each section
Fairphone efforts at each phase of its life cycle
IPhone's future strategies for each phase of its life cycle</td></tr>
<tr><td>System level thinking and its importance</td></tr>
<tr><td>The five business strategies</td></tr>
<tr><td>Stakeholder management theory</td></tr>
<tr><td>Exploring environmental needs</td></tr>
<tr><td>Government regulatory reforms</td></tr>
<tr><td>Reporting</td></tr>
<tr><td>Companies' political role</td></tr>
<tr><td>Redefining supply chain and innovations</td></tr>
<tr><td>Forming industry clusters</td></tr>
<tr><td colspan="2">Overview of the chapter</td></tr>
</table>

Chapter 5 answers question 3 related to companies' business benefits and creation of bigger value pool. It revolves around redefining the supply chain, forming industry clusters and using innovations. It is based on the strategy from chapter 4, and related practical examples that have led to business benefits and creation of a bigger value pool resulting from environmental friendly management practices. Findings in chapter 5 will lead to what I call the starting point or the beginning which is discussed in chapter 6, summarising the overall strategy of mitigating the environmental impact of the smartphone and creating a bigger value pool. Chapter 5's sequence is illustrated in Table 2.5.

Table 2.5 Chapter 5 Outline

<table>
<tr><td colspan="2">Business Benefits and Creating a Bigger Value Pool</td></tr>
<tr><td>Redefining the purpose of the corporation</td><td rowspan="5">Examples from companies at each phase
Fairphone strategies at each phase
IPhone's benefits from the "meta strategy" at each phase</td></tr>
<tr><td>Business benefits and bigger value pool explained</td></tr>
<tr><td>Redefining supply chain and innovations</td></tr>
<tr><td>Forming industry clusters</td></tr>
<tr><td>Increasing the overall value loop</td></tr>
<tr><td colspan="2">Overview of the chapter</td></tr>
</table>

Chapter 3: Environmental Impact of Smartphones

In the world of competition and profit maximization, smartphone manufacturers are frantic to meet both aesthetic and functional requirements of their product. In their pursuit of becoming 'electronic monarchs', so they can control production systems, environmental sustainability seems to be situated at their blind spots. The environmental impact of the smartphone is evident at the extraction of raw material, manufacturing, distribution and packaging, use, and end of life phases (Suckling and Lee 2015). The increasing number of phones produced and their shortening life span further increase the environmental impacts created throughout the life cycle of the smartphone (Babayemi et al. 2016). Not only does the quantity of produced smartphones increase, but also the need for valuable metals used to increase performance requirements in an extremely competitive market (Buchert et al. 2012). Moreover, as more and more people are using and discarding smartphones, e-waste continues to accumulate and precious metals are becoming increasingly scarce therefore, understanding the environmental impacts created by smartphone industry is becoming imperative (Gaidajis et al 2010).

One key challenge for understanding these impacts is the complexity of the smartphone and its value chain (Guvendik 2014). The different metals used in smartphones come from suppliers who are positioned in different parts of the world (Navazo et al 2014). As components become more intricate, a higher number of suppliers are added to the manufacturing inventory to deliver the required materials (Guvendik 2014). As a result, the roots of components are typically unknown by the smartphone manufacturer (Irimia-Vladu 2014). It is challenging to trace back the materials and find out where they were extracted, processed, and used in each component (Guvendik 2014). Some of the metals used in a smartphones travel at least three continents during various processes before they reach the assembly plants (Fairphone, 2013). In the light of the above, it is complex but urgent to explore the smartphone's environmental impact throughout its life cycle. All through history there are stories of people being told not to open Pandora's Box for it can reveal a whole heap of evils. Yet, I opened it and the first evil it reveals is the extraction and manufacturing of raw material required for the smartphones.

3.1 Extraction and Manufacturing

The design and manufacturing includes all of the processes, including extraction, that turn raw materials into a finished product (OECD 2011). Acquiring the critical metals and other materials required to manufacture a smartphone involves environmental issues (Hu 2012) because the extraction of raw materials including critical metals includes procedures that produce pollution in the form of air emissions, effluent discharges, land disturbances, mine waste and tailings (EC 2011, EPA 2011). If not properly mitigated or controlled, this pollution can result in serious environmental degradation (Hu 2012). Some main contributors to manufacturing-phase impacts comprise semiconductors, printed circuit boards and batteries which are highly energy intensive and involve enormous amount of water, and some industrial chemicals, many of which are toxic (Greepeace Report 2014). Smartphone manufacturers claim to have reduced the environmental impact at extraction and manufacturing stages but they are far behind from what they claim (Friends of the Earth Report 2012).

Smartphones contain hundreds of components and require more than 40 different chemical elements (Including rare earths) and non-renewable resources (FOE 2012). Rare earth metals or elements refer to 17 elements in the periodic table and some other by-product metals that occur in copper, gold, silver, platinum, aluminum, uranium, phosphates, and iron or zinc ores (Renee 2012, Congressional Research Service Report 2013). Rare earth metals are quite common but they are seldom found in sufficient amounts to be extracted economically (Renee 2012). The world's demand for rare earth metals is estimated to be 136,000 tons per year, and projected to rise to at least 160,000 tons by 2016 (Congressional Research Service Report 2013).

The way these materials are used in electronics manufacture makes them difficult to recover at the end of the product's life (Hu 2012). These resources are dug up in mines around the world but smartphone manufacturers rarely disclose where or how they get these elements, and they aren't obliged to tell us because there are no rules to make publicly available the source of their product's raw materials (FOE 2012). As technology continues to advance, more uses for chemical elements and rare earths are being discovered by smartphone industry (Greene 2012).

Many of these elements (including rare earths) are present in only minute amounts in smartphones but they are very important for the function of the device (Nuwer 2014). Each iPhone 5, for instance, contains $1.58 of gold, $.36 of silver, $.05 of platinum, and $.12 of copper (Koetsier 2013). Those numbers may sound small, but the phone holds anywhere from six to 300 times less precious metal than the equivalent amount of ore from a mine (Koetsier 2013). Processing one ton of rare earths produces an incredible 2,000 tons of toxic waste (Greene 2012).

Rare earths have come under particular scrutiny because they are a vital ingredient in smartphones, hybrid cars, wind turbines, computers and more (Nuwer 2014). China produces around 90% of the world's rare earth metals and claims that its mines might run dry in just 15 to 20 years (Nuwer 2014). For instance, indium will be gone in about 10 years, platinum in 15 years, silver in 20 years and aluminum in about 80 years (Nuwer 2014). Table 3.1 comprises the main chemical elements out of the 40 used in smartphones which are contributing to the environmental degradation:

Table 3.1 Smartphone Elements

Elements	Significance	Per Phone Average Containment
Transition Metals		
Tantalum	Used to power the electronics in mobiles, smartphones and other devices.	0.04 grams
Gold	Used in circuit boards and as a conductor in smartphones.	0.35 grams
Copper	Copper is used specifically for wiring.	16 grams
Silver	Used in circuit boards and as a conductor in smartphones	0.34 grams
Platinum	Used for electric conductivity.	0.00034 grams
Tungsten,	Used in Circuit boards and extracted from mineral resources which are on 2011 British Geological Surveys Risk List	Not Known
Palladium	Used in Circuit boards and extracted from mineral resources which are on 2011 British Geological Surveys Risk List	0.015 grams
Cadmium	Used to make batteries in Smartphones	Not Known
Nickel	Used for chips, microphones and cases	
Mercury,	Used in circuit boards, buttons, processors and cases.	0.096 grams
Post Transition Metals		
Indium, Holmium	Used in smartphones for screens. It is a very thin, transparent and electrically conductive material.	Not known
Tin	Used to create solder, also in combination with other metals	2 grams
Lead,	Used in circuit boards, buttons, processors and cases.	0.29 grams
Aluminum	Used for smartphones screens and for packaging materials	Not known
Rare Earth Elements		
Neodymium	Used to make smartphones' speakers and microphones.	Not known
Ytterbium, Europium	Used to make screens, lasers and alloys	Not known
Yttrium Cerium	Used in Circuit boards, polish devices and extracted from mineral resources which are on 2011 British Geological Surveys Risk List	Not Known
Alkali Metals		
Lithium	Used to make batteries in Smartphones	Not Known
Non Metals		
Silicon	Used for chips, microphones and cases	0.30 grams
Bromine,	Used in circuit boards, buttons, processors and cases.	0.33 grams
Chlorine,	Used in circuit boards, buttons, processors and cases.	30 grams

Source: Compiled from Friends of the earth report (2012), Gayle (2012), World of Chemicals (2014), Namibia Rare Earths Inc. (2016), Veronese (2012), Nick (2014) and Sullivan (2006)

In addition, flame retardants (FRs) are widely used at relatively great concentrations in electronics, mainly to protect materials against ignition (Segev et al 2009). Among the different FRs groups, the brominated flame retardants (BFRs) used in smartphones are the largest market group because of their high performance effectiveness and low cost but this constitutes a hefty and varied group of anthropogenic environmental pollutants (Alaee and Wenning 2002). Its demand in electronics industry is mounting and is estimated to be 200,000 tons each year (Segev et al, 2009). Companies do not have any obligation to reveal which chemical flame retardants they use, or how much, so it is unclear how much is used in smartphones and in general by electronics industry (Westervelt, 2015). But around 370,000 metric tons of BFRs are sold in the US annually, for use primarily in the construction, electronics, automotive and aerospace industries (Westervelt, 2015).

BFRs generally have limited biodegradability, are persistent and tend to accumulate at various concentrations in air, water, soil, wastewater and residues far from the sites where they are produced and thus are of great concern (Segev et al, 2009). In different environmental conditions, various abiotic and biotic processes can occur (Segev et al, 2009). “Abiotic processes are physical-chemical processes that include photodegradation, decomposition at high temperature and chemical reactions with other compounds or metals which are present in the environment” (Segev et al, 2009: 482). “Biotic processes can be defined as those biological processes that include bioaccumulation and entry into the food chain, biotransformation and biodegradation” (Segev et al, 2009: 482). All of these processes have substantial environmental significance when discussing the BFRs, as well as remediation of polluted sites and risk assessment since such conditions can increase toxicity (Segev et al, 2009).

Consequently, a compound can be found even more toxic to plants, wildlife and people than was the original compound (Herat 2008). Large traces of BFRs have been found in plants, wildlife and even in human samples (Herat 2008). “One of the main reasons for the current concerns regarding the use of BFRs is that nearly all of the BFRs generate polybrominated dibenzo-dioxins and polybrominated dibenzo-furans (a highly toxic compound produced as a by-product in manufacturing processes and also during end of the life phase of electronic products with BFRs)”(Herat 2008; 4).

PVC, also known as 'vinyl', is another key product of the chemical industry and one of the most widely produced chlorinated plastic which is used almost by all the industries, including electronics (Somheil 2014). PVC is relatively cheap and often used mainly as an insulator and coating for smartphone cables (Greenpeace Report 2010). It is made of 57% chlorine and 43% carbon and its production involves the creation of many toxic chemicals (Greenpeace Report 1997). PVC presents environmental problems throughout its lifecycle because its production involves the use of hazardous raw materials, which are highly toxic and carcinogenic (Greenpeace Report 2010). PVC is not biodegradable and the items it is made from will retain their form for decades (Greenpeace 1997).

Animals can ingest these pieces and the plastic can block their digestive tracts (Greenpeace 1997). PVC's manufacturing creates dioxin, the most deadly man-made poisons, which stays in the human body for a long time and concentrates in food chains at the highest levels (Greenpeace 1997). PVC production requires the largest use of chlorine gas in the world and consumes approximately 16 million tons of chlorine per year worldwide to produce one million ton of PVC (Thornton 2002). PVC has come under scientific and regulatory inspection because of their worldwide delivery and the severe hazards they pose to the environment throughout its life cycle by forming and releasing very large quantities of perilous organochlorine by-products (Thornton 2002). Moreover, PVC is also difficult to recycle because of the presence of additives like lead and cadmium (Somheil 2014). In order to see the extent to which the smartphone is a contributor towards environmental degradation, it is wise to provide some evidence from the real world.

3.1.1 Environmental Damage Evidence

Blessed are those who have not seen and yet believe but I don't have any biblical power to bless my readers nor would they believe me. Therefore, evidence will definitely make you think twice when you stay in line for days and hours to buy a smartphone. The manufacturing phase of smartphone is the most energy intensive phase carried out across numerous tiers of suppliers and in general causes larger environmental impacts (Mattila et al 2014).

Smartphones alone will produce 122 megatons of CO_2 by 2017 (more than what Belgium alone produced in 2013), with over 60 percent of that total due to manufacturing (Greenpeace Report 2014). During manufacturing process, one smartphone emits 30 kg CO_2 (Fehske et al 2011). I

have simplified the calculations, given that everything remains the same, based on the data from Lunden (2015) and Ericsson Mobility Report (2015) in Table 3.2:

Table 3.2 CO2 Emissions from Manufacturing Phase

Manufacturing Phase (1 Smartphone Emits 30kg CO_2)			
Year	Numbers of smartphones	CO_2 Emissions/Smartphone	Total Emissions
2015	2.6 Billion	30kg	78 Billion kg CO_2 (78 megatons)
2020 (Forecast)	6.1 Billion	30kg	183 Billion kg CO_2 (183 megatons)

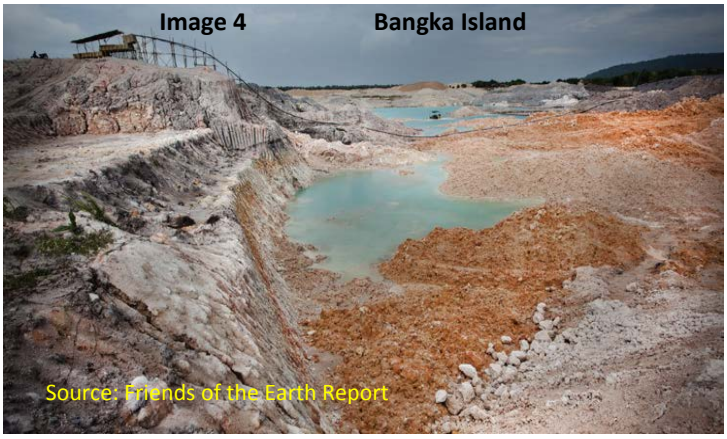
Not only smartphone manufacturing stage play a huge part in perilous climate change but there is a huge demand for minerals required for smartphone at the moment and gold is one of them. Deforestation is just one of the environmental impacts of gold mining and uncontrolled small-scale operations around the world (Snelgrove 2015). Due to minerals required, mining looks to boom in the coming years, promising to have serious impacts on the Peruvian forests, among other places (Cormier 2012). In 2012, deforestation rates in Peru were six times higher in regions along the Amazon River due to gold mining (Cormier 2012). The use of cyanide and mercury to release gold from the soil has led to extensive environmental contamination, soil erosion, loss of biodiversity, and pollution of river systems in Peruvian rainforest (Fraser 2011). Galindo (2012) warns that six-fold increase in deforestation is also endangering the plans of the country to benefit from UN-REDD (Food and Agriculture Organisation of the United Nations) schemes. Decades of illegal gold mining have transformed large areas of virgin Peruvian rainforest into cratered, denuded, mercury-poisoned wastelands (NBC News 2015).

Besides other materials used in smartphones, tin is one of the key component used in all smartphones (FOE Report 2012). There are about 2g of tin in every phone, but manufacturers rarely disclose where or how they get their tin because they don't even know the ultimate source (FOE Report 2012). It's not just phones that contain tin. "The glue that holds together the

resistors, transistors and integrated circuit boards in all electronics devices is a tin-rich solder – an alloy of at least 95 per cent tin plus a little silver and copper" (FOE Report 2012: 6). Nearly half of all mined tin is turned into solder (metallic alloy used when melted to join metallic surfaces) for the electronics industry (Fagotto 2014, FOE Report 2012).

Therefore, I will present you with the Indonesian horrors brought on them by tin mining. The Indonesian island of Bangka, along with adjacent island Belitung, produces almost one-third of the worlds' supply, yet people in these islands live in terrible conditions and at the same time these islands provide shocking evidence about harm to environment (FOE Report 2012). Bangka has a population of about 1 million people and more than half of the islanders depend on agriculture, fishing or tin mining for a living (FOE Report 2012). The Gross Domestic Product (GDP) in Indonesia was 861.93 billion US dollars in 2015 whereas the per capita income was 3,362 US dollars (Trading Economics Report 2015). Bangka Island's per capita income is around 4,750 US dollars (Trading Economics Report 2015) which make it 375 US dollars a month. The GDP value of Indonesia represents 1.39 percent of the world economy whereas the GDP from mining in Indonesia averaged 144.45 billion US dollars (Trading Economics Report 2015). Around 44,000 to 50,000 metric tons of tin was mined in 2012 (Hodak 2012, FOE Report 2012). But regulations are weak and many mines are unlawful and in some cases even employ children (Hodak 2012). Informal miners sell their every day's findings to intermediaries, who also collect tin from miners working in certified mines (Hodak 2012).

The rapid spread of tin mining on land and at sea is transforming parts of the Indonesian tropical island of Bangka into an infertile cratered landscape (Fagotto 2014). It is spoiling fresh water supplies, destroying coral reefs and ruining the lives of native communities as deposits from tin mining dredgers and boats are polluting the sea around Bangka, killing the sea grass eaten by turtles and driving away fish which is ruining fishermen's livelihoods (FOE 2012). Also, farmers at Bangka Island struggle to grow crops on land that is turned acidic by the destruction of forests,



due to tailings for tin mining where one can witness abandoned craters on large parts of Bangka Island (FOE Report 2012). Table 3.3 highlights some of the mining evils in Indonesia:

Table 3.3 Mining Evils in Indonesia

Land	Sea Bed
Pollution of drinking water Loss of soil fertility Hard to grow crops on mining areas Landscape drastically changed forever Little or no restoration once land is mined	Silt and sludge killing coral, sea grass and mangroves 60-70 per cent of the coral reef is dead Endangered turtles disappearing because of the loss of their beach nesting sites and food sources like sea grass Fish stocks are down, therefore, fishermen have to travel further for fewer fish Crab and shrimp catch is down and endangered Napoleon fish are also disappearing from the area Endangered giant clams are killed by silt deposits

Source: Friends of the earth Report (2012)

Large deposits of rare earth metals (REMs) are found in China constituting 90 percent of the world's total supply (Greene 2012, Statista 2015a). Among various mining sites in China, Baotou in Inner Mongolia, according to Ryan (2015), is the world's biggest supplier of rare earth minerals and is a hell on earth. Our smartphone has various 'rare earths' (Table 3.1) in it and everything from the material used in its memory to the colored pixels of its screen, all come from Baotou (Ryan 2015). The rare earth industry has transformed Baotou where the devastating environmental impacts are horrible (Ryan 2015).

Image 5 **Baotou Man-made River**

The effect of this industry is evident everywhere, and no better is this epitomized than by Baotou's toxic lake and farmland (Ryan 2015). A gloomy dark pool of waste material is pumped out from nearby factories to farmland which was once fertile but is now turned into a toxic lake because people need an iPhone every year (Ryan 2015). Surrounding smelters at Baotou pump their toxic waste into the lake far from the bulk of iPhone users. Baotou's farmland and river is a toxic nightmare with radiation levels three times the background radiation level (the ubiquitous radiation present in the environment) and made up of a mixture of acids, metals, carcinogens and radioactive material used to process essential minerals for smartphones (Ryan 2015).

Image 6 **Baotou Toxic Farmland**

Also, in China's Longjiang River in Guangxi, firefighters dilute water polluted with cadmium, a mineral used for smartphone batteries (Eimer 2012). Cadmium, which is found in rechargeable batteries, can cause death and kidney damage when ingested (Garlapati 2016). "Cadmium is the seventh most toxic heavy metal which humans and animals may get exposed to at work or in the environment" (Jaishankar et al. 2014: 63). "Once cadmium gets absorbed by humans, it will accumulate inside the body throughout life and if distributed in the environment, it will remain in soils and sediments for several decades" (Jaishankar et al. 2014: 63). Plants gradually absorb cadmium which gathers in them and concentrate along the food chain, reaching eventually the human body (Jaishankar et al, 2014). "The total area polluted by cadmium in China is more than 11,000 hectares, and the total annual amount cadmium discharged into the environment is assessed to be more than 680 tons" (Jaishankar et al. 2014: 63). The scale of the disaster in Guangxi region in China is enormous, with millions of people already affected and at least 200 miles of the Longjiang River at risk (Eimer 2012).

In 2005, the discharge of around 6 tons of cadmium into the Pearl River in Guangdong Province in China resulted in a massive pollution fright and cut off water supplies for over 100,000 people (Eimer 2012). The scale of the disaster in Guangxi is far larger than the Pearl River, as twenty tons of cadmium has been discharged into a Longjiang river in southern China (Eimer 2012). This is one of the worst chemical spills of its kind, with cadmium levels 80 times higher than the safe limits, which could affect up to 4 million people (Eimer 2012). Longjiang River, where the cadmium discharge happened, is the main source of drinking water for the 3.7 million residents of the city of Liuzhou (Eimer 2012). All seven of the heavy metal-producing factories along the Longjiang River have been blamed but the origin of the pollution is still unknown (Eimer 2012).

On the other hand, approximately 39.3 million tonnes of PVC were consumed globally in 2013 and its demand is expected to increase about 3.2% per year until 2021 but unfortunately, only under 1% of PVC is recycled (Somheil 2014). The additives used in PVC can leach out, threatening water supplies if PVC is landfilled, or even during a product's lifetime (Greenpeace 1997). The toxic chemicals released during the production, use and disposal of PVC threaten the environment and human health (Greenpeace 1997). PVC production plants have a long history of creating intricate and harmful chlorinated wastes, some of which are inexorably released into the nearby environment (Font et al 2004).

An example is China's Qihua PVC plant in Qiqihar, Heilongjiang Province, which is responsible for extensive pollution (IPEN 2015). Qiqihar's population is about 1.5 million (IPEN 2015). The waste produced as shown in the image 8, when it enters the waste stream, contributes to the formation of extremely toxic and persistent chlorinated dioxins (IPEN 2015). In landfills near the Qihua PVC plant, the chemical additives contained in PVC have leached-out and transformed the entire village land into a huge wastewater pond (IPEN 2015). Large quantities of toxic chemical pollutants which persist in the environment, bio-accumulate through the food chain, and cause adverse effects to human health and the environment at Qihua (IPEN 2015). During the PVC production at Qiqihar, liquid chlorine rapidly turns into a gas and even a small exposure can trigger coughing, choking and wheezing, constriction of airways, inflammation of

lungs and burning of the eyes, skin and throat (IPEN 2015). Moreover, "as the main constituent of the stored calcium carbide-derived slurry is slaked lime, this practice has essentially changed the nature of agricultural land into non-agricultural land" (IPEN 2015: 5). The above examples cite some of the evidence of the environmental damage that can result from smartphone manufacturing, but let's see the role of the iPhone at the manufacturing phase.

3.1.2 IPhone's Extraction and Manufacturing

The extraction of raw materials, combined with the design and production stage, resulted in 24.8 million tons of CO_2 emissions whereas the total CO_2 emissions for all the phases of iPhone in 2015 were 34.2 million tons (Apple Responsibility Report 2015). This indicates that manufacturing phase contributed 72% of the total CO_2 emissions for the creation of the iPhone in 2015 (Apple Report, 2013). Interestingly, for the iPhone 6S alone, the overall CO_2 emissions were 33.8 million tons whereas CO_2 emissions due to manufacturing were 23.6 million tons, making it 84% of the total emissions (IPhone 6S Environmental Report 2015). Converting the percentage data related to CO_2 emissions using other data from Apple's reports provides an estimate of approximately 30kg CO_2 emissions per smartphone. This number corresponds with what research indicated about other smartphones.

As noted, the raw materials for the iPhone include minerals and rare earth metals (REMs) which are obtained through various types of mining and is an inefficient process, involving the creation of chemical slurries in which only 12 percent of the material is considered usable (Rodriguez et al 2015). About sixty miles southwest of Las Vegas, in a mine some 500 feet deep, the beginnings of an iPhone come to life (Greene 2012). The iPhone has flourished while creating a mine bigger than 100 football fields where the ore is not just spiked with radioactive materials but the process involves enormous amounts of carcinogenic toxins (Rodriguez et al 2015). Inside the rocks from this mine are the crucial ingredients for iPhones (Greene 2012). Neodymium was extracted to be used in magnets that make speakers vibrate to create sound and europium for making the screen bright (Greene 2012). Moreover, cerium was mined to put into a solvent to polish devices as they move along the assembly line (Greene 2012).

Since China is heaven for rare earth elements, therefore, after digging one part of the earth, iPhone moved to mining heaven (of course for them), Baotou, Inner Mongolia which we already

discussed. Interestingly, the majority of Apple's 700 worldwide suppliers are located in China where environmental laws have historically been inadequate and enforcement negligent (Greene 2012). The worrying sign is that Apple only mentions 200 tier 1 and 2 suppliers in its Supplier list (2015) but never mentioned anything about tier 3 and other lower suppliers. Marshall (2014) explains that REMs contained in iPhone are part of complex mixtures and a disaster for environment.

Moreover, according to Apple Supplier Responsibility Report (2015), it requires suppliers to only use materials that have been procured through a conflict-free process and from sources that adhere to its standards of environmental protection. However, according to FOE (2012), when Apple was linked to tin mining in Bangka Island by Business Week in August 2012, it declined to comment on the identities of any of its suppliers, particularly FOXCONN. FOXCONN assembles iPhones for Apple and buys solder made of Indonesian tin from two companies namely, Shenmao and Chernan (FOE 2012). It is clear that iPhone's extraction and manufacturing phase is also a culprit when it comes to environmental degradation and thus, they need to come up with a strategy to mitigate its impact.

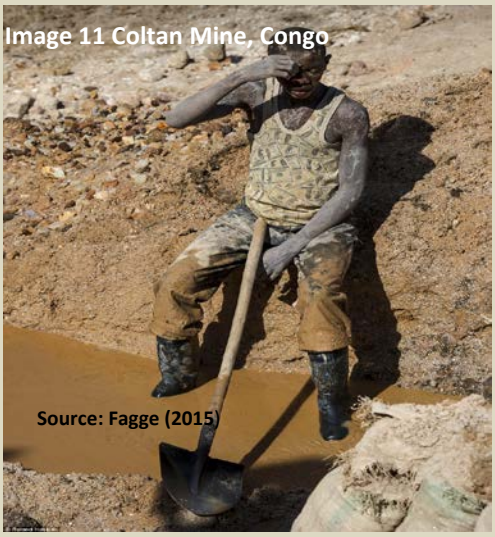
On a bright side, Apple has attempted to reduce the environmental impact of recent iPhone models by minimizing hazardous chemical components used in manufacturing processes (Apple Environmental Responsibility Report 2015). The iPhone 4, 4s and 5 are (BFR)-free, and (PVC)-free and include batteries free of lead, cadmium, and mercury, which previous models did not include (Rodriguez et al 2015). While Apple has made improvement in decreasing the use of certain environmentally costly materials in the design and production of iPhones, many of those benefits are counteracted by the short life cycle of each model (Rodriguez et al 2015). Apple has released a new iPhone model almost every year (Apple Environmental Reports (2008 - 2015). Newer design features, like batteries that are not user-replaceable, also prompt consumers to replace, rather than repair, their iPhones (Forbes, 2013), therefore, it require more REMs. Moreover, I would like to mention before discussing packaging and distribution phase some food for thought regarding the impacts of smartphones at extraction and manufacturing stage which are not focus of this research but they need due attention for these issues are as important as any other or may be more.

Food For Thought

Malasari Amirudin and her 15-year-old daughter Novi Akher in the apartment they share with five fellow miners at Bangka Island, Indonesia. Amirudin and her daughter have just arrived from Pangkal Pinang, the capital of Bangka, to gather scraps of tin that have dropped from other people's washing lines. This job earns them around £12.50 per day. Like most of the other miners, they have no clue what the tin they collect is used for. When showed an iPhone, they were astonished. We should ask for more money, jokes Amirudin (Source: Fagotto 2014).

Workers in Congo mine gold for smartphones for less than $5 a day and it involves child labor (Amnesty International 2016). The dazzling shop presentations and marketing of smartphones are a blatant contrast to the kids carrying gears of rocks and mine in narrow tunnels chancing permanent lung damage (Amnesty International 2016). It is a major contradiction of the companies who market amazingly sophisticated smartphones without an obligation to show the sources of raw materials for their components (Amnesty International 2016). Charles, 13-years-old goes to school each morning, sort stones before taking them to a nearby trading house which buys the ore from him, hence he works in the afternoon and that is how he affords the school fees (Amnesty International 2016).

The hidden coltan mines in a corner of the Democratic Republic of Congo fuel our 21st century lifestyle (Fagge 2015). The black tar-like mineral is the enchanted component that controls power-flow in your iPhone, yet the men who pull coltan from the earth use picks and shovels working in treacherous and pressurised conditions (Fagge 2015). Many of the mines have been controlled by militia during years of conflict to fund weapons and ammunition for war (Butsic et al 2015). In Apple's environmental sustainability reports, there is not a single word about how their mining sights are damaging environment at Congo and if they have done something about Congo's issues. Apple says most iPhone metal suppliers are conflict-free (Apple Supplier Responsibility Report 2014) but they are not mentioned in their reports (Buckley 2014). Despite the significance of the mineral to the smartphone industry, the miners who sweat under the hot sun every day earn between 3 and 5 dollars a day for a 12-hour day for this backing-breaking work (Fagge 2015).



Food for Thought 1: Mining

3.2 Packaging and Distribution

Smartphones need decorative packaging to protect them from damage, to identify contents and to provide information but this consumes valuable natural resources, such as paper (from trees) and aluminum (from ore), all of which use energy and water in production and can result in waste. According to Greenpeace (2012) most of the smartphone manufacturers do not have a paper-sourcing policy which results in the use of prohibited rainforest sources. The destruction of rainforests is a serious issue for the protection of our climate as well as for biodiversity (Smith and Mayfield 2015). On the other hand, of all the earth's natural elements, aluminum is the third most copious resource on our planet in its raw form (Leigh 2010). Its transformation from raw bauxite (aluminium ore) into aluminum is incredibly energy intensive, requiring ample amounts of electricity, water and resources to produce, therefore, power plants are built solely to support the aluminum industry (Leigh 2010). The US Environmental Protection Agency says that the release of per-fluorocarbons (group of human-made chemicals) during the aluminum smelting process is 9,200 times more damaging than carbon dioxide in terms of their effect on global warming (Leigh 2010). There is no data available on how much aluminum is used in smartphone packaging which give rise to the transparency issue in the industry.

3.2.1 Environmental Damage Evidence

Packaging and distribution also play their part in climate change. Smartphone parts and shipping the finished products to manufacturing facilities, and then to distributers and customers, requires transportation by plane, truck, ships and rail; all require the use of fossil fuels for energy, which has negative impacts on the environment like climate change, air and water quality (Rodrigue 2013). Transportation and packaging of the smartphone's contribution towards CO_2 ranges from 5 to 10 percent (Guvendik 2014, Suckling and Lee 2015, Apple Environmental Report 2015, Fairphone Factsheet 2015, Rodriguez et al 2015) but it is impossible to find any CO_2 emissions data related to tier 1, 2, 3 and other lower suppliers of packaging materials and transportation. Therefore, CO_2 emissions I calculated will definitely increase if tier 1, 2, 3 and other lower level suppliers are included. But based on the data provided by Ercan (2013), Suckling and Lee (2015), Ericsson Mobility Report (2013), and Matilla et al (2014), transportation and packaging roughly contributes around 3kg CO_2 per smartphone. Therefore, after simplifying the calculations, I estimated the smartphone related CO_2 emissions for 2015 and 2020 in Table 3.4:

Table 3.4 Emissions from Packaging and Distribution Phase

Packaging and Distribution Phase (1 Smartphone Emits 3kg CO_2)			
Year	Numbers of Smartphones	CO_2 Emissions/Smartphone	Total Emissions
2015	2.6 Billion	3kg	7.8 Billion kg CO_2 (7.8 megatons)
2020 (Forecast)	6.1 Billion	3kg	18.3 Billion kg CO_2 (18.3 megatons)

CO_2 is not the only problem. The environmental impact of packaging is also evident from deforestation. Sadly, about half of the world's tropical forests have been cleared (Bradford 2015) and it is estimated that around 46 to 58 thousand square miles of forest are lost each year, equivalent to 48 football fields every minute (WWF 2015). One of the causes is to create paper and fiber (Bradford 2015). One example is the loss of Indonesian forest (Riau) which is pushing critically endangered species such as tigers closer to extinction as well as driving climate change (Alfred 2008). The WWF (2008) study found that in central Sumatra's Riau Province nearly 10.5 million acres of tropical forests and peat swamp have been cleared in the last 25 years. The loss of Sumatra's carbon-rich forest ecosystems is not just Indonesia's problem but this issue affects the environmental health of the entire planet (WWF 2008). The forestry industry in Indonesia is out of control in regards to corruption and illegality where ninety per cent of all industrial wood extraction is illegal (Greenpeace Investigative Report 2004). The Indonesian government pinpoints the pulp and paper sectors as the two chief industrial drivers of rainforest destruction (Greenpeace 2011). The largest player in both these sectors in Indonesia and among top three in the world is the Sinar Mas Group (Lee 2015). The Sinar Mas main production bases are in Indonesia and China, and they use virgin fiber for high-quality packaging materials (Greenpeace 2011).

Image 12 Indonesian Forest

Also, China is the second largest market after the United States for luxury packaging (Casey 2011). China provides packaging material for various electronics companies and particularly for

toys manufacturing companies (Greenpeace 2011). Yunnan is the region in China that has the largest resource of wildlife varieties and the most abundant types of ecosystems (Greenpeace Investigative Report 2004). Yunnan has been known as one of the key areas which possess the most significant groups of biodiversity and is of global significance for the distribution of biodiversity (Greenpeace Investigative Report 2004). But, due to Sinar Mas activities, Yunnan is faced with soil retrogression caused by excessive use of soil fertilizers, falling underground water levels, decreasing biodiversity and a changing microclimate (Greenpeace Investigative Report 2004). Deforestation resulted in series of massive floods exacerbated by destructive logging in Yunnan, whereas since 1997, Sinar Mas has cleared large areas of Yunnan forest for fast-growing eucalyptus plantations to obtain paper (Greenpeace Investigative Report 2004).

Moreover, in Taoyuan County, Changde city, in central China's Hunan province, aluminum transformation process removed native vegetation in the mining region, resulted in a loss of habitat and food for local wildlife as well as significant soil erosion (Oliver 2015). The acidic red muck and toxic mine tailings that remain are commonly deposited into excavated mine pits where they eventually leach into aquifers, polluting local water sources whereas GHG emissions released during processing have been found to blanket adjacent zones with toxic vapors and has compromised air quality (Oliver 2015). Oliver (2015) photographed aluminum-polluted water, which flows into the Yuanjiang River, in Taoyuan County, Changde city, central China's Hunan province.

3.2.2 IPhone Packaging and Distribution

Packaging and distribution produces approximately 5% of total GHG emissions in the iPhone life cycle (Apple Environmental Report 2014, 2015). Apple has made some efforts to improve their packaging materials with each new generation of iPhone (Rodriguez et al 2015). Since 2007, packaging materials have been reduced by 26%, creating 60% more space for iPhone 5s shipments (Apple Environmental Report 2015). This is a distraction point because it does not

include iPhone accessories and it does not include the increase in numbers of the iPhone produced and transported. Moreover, Apple use virgin paper in their product packaging and certify that it comes only from sustainably managed forests and controlled wood sources (Apple Environmental Responsibility Report 2015) but Apple did not provide all the sources nor did it mention how it has an impact on Indonesian rainforest and what influence they have on Sinar Mas because they are the ones responsible for providing virgin paper globally.

On one side, Apple is making progress because over 80 percent of the paper and grooved cardboard used in the iPhone packaging comes from certified sustainably managed forests and controlled wood sources, plus they also have a strategy to achieve 100 percent of the fibers to meet standards (Apple Environmental Responsibility Report 2015). But on the other side, according to Apple Sustainability Report (2015), their packaging includes paperboard, fibreboard, high-impact polystyrene and other plastics for which no source is provided and no information is given regarding their environmental impact. Moreover, Apple chooses to transport iPhones by air despite the higher fuel costs linked with this (Satariano 2013). Approximately, 450,000 iPhones are transported using Fed Ex's Boeing 777 planes, in which a fifteen hour trip from China costs around $242,000, with fuel accounting for more than half the expense (Satariano, 2013).

But Apple, like other smartphone manufacturers, does not calculate emissions from transportation of their tier 1, 2 and 3 suppliers. Therefore, it is not possible to calculate exact CO_2 emissions of the transportation and packaging phase. On the brighter side, the packaging for iPhone is recyclable, and its retail box is made primarily from bio-based materials, including fiberboard containing ninety percent post-consumer recycled content (Apple Environmental Report 2015). In addition, the iPhone 6S' (released in 2015) packaging is extremely material efficient, allowing fifty percent more items to be transported in an airline shipping container compared to the previous iPhones released in 2015 and before (Apple Environmental Report 2015).

Food for Thought

The island of Sumatra is the only place where tigers, rhinos, orangutans and elephants live together. The existence of the Sumatran tiger is a significant indicator of a forest's biodiversity. Protecting tigers and their locales means many other species benefit (WWF 2015). The last of Indonesia's tigers, as few as 400 today, are holding on for survival in the remaining areas of forests on the island of Sumatra. Accelerating deforestation and extensive poaching mean this noble creature could end up like its extinct Javan and Balinese relatives (WWF 2015).

Food for Thought 2: Sumatran Tiger

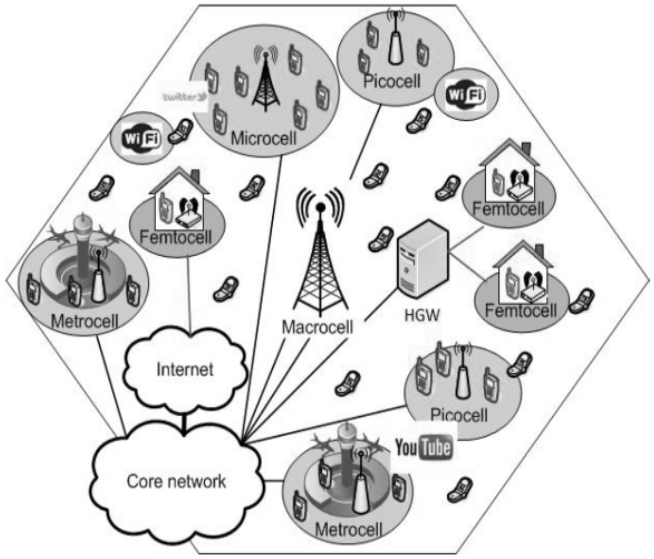
3.3 Use Phase

The smartphone use has become an ultimate necessity due to its functions. This use phase in the life of the smartphone is determined by producers and consumers together (Fehske et al 2011). Different people have different behaviours and different cognitive limitations which ultimately determine the life of the smartphone. Some smartphone investigations have revealed that the use phase is dwarfed by the huge emissions of the extraction and manufacturing phases of the smartphone and some indicate that the role of the user is not important in the overall life cycle (Mattila et al. 2014).

In my view, this information is not correct, because they only include the direct electricity consumed by the smartphone during its use (Li et al. 2012, Hu 2012). In reality, a smartphone requires substantial amount of infrastructure to provide its services, because during use, the operation of the radio access network (RAN) requires many times more energy than is consumed by the smartphone usage alone, on a per-subscriber basis (Li et al. 2012, Hu 2012). RAN includes the radio base stations (RBS), Femtocells and antennas in a cellular network and exists in between the cellular phones and core network (Fehske et al. 2011). Base station is a wireless communications station permanently installed at a location and is used for the purpose of communication of various types including data transfers, talk, streaming videos etc., (Knight 2004). A femtocell is a wireless access point that improves cellular reception inside a home or office building (Claussen et al. 2008).

Networks and data centers are required to provide internet access and to allow phone calls (Fehske et al 2011). Data is commonly stored outside the phone and computation is done outside the device, for example, Google provides navigation services with Google Maps, which function on distant servers (Mattila et al 2014). This ‘‘cloud computing’’ infrastructure cannot operate without energy and forms a fundamental part of the life cycle energy demands of mobile technologies (Fehske et al 2011). Most of the services required by the smartphone user are provided by the infrastructure outside the actual product (Mattila et al 2014). According to Mattila et al (2014), very few studies have been done on the carbon footprint of server computing and data transfer. Fehske et al (2011) forecasted an increase in global radio access network operations and a growing share of emissions due to data transfer subsequent to rising mobile traffic volumes, demand for services and universal access which will ultimately be at the price of a sizable carbon footprint.

Image 15 **Networks and Data Centers**



Source: Google images

3.3.1 Environmental Damage Evidence

Li et al (2012) surveyed a large sample of smartphone users about their behaviors, and found that different users interact with their phones up to 200 times a day and receive around 1000 megabytes of data per day. The reason these numbers are so meaningful is because the multiplication of the numbers with actual smartphones subscriptions gives an enormous number. I have done simplified calculations based on the data from Hunt (2010), Lie et al (2012), Matilla et al (2014), Fehske et al (2011) and Cisco (2016) in Table 3.5:

Table 3.5 Emissions from Use Phase

Use Stage (1 Smartphone use Emits 10kg CO_2/year in case of direct energy use and 30kg CO_2/year for indirect plus direct energy use combined)			
Year	Numbers of Smartphones	CO_2 Emissions/Smartphone	Total Emissions
2015	2.6 Billion	10kg (Direct Energy Use) 30kg (Indirect plus direct Energy Use)	26 Billion kg CO_2 (26 megatons) 78 Billion kg CO_2 (78 megatons)
2020	6.1 Billion	10kg (Direct Energy Use) 30kg (Indirect plus direct Energy Use)	61 Billion kg CO_2 (61 megatons) 183 Billion kg CO_2 (183 megatons)
Generating 1.6Kwh electricity emits 1kg CO_2			
Generating 1GB of emails or web-pages, blog posts, or tweets costs about 1kg of CO_2.			
Streaming 500 GB worth videos emit 1kg CO_2 and One month Wi-Fi emits 7kg CO_2.			
Smartphone direct use consume 16kwh/year			
Smartphone Indirect Use (RAN sites, Femto Cells, Data Centres) consumed per average subscription about 32kWh/year			
All the chargers plugged for 1 day waste enough electricity to power 28000 houses because unplugged charger still draws half a watt			
Direct + Indirect Energy (Smartphones consume 48 KWh/year (32kwh + 16kwh) which is equivalent to emitting 30 kg of CO_2)			

Source for dark shaded part of the table: Cisco (2016), Suckling and Lee (2015), Matilla et al (2014), Fehske et al (2011), Hu (2012)

Based on the data above, one month of smartphone use causes emissions of around 30kg CO_2 which is equivalent to that emitted during the smartphones' extraction and manufacturing phase. It is also equivalent to a person's breathing for 30 days. Fehske et al (2011) and Weber (2012) predicted that the footprint of mobile communications due to smartphones might triple by 2020 and interestingly for the first time in history, the volume of worldwide mobile data traffic exceeded that of voice traffic in December 2009 and will continue at an enormous rate due to the proliferation of smartphones. Their point is underscored by the Cisco (2016) report mentioning a 100% increase per year in the last few years. With respect to the network infrastructure, about 3.3 million radio base station (RBS) sites were in operation in 2007 and this is expected to increase to 12 million by 2020 (Cisco 2016). According to the forecast, the overall carbon footprint of mobile communications will increase almost linearly until 2020 with annual increase of 11 mega tonnes CO_2, an increase equivalent to the annual emissions of the whole of

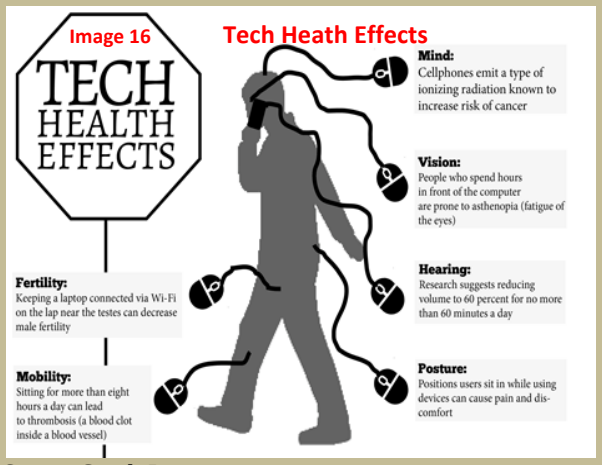
Luxembourg or 2.5 million European Union's households (Fehske et al 2011). The emissions in 2020 will amount to more than 235 mega tonnes of CO_2, which corresponds to more than one third of the present annual emissions of the entire United Kingdom (Fehske et al 2011).

3.3.2 IPhone Use

Use and maintenance of the iPhone account for 30 percent of the total CO_2 emissions (Rodriguez et al 2015) but according to Apple Responsibility Report (2015), it accounts for 22% or 7.5 metric tonnes per year. IPhone users, when surveyed, indicated a trend to cycle through multiple iPhone models, on average 3, over 2 years' time, and replace their current version because a new model was available every year (Rodriguez et al 2015). On the brighter side, since 2012, Apple's data centers have been powered by 100 percent renewable energy sources (Environmental Responsibility Report 2015) but they don't mention the energy sources of their tier 1, 2 and 3 suppliers. That means there is a zero greenhouse gas impact on the environment from their own energy use (Environmental Responsibility Report 2015) but energy use by their tier 1, 2 and 3 suppliers are not accounted for. Apple's data centers use renewable energy sources like solar, wind, biogas fuel cells, micro-hydro power, and geothermal power from onsite and locally obtained resources (Environmental Responsibility Report 2015).

Food For Thought

Cell phones emit microwave radio-frequency radiation which has the ability to penetrate our bodies (Burell 2016). A review of 23 epidemiological studies by 7 scientists on the link between cell phones and cancer concluded there is a harmful association between phone use and tumor risk (Burrell 2016). More than 60% of 18 to 29-year-old smartphone users take their phones to bed but studies have found that just two hours exposures to brightly lit screens can supress melatonin and lead to sleeping troubles (Goldhill 2015) whereas the blue light which is emitted at high levels by smartphones may be damaging your vision (Loria 2014).



Source: Google Images

Food for Thought 3: Tech Health Effects

3.4 End of Life

The lifetime of smartphones is estimated to be shorter than other mobile phones and is in the range of 1 to 1.5 years, therefore, enormous electronic waste is generated (Paiano et al. 2013; Yin et al. 2014). Due to consumer demand and newest technologies, electronic waste (e-waste) is the fastest growing waste stream in the world, with tens of millions of tonnes of devices being thrown out on a yearly basis and piling up in landfills. The total amount of e-waste generated in 2014 was 41 million metric tons and forecasted to reach 50 million metric tons in 2017 (UNEP Report 2014). Of that enormous volume, 725 metric tonnes were generated by Canadians (Mortillaro 2015). Interestingly, 90 percent of this volume is considered to be illegally traded, exported or discarded, which puts the environment and local communities at risk, and this number is rising (EPA 2015, UNEP 2015). Yet, this is an area which is not typically highlighted in product declarations with their emphasis on recycling and emissions (UNEP Report 2015).

Landfills and incineration facilities are commonly used discarding methods for consumer electronics (Bodeen 2007) but the end of life disposal of smartphones does not often follow the recycling course assumed in companies' declarations, due to variations in human behaviour and companies' policies; therefore, this is a rich area for further studies (Ongondo and Williams 2011; Yin et al. 2014). Regardless of geographical location, stockpiling of phones is a main method for disposal (Fairphone 2014). 140 million phones (4 phones per second) ended up in landfills in 2011 leaching 80,000 pounds of lead into the earth and 4.7 tonnes of gold worth $56 million and 49 tonnes of silver worth $8.4 million (Lerner 2011), out of which 70% is outsourced to China for dumping (Watson 2013). Moreover, informal recycling markets in China, India, Pakistan, Vietnam, and the Philippines handle around 50% to 80% of e-waste, which often means shredding, burning, and dismantling the products in residential backyards (McAllister 2013). Developing countries with fast growing economies handle e-waste from developed countries and from their own internal consumers (UNEP 2015). Currently, an estimated 70 percent of e-waste handled in India is from other nations (UNEP 2015). Between 2015 and 2020, smartphones' e-waste will increase up to 18 times (UNEP 2015).

3.4.1 Environmental Damage Evidence

As in all the phases of the product life cycle, throughout the life cycle of the smartphone, at the end of its life, it contributes CO_2 emissions. Based on the data from Suckling and Lee (2015),

Apple Environmental Report (2015), Samsung Environmental Special Report (2015) and Nokia Environmental Report (2015), on average the smartphone's end of life disposal contribute 2% to the total CO_2 emissions. I have simplified the calculation based on the above data to figure out how much in total this stage contributes towards CO_2 emissions, in Table 3.6:

Table 3.6 Emissions from End-of-Life Phase

End-of-Life Phase (1 Smartphone Emits 3kg CO_2)			
Year	Numbers of Smartphones	CO_2 Emissions/Smartphone	Total Emissions
2015	2.6 Billion	1kg	2.6 Billion kg CO_2 (2.6 megatons)
2020	6.1 Billion	1kg	6.1 Billion kg CO_2 (6.1 megatons)

Besides CO_2 emissions, landfills are of great concerns for other reasons. One example is the Odaw River in Accra, Ghana, one of the most polluted in the world, where much of the e-waste comes from the Agbogbloshie e-waste landfill of Ghana for burning (Chow 2015). Smartphones and their accessories contain numerous toxins, such as cadmium, mercury and lead, that when tossed in a landfill leach into the ground, contaminating water sources and threatening environment (Chow 2015). The fumes at Odaw River are described as "head-pounding" (The Guardian 2014).

At the same time, wire is burned to free the copper from its plastic casing in the the Agbogbloshie scrapyard for USB chargers and smartphones (Plenke 2015). Plastics are non-bio-degradable and by-products of plastic combustion which include airborne particulate emissions (soot) and solid residue ash which possess a high potential of causing significant environmental concerns (Wang et al. 2004, Valavanidid et al. 2008, EPB 2012, and Font et al. 2004). These emissions and ashes are often accompanied by volatile organic compounds

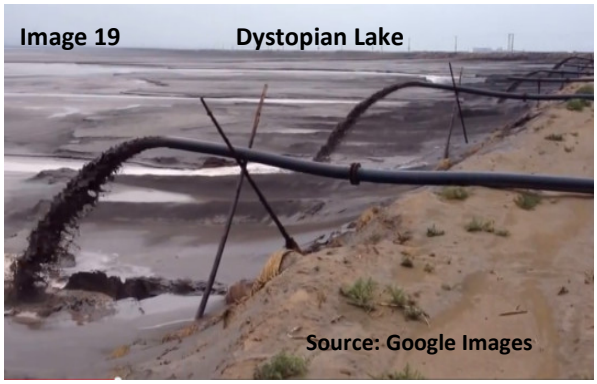
and dioxins, and can travel thousands of kilometers before they drop back to earth and enter into the food chain (Valavanidid et al 2008). The potential pollutants generated from burning plastic and environmental effects in Ghana are evident from Table 3.7:

Table 3.7 Incineration Effects

Potential Pollutant Generated from Burning of Plastics	Environmental Effects
Carbon Monoxide	Oxidized to carbon dioxide (which is a greenhouse gas) in the atmosphere
Dioxins and Furans	Increased toxic loading on environment lead to contaminated water and land and affected animal health
Poly-nuclear Aromatic Hydrocarbons (PAHs)	Increased toxic loading on environment leads to contaminated water and land and affected animal health
Volatile Organic Compounds (VOCs)	Contributes to low level ozone (smog), causes vegetative damage. Leads to contaminated water and land, and affects animal health
Particulate Matter (PM)	Increased toxic loading on the environment leads to contaminated water and land, and affects animal health
Aldehydes	Increased toxic loading on environment leads to contaminated water and land, and affects animal health

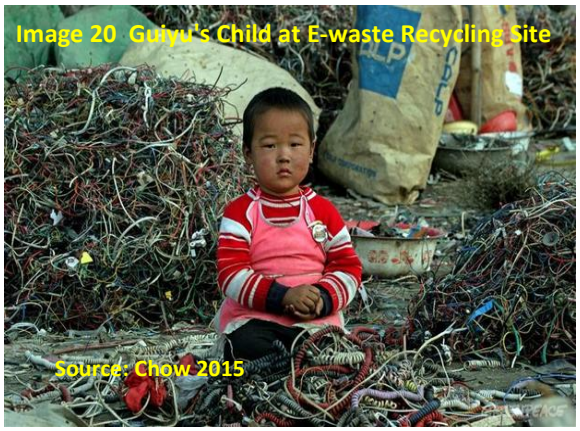
Source: Compiled from Valavanidid et al (2008), Abota (2012) and EPB (2012)

The city of Guiyu in the Guangdong region of China is the largest e-waste recycling site in the world where recycling has been happening since 1995 (Robinson 2009). Wind carries particulate matter from Guiyu to the Pearl River Delta Region, which has a population of around 45 million people where toxic chemicals from e-waste enter the "soil-crop-food" pathway (Deng et al. 2007). These chemicals are not biodegradable and they persist in the environment for long periods of time, increasing exposure risk (Robinson 2009). Environmentally unsound techniques are used to recycle e-waste which includes heating and manual removal of components, open burning to reduce volumes and to recover metals, and open acid digestion of e-waste to recover precious metals (Robinson 2009). "The waste-acid, rich in heavy metals, is then discarded onto the soil or into waterways and solder is melted from printed circuit boards over makeshift coal grills which has resulted in widespread environmental contamination with mercury, bromine, cadmium, copper, indium, lead, lithium, nickel, PVC, BFRs etc. (Robinson 2009: 188).



E-waste contaminants entered aquatic systems via leaching from dumpsites where processed or unprocessed e-waste may have been deposited (Robinson et al. 2009). Similarly, the disposal of acid into waters or onto soils, as well as the dissolution or settling of airborne contaminants, can also result in the contamination of aquatic systems (Robinson 2009). Waterfowl from downstream areas in the Pearl River Delta also contained traces of BFRs and other chemical elements at high levels (Luo et al, 2008). Many e-waste contaminants are spread into the air via dust which is a major exposure pathway for humans through ingestion, inhalation and skin absorption (Chatterjee 2007). Air samples taken near Guiyu contained dioxins which are considered as the highest level of atmospheric dioxins ever reported (Chatteree 2007). Soils from a site where acid leaching was used to recover valuable metals also contained high level of dioxins (Chatterjee 2007). Aerial contamination with dioxins at Guiyu has resulted in levels of human exposure some 15 to 56 times the WHO recommended maximum intake (Chatterjee, 2007). Elevated levels of dioxins were found in human milk, placentas and hair, indicating that dioxins are being taken up by humans, from the air, water, or foodstuffs, at sufficient levels to pose a serious health risk (Chan et al. 2007). Also, in Inner Mongolia, China, is a toxic nightmarish 'Dystopian Lake' filled by the world's tech sludge and created by our thirst for smartphones which face the same pollution problems as Pearl Delta River (Maughan 2015). How would you feel if the mobile phone you just replaced with a newer model ended up in a landfills and rivers like the ones mentioned above?

Moreover, several studies in the Guiyu, a city in southeastern China, known as the largest e-waste recycling site in the world, showed that 80 percent of Guiyu's children experience respiratory ailments, and are especially at risk of lead poisoning (Leung et al 2008). Old transistors are boiled in metal pots to melt away the plastic so the metal parts can be sold (Chow 2015). Emissions from these recycling practices are damaging to the environment because primary and secondary exposure to toxic metals, such as lead, results mainly from open-air burning used to retrieve valuable components whereas combustion from burning e-waste creates fine particulate matter, which is linked to pulmonary and cardiovascular disease (Chow 2015). Lead,



mercury and cadmium found in smartphones release dangerous toxins into the air and water when burned or deposited in landfills improperly (Wilcox et al 2015). In these situations, there can be significant environmental impacts, for example, the U.S. Environmental Protection Agency reports that ecosystems near point sources of lead often demonstrate biodiversity loss, decreased growth and reproductive rates, and neurological effects in vertebrates (Wilcox et al 2015).

3.4.2 IPhone Recycling and Disposal

Apple's efforts to be environmentally friendly during the disposal phase account for 2% of CO2 for the iPhone life cycle (Apple Environmental Report 2015). Apple sold 74.8 million iPhones in the first quarter of 2016 which replaced older models (Medwechuk 2016). The latest iPhones have less harmful elements than ever before because Apple recently removed beryllium and benzene from the iPhone, which are linked to leukemia and nerve damage respectively (Medwechuk 2016). But older models were not built to the same standard and these are the ones that are reaching the very end of their useful life (Medwechuk 2016).The iPhone, whether new or old, has harmful chemicals inside that need to be disposed of properly whereas one thing that seems clear is that these phones and their components wind up in dumping sites at Guiyu (Greene 2012).

IPhones can be recycled for parts and components to be reused in production stages (Apple Environmental Report 2015). Reuse, possible due to refurbishing, has become more common in recent years (Rodriguez et al. 2015). Apple also considers recycling and disposal of an iPhone through the garbage as the least favored method (Apple Environmental Responsibility Report 2015). Other than that statement, iPhone do not have a proper plan for REMs to be recycled later in the product life cycle (Rodriguez et al. 2015). An example is the iPhone touchscreen which contains a range of rare earth elements, including indium (Minter 2013). There is no commercially viable means of extracting indium from touch-screen glass plus the iPhone touch screen is unrecyclable (Minter 2013). Moreover, the way these iPhones are designed with a thin profile and tightly packed innards, it means that its components like memory chips and processor are packed so tightly in the case that there is no room for upgrades, and from the perspective of recycling, it means that the product is exceptionally difficult to break down into individual

components when it comes to recycle it (Minter 2013). One can deduce that these machines are built to be torn, not repaired, upgraded, and reused.

Rodriguez et al. (2015) conducted a survey revealing that 90% of the iPhone users did not even know about Apple's Recycling Program. Apple operates a recycling program and uses a third party, 'SIMS Recycling Solutions', to disassemble and recycle iPhones (Apple Environmental Responsibility Report 2015). Yet, the problem is that Apple does not have any strategy to monitor SIMS Recycling Solutions and there is no information on whether the phones end up in Dystopian Lake in Inner Mongolia which according to Greene (2012) is an apocalyptic sight. The iPhone sustainability reports do not mention how at Guiyu, workers heat iPhone's components over coal fires to recover lead and how the ash from the burning of coal gets dumped into the city's streams and canals, turning them black and poisoning the wells and groundwater (Greene 2012). According to Greene (2012), Guiyu has the highest level of cancer-causing dioxins in the world, elevated rates of miscarriages, and children with extremely high levels of lead poisoning.

Therefore, Apple, instead of defending its activities, should convey a more realistic picture of what recycling can and can't do (Minter 2013). According to Minter (2013), an important issue would be to identify ways to push consumers toward recycling while also making them aware that recycling is not a perfect solution and that reducing overall consumption is desirable as well. If the goal is a realistic sustainable future, then it's necessary that Apple should lengthen the lives of iPhones and start designing them for repair, reuse, and recycling.

Food for Thought

The danger of plastics in our ocean is a growing threat, and now a new study has estimated that by 2050, 99 per cent of seabirds will have consumed some sort of plastics from our oceans (Wilcox et al 2015).

Food for Thought 4: Red-Footed Booby, Indian Ocean

Overview of Chapter 3

The environmental impact of the smartphone is evident at the extraction of raw material, manufacturing, distribution and packaging, use, and end of life phases. The increasing number of phones produced and their shortening life span further increase the environmental impacts created throughout the life cycle of the smartphone. With the increase in the quantity of smartphones produced, the need for valuable metals, rare earths, plastics and flame retardants also increases, and more e-waste is generated. Deforestation is one of the environmental impacts of mining metals and other rare earths, and uncontrolled small-scale operations around the world.

One of the key challenges for understanding these impacts is the complexity of the smartphone and its value chain. The different metals used in smartphones come from suppliers who are positioned in different parts of the world and tracing them is almost impossible. Moreover, it is impossible to calculate and monitor CO_2 emissions for the smartphone manufacturers' tier 1, 2, 3 and other lower level suppliers at all the phases of the life cycle of the product whereas the data provided regarding CO_2 emissions for the use phase of the smartphone, in my opinion, is incorrect. As said earlier, due to consumer demand and newest technologies, electronic waste is the fastest growing waste stream in the world, with tens of millions of tonnes of devices being thrown out on a yearly basis which piles up in landfills and results in putting the environment and communities at risk, yet this is an area which is not highlighted in product declarations with their emphasis on recycling and emissions.

Moreover, smartphone, throughout its life cycle, plays huge part in perilous climate change. It is very difficult to bring down the equivalency of CO_2 emissions to any scale but I have done some calculations based on the data from US Environmental Protection Agency. According to US Environmental Protection Agency, 1 million tons of CO_2 is roughly equal to the annual energy used by 91000 houses (figures rounded), and it is also equal to the amount of carbon sequestered annually by 32,390 acres of forest preserved from deforestation (Mullikin 2009). Based on the data and figures given by the US Environmental Protection Agency, I rounded all the figures and applied it to the data I collected and calculated for smartphones' CO_2 emission (Table 3.9).

Based on my calculations presented in Table 3.9, in the year 2015, 2.6 billion smartphones during their complete life cycle emitted 166.4 billion kilograms of CO_2 (164.4 megatons) which

is roughly equivalent, according to my calculations, to the energy used annually by 1.5 billion houses and also to the amount of carbon sequestered annually by 116 million acres of forest preserved from deforestation. These figures become even more shocking with the prediction of the smartphones' CO_2 emissions for the year 2020 as shown in Table 3.9. Based on the figures I calculated for the smartphones' CO_2 emissions for the year 2020, which is estimated to be 390.4 billion kilograms (390.4 megatons), are roughly equivalent to the energy used annually by 3.5 billion houses and also to the amount of the carbon sequestered annually by 273 million acres of forest preserved from deforestation. These figures clearly indicate the huge negative impact of the smartphones on the environment. Therefore, understanding the environmental impacts created by smartphone industry is becoming imperative and there is a need for effective strategy to cope with the situation. I have summarised chapter 3 in Table 3.8 and 3.9.

Table 3.8 Environmental Impact of the Smartphone

Complexity of product and Its Value Chain		
Extraction and Manufacturing	Focus	Rare earths, critical metals, chemicals and CO2 emissions
	Problems	Mining, disclosure of material used and sources, metal depletion, recovery at the end of life, air, water and land pollution, child labour, deforestation, sea pollution, landfill leachate, human health, energy intensive
	Countries of Reference	Ghana, Congo, Peru, China, Indonesia
	C02 Emissions	164.4 megatons in 2015 and 390.4 megatons in 2020
	IPhone	Inefficient mining process, 700 world suppliers, disclosure problem, FOXCONN issue, Congo issue, Indonesian issue, new iPhone every year, cadmium, BFR and PVC free
Packaging and Distribution	Focus	Paper and aluminum
	Problems	Destruction of rain forests, biodiversity loss, energy intensive, extremely harmful smelting process, suppliers problem, tier 1, 2 and 3 suppliers emissions unknown, toxic mine tailings,
	Countries of Reference	Indonesia and china
	CO2 Emissions	7.8 megatons in 2015 and 18.3 megatons in 2020
	IPhone	Improved packaging material and small size, sustainable managed forests, transport by air, no environmental impact data
Use	Focus	Direct and indirect electricity consumed
	Problems	Measurement of direct electricity use only, indirect electricity use environmental impact unknown, dependency on smartphones and enormous increase in use
	Countries of Reference	Global
	C02 Emissions	78 megatons in 2015 and 184 megatons in 2020
	IPhone	7.5 metric tons co2, new model every year, data centers with 100% Renewable energy, impact of related network sources unknown,
End of Life	Focus	E-waste, recycling, landfills
	Problems	Shorter smartphone life, fastest growing waste, illegal trade, not mentioned in product declarations, ineffective company policies and consumer behaviour, 140 million phones in landfills, sea pollution and seabirds, biodiversity loss, air, water and land pollution, toxic rivers, child labour, health conditions
	Countries of Reference	Ghana, China and Indian ocean
	C02 Emissions	2.6 megatons in 2015 and 6.1 megatons in 2020
	IPhone	Refurbishing and recycling program unknown to consumers, no proper plan for rems, no monitoring of third party activities

Table 3.9 Total CO_2 Emissions

Total Number of Smartphones	
Year	**Number**
2015	2.6 Billion
2020	6.1 Billion

Manufacturing Stage (1 Smartphone Emits 30kg CO_2)			
Year	Numbers of Smartphones	CO2 Emissions/Smartphone	Total Emissions
2015	2.6 Billion	30kg	78 Billion kg CO_2 (78 megatons)
2020	6.1 Billion	30kg	183 Billion kg CO_2 (183 megatons)

Packaging and Transportation Stage (1 Smartphone Emits 3kg CO_2)			
Year	Numbers of Smartphones	CO_2 Emissions/Smartphone	Total Emissions
2015	2.6 Billion	3kg	7.8 Billion kg CO_2 (7.8 megatons)
2020	6.1 Billion	3kg	18.3 Billion kg CO_2 (18.3 megatons)

Use Stage (1 Smartphone use Emits 10kg CO_2/year in case of direct energy use and 30kg CO_2/year for indirect and direct energy use)			
Year	Numbers of Smartphones	CO_2 Emissions/Smartphone	Total Emissions
2015	2.6 Billion	10kg (Direct Energy Use) 30kg (Indirect plus Direct Energy Use)	26 Billion kg CO_2 (26 megatons) 78 Billion kg CO_2 (78 megatons)
2020	6.1 Billion	10kg (Direct Energy Use) 30kg (Indirect plus Direct Energy Use)	61 Billion kg CO_2 (61 megatons) 183 Billion kg CO_2 (183 megatons)

End of Life Stage (1 Smartphone Emits 3kg CO_2)			
Year	Numbers of Smartphones	CO_2 Emissions/Smartphone	Total Emissions
2015	2.6 Billion	1kg	2.6 Billion kg CO_2 (2.6 megatons)
2020	6.1 Billion	1kg	6.1 Billion kg CO_2 (6.1 megatons)

Total Life Cycle (1 Smartphone Emits 66kg CO_2)			
Year	Numbers of Smartphones	CO2 Emissions/Smartphone	Total Emissions
2015	2.6 Billion	64kg	166.4 Billion kg CO_2 (164.4 megatons)
2020	6.1 Billion	64kg	390.4 Billion kg CO_2 (390.4 megatons)

Chapter 4: Mitigating the Smartphone's Environmental Impact

I am writing my paper in a country which opted out of Kyoto Protocol (CBC News 2011) and passed an industry friendly Canadian Environmental Assessment Act (CEAA 2012) with limited scope and restricted role of the public, all going counter protecting our environment (Doelle 2012). I am aware that in multinational companies, self-interest is dominant by default. Imagine business tycoon Bill Gates shaking hands with the Rockefeller Foundation, Monsanto Corporation and Syngenta Foundation to build what is called the 'doomsday seed bank' on the Norwegian island of Spitsbergen so that crop diversity can be conserved for the future in case of doomsday (William 2016). Companies know what they have done to our ecological system and they are preparing for doomsday rather than mitigating environmental impacts. Anytime Bill Gates, the Rockefeller Foundation, Monsanto and Syngenta get together on a common project, it is worth digging a bit deeper (William 2016). Last but not least, I am trying to convince those 'homo economicus' who watch a boxing match, where one human being hurts another human being, that this teaches us the survival of the fittest theory and reflects dominance, brutality and power, and at the end the human who hurts another human more, takes away $300 million and buys 10 houses and 50 different cars with it. We all pay for it and never consider if it is just.

No doubt, everyone is hypnotised by the present malevolent system that inherently embodies the tenets of economic and social evils. The result is the confinement of our beliefs and dogmas to the level that allows us only to think within prearranged and established limits. Our enslaved beliefs are so strongly held that, even when contrary evidence appears, the evidence is often rejected (Harding 2001). But this is what I call finite disappointment and there is always infinite hope. As Helen Keller, an author, political activist and a lecturer, once said, "the only thing worse than being blind is having sight but no vision". We must have a positive vision of a sustainable ecological system but as Pablo Picasso, a Spanish painter, ceramicist and poet said, our goals can only be reached through a vehicle of a plan, in which we must passionately believe, and upon which we must vigorously act, otherwise there is no other route to success. I think we have not passionately believed and vigorously acted. But as human beings, we all make mistakes and as Albert Einstein said, "a person, who never made a mistake, never tried anything new". Therefore, let me try something new to play our part towards environmental sustainability.

4.1 Meta Strategy

If environmental sustainability refers to the long-term conservation of ecological systems (Matten and Crane 2005), than I think environmental sustainability objectives require complex systems thinking for which we need collaborative effort. That is why I briefly introduced complexity theory previously to highlight the point that our smartphone dilemma is complex. Every individual, for-profit organisation, not-for-profit organization and the government, all have their own motivations, specialties, enticements and cognitions, and they are part of the system in which they influence other actors and get influenced by other actors. In this regard, I have designed what I call a "meta strategy" for "environmental sustainability".

The "meta strategy" calls for forming networks or systems of autonomous organizations, each one with their own motives but with a system level goal or guiding logic. This platform can then be used to exercise environmentally friendly management practices. In this way we can think beyond the holy trinity of the triple bottom line, and design a transformational strategy by taking advantage of each other's competencies that can result in environmental sustainability. This can also lead to an effective supply chain, as well as innovations. As the smartphone industry has an impact on the environment throughout its supply chain, therefore, it is critical to think sustainably for every stage of the smartphone's life cycle. The 'meta strategy' calls for effective and positive actions to mitigate smartphones' environmental impact with a vision of transformation.

4.1.1 Vision and Transformational Strategy

In order to understand a vision based on 'transformational strategy', there is need to understand the five business strategies first. There are five business strategies namely; denial, defence, isolated, embedded and transformational (Valente 2015). In the denial strategy, sustainability and corporate social responsibility are highly irrelevant to the firm's strategy whereas in defence strategy some philanthropic steps are taken and companies admit to be partially accountable for the destruction of ecological systems for instance, but at the same time they also defend their entire supply chain by introducing a product or two to divert attention (Valente 2015). In isolation strategy, sustainability is brought into the firm's strategy and operations and also involves an entire department or product line being positioned according to sustainability but

part of their processes of their product line distort sustainability principles which shows contradiction in their overall motives.

Embedded strategy on the other hand means sustainability is infiltrated throughout the firm and not just a few departments (Valente 2015). The fifth and final strategy is called transformational because companies espousing this strategy make significant changes to the external environment in which they operate (Valente 2015). The external environment can be defined here as an industry, supply chain, local community, or even broader society in which the company operates (Valente 2015). To further clarify, I have provided some examples in Table 4.1 keeping in mind that the ultimate goal and vision of the smartphone industry should be transformation.

Table 4.1 Business Strategies

Denial	• Exxon knew of the realities of human-induced climate change in the 1970s • They were warned of the potential impact • They Led research efforts to study CO2 in air	• By the 1980s, Exxon changed course • Millions dollars were allocated to fund efforts to reject the findings of its own science (Democracy Now 2015)
Defence	• Coca-Cola begun to acknowledge linkages between obesity and food and beverage consumption	• But huge investments were done in advertisements to convince consumers that despite this problem Coca-Cola makes people happy and is a reward for those who exercise • Supplied Coca Cola through third parties in Schools
Isolated	• According to Volkswagen "they take environmental considerations into account from the very earliest stages of the product development process" (Sustainability Report, 2014)	• But 500,000 diesel-powered VWs were programmed to provide false emission data during testing (CBC NEWS 2015)
Embedded	• Chipotle, a Mexican Fast Food Model	• Most/all decisions encompass social, ecological, and economic dimensions • Positioned as a challenger to the conventional fast food model ("doing the impossible") • Employees are well trained on product sourcing and impacts
Transformational **The ultimate Goal and Vision**	• SEKEM (organic conglomerate located just outside Cairo, Egypt that specializes in agricultural commodities for a wide range of industries) that changed the system	• Dramatically improved soil conditions throughout Egypt • Transitioned 800 Egyptian farmers to biodynamic cultivation • Influenced government regulation based on biodynamic harvest success

Source: Compiled from Democracy Now (2015), Valente (2015), CBC NEWS (2015), Volkswagen Sustainability Report (2014)

I think most smartphone manufacturers are playing around either defence strategies or got stuck in the isolated one. Environmental sustainability has started to make inroads into their strategies and operations, but not for all products and processes. Smartphone manufacturers try their best to defend their environmental externalities with corporate social responsibility and sustainability reports. Apple is one of the examples (See Table 4.10). There is a need to get out of denial and defence, and move towards transformation that could influence the entire system otherwise we will keep moving in circles till it is too late to rectify. Once the vision is transformational, than the primary step and key part of the "meta strategy" is the exploration of environmental needs first, which can only be effectively done through exploring stakeholders' needs. Exploring stakeholders' needs will lead to the discovery of new opportunities (Partridge et al 2005).

4.1.2 Stakeholder Engagement

It should be clear that I am not at all talking about stakeholder management rather I am stressing on stakeholder engagement. These are two completely different ideas. Stakeholder management is more or less controlling stakeholders and is mostly incorporated in corporate social responsibility activities (Reed 1999, Friedman 2007). Stakeholder engagement, on the other hand, means their input is respected and acknowledged in decision making because companies seek out stakeholders to build solutions collaboratively and come up with multiple, interconnected outcomes by network of stakeholders (Valente 2015). Table 4.2 highlights comparative analysis of stakeholder management and engagement to clarify the points of differentiation between them.

Table 4.2: Differentiation between Stakeholder Management and Engagement

	Stakeholder Management	Stakeholder Engagement
Motivation for interaction	Mitigating risk, appeasing stakeholders	Complementary capabilities, pivotal to business
Important characteristics	Stakeholders can erode shareholder value	Unique perspectives, Stakeholders have lucrative capabilities
Process	React to pressures and respond to stakeholder's demands unilaterally	Seek out stakeholders to build solutions collaboratively
Outcome	Multiple, disconnected outcomes by firm only	Multiple, interconnected outcomes by network of stakeholders

Source: Valente (2015), Schulich Business School

Deciding on the relevant stakeholders (Table 4.3) and their roles and engaging them properly will ultimately result in highlighting the main environmental needs of a particular area (Partridge et al 2005) which will then lead to corresponding actions to mitigate the environmental impacts. This kind of stakeholder engagement leads to redefining productivity in the value chain, build supportive industry clusters and can also enact the right form of government regulations and policies at each stage of the life cycle of a smartphone.

4.1.3 Exploration of Environmental Needs

Based on the information in section 3.1, 3.2, 3.3 and 3.4, I have developed a scenario and an overall picture for Apple Inc. in Table 4.4, 4.5, 4.6, and 4.7. Stakeholders (shown in Table 4.4, 4.5, 4.6 and 4.7) must be included to explore the environmental needs if Apple is committed to mitigate the environmental impact of the iPhone, and if they want to influence the external environment. Once stakeholder engagement highlights the environmental needs, then I believe corresponding action will be taken to mitigate the environmental impact.

According to my "meta strategy", stakeholders are divided into permanent and based on location categories. Since Apple is the focus of this research, I call for some mandatory stakeholders, highlighted in Table 4.3, without whom transformation is not possible. Other than Apple's management, employees and the iPhone research and design team, it is the relevant government officials, the Green Electronic Council, UNEP, FOXCONN, the Global Reporting Initiative (GRI) and the iPhone users who are considered as the permanent stakeholders. On the other hand, local governments and communities, concerned NGOs and ministries, and related tier 1, 2 and 3 suppliers are included also, based on location. Location refers to a particular area, region, city, district or province where tier 1, 2 and 3 suppliers of the original equipment manufacturers (OEM) operate. As mentioned earlier, original equipment manufacturers are the companies that make the final product for sale to the consumers whereas tier 1 suppliers provide components directly to the OEM, fulfilling the outlined specifications required for the making of the product (Ross 2016). Tier two suppliers deliver their goods and provide their services to tier one suppliers, and not directly to the OEM, whereas tier three outputs are directed to tier two suppliers (Ross 2016). The reasons for the inclusions of stakeholders are presented in Table 4.3. Moreover, the local based stakeholders in each case I examine are listed in Table 4.4 – 4.7.

Table 4.3 Apple's Stakeholders

Apple's Permanent Stakeholders
Government interference to warrant that decisions in the public and private sector give due weight to environmental factors is really vital because it is a known fact that corporate sector has been guilty of environmental degradation in the name of economic development (Forest and Morrison 1991). It should not be overlooked that economic health depends on protection of natural resources; therefore, environmental protection cannot be left to market forces (Chang et al 2015). There is a need for co-ordinated and holistic approach where government must be engaged as an important and a mandatory stakeholder in public policy-making related to corporate social responsibility (Chang et al 2015).
The Green Electronics Council is a non-profit organization working towards inspiring and catalyzing environmental leadership throughout the lifecycle of electronic technologies (Green Electronic Council 2016). The Council accomplishes this mission by supporting the production of consensus-based environmental leadership standards; by operating EPEAT (the definitive global rating system for greener electronics) and by convoking global thought leaders in environmental design, strategy and marketing to envision more sustainable electronics design and delivery methods (Green Electronic Council 2016). Therefore, its inclusion as a permanent stakeholder is vital for guidance and monitoring.
The United Nations Environment Programme (UNEP) is the leading global environmental authority that sets the global environmental program, support and promotes the comprehensible and coherent execution of the environmental dimension of sustainable development within the United Nations system and serves as a commanding advocate for the global environment (UNEP 2016). Therefore, there inclusion as a permanent stakeholder is vital for developing standards and regulations and help in monitoring.
FOXCONN is given due importance because it assembles IPhone for Apple (FOE 2012) and is considered the most dependable partner for joint-design, joint-development, manufacturing, assembly and after-sales services for communication and Consumer-electronics, especially iPhones (FOXCONN Social and Environmental Responsibility Report 2014).
The Global Reporting Initiative (GRI) is an international autonomous organization that helps companies, governments and other organizations comprehend and communicate the impact of business on dire sustainability issues. GRI currently provides the world's most widely used standards on sustainability reporting and disclosure, enabling businesses, governments, civil society and citizens to make better decisions based on information that matters (GRI 2015). In fact, 92% of the world's largest 250 corporations report on their sustainability performance (GRI 2015) where 80% of top 250 adhere to GRI reporting standard (Valente 2015). It will definitely help in achieving transparency and reports on future planning to mitigate environmental impact.
IPhone users are directly and indirectly impacted by Apple's decisions. Moreover, there is need for complete overhaul in the behaviour of the IPhone user regarding using their gadgets (Arruda-Filho et al 2010), and also in getting rid of them at the end of life of their smartphones.
Stakeholders based on Location
NGOs, local governments, local communities, concerned ministries and local companies or suppliers are always in the best position to point out the main environmental problems and needs, and they have local knowledge and experience to help in tackling those issues which could be of great help in decision making and monitoring (Partridge et al 2005). Moreover, they are the ones highly impacted by any decisions.

Table 4.4: Extraction and Manufacturing Phase

Stakeholders				
Peru (Gold)		**Indonesia (Tin)**	**China (Chemicals)**	**China (REMs)**
Permanent Stakeholders				
Federal Government		Federal Government	Federal Government	Federal Government
Green Electronic Council, EPEAT		Green Electronic Council, EPEAT	Green Electronic Council, EPEAT	Green Electronic Council, EPEAT
UNEP		UNEP	UNEP	UNEP
FOXCON		FOXCON	FOXCON	FOXCON
Other Smartphone Manufacturers		Other Smartphone Manufacturers	Other Smartphone Manufacturers	Other Smartphone Manufacturers
Global Reporting Initiative (GRI)		Global Reporting Initiative (GRI)	Global Reporting Initiative (GRI)	Global Reporting Initiative (GRI)
IPhone Users		IPhone Users	IPhone Users	IPhone Users
IPhone Employees		IPhone Employees	IPhone Employees	IPhone Employees
IPhone Executive Management		IPhone Executive Management	IPhone Executive Management	IPhone Executive Management
IPhone Research and Development		IPhone Research and Development	IPhone Research and Development	IPhone Research and Development
Stakeholders Based on Location				
Local Governments		Government of Sumatra	Guangxi, Liuzhou Government	Baotou Government
Local Communities		Local Community of Bankga	Liuzhou Local communities	Baotou Local Community
Ministry of Environment, Conservation and Tourism, Ministry of Mines, Ministry of Forestry (SERFOR)		Ministry of Environment and Ministry of Maritime Affairs and Fisheries	Ministry of Environmental Protection, Ministry of Heath, Ministry of Water Resources	Ministry of Environmental Protection, Ministry of Heath, Ministry of Water Resources, Ministry of Agriculture
UN-REDD		Friends of the earth (NGO)	WWF and The Yangtze Forum	WHO, World Bank, All China Environmental Federation
Sumatra Copper and Gold (ASX)		PT Timah, Koba Tin, Shenmao, and Chernan mining companies	Qihua PVC plant, Liuzhou Chemical Industry Ltd.	REMs Smelting Plants
Environmental Needs				
Priority 1	Protection of Peruvian Rainforest	Protect Soil Fertility and Restore Farming	Depollute Longjiang River	Depollute Water in Dystopian Lake
Priority 2	Protect Wetlands	Protection of Bangka Forest and Provision of Clean Water	Landfill Cleanup	Restore Farming
Priority 3	Control soil erosion	Protection of Fish Habitat	Provision of Clean Water	Restore Fisheries
Priority 4	Protect Rivers	Protection of Coral Reefs and Turtles	Provision of Heath Facilities	Provision of Clean Water
Actions				
Mining regulatory reforms with input from all stakeholders and according to International Laws				
	Ban on Logging Concessions	Remediation of land	Ban PVC and BFRs (The only way) IPhone is PVC and BFR free	Remove Cadmium from Rivers completely and Remediation of Land
	Remediation of Wetland	Limit mining (only local communities) and provide education and funding for sustainable farming	Remediation of Liuznou Land for 200 km and build Hospitals and Create various standard Landfills	Funding and Education for sustainable farming and fisheries
	Collaborated Continuous Monitoring of Rainforests, wetlands, Rivers and Soil Fertility	Collaborated Continuous Monitoring of Bangka forest and Fish Habitat	Collaborated Continuous Monitoring of Chemical factories, River and Landfills	Collaborated Continuous Monitoring of leachate from Chemical factories
	Research and Development to eradicate gold from smartphone in Future	Research and Development to minimize the use of tin in smartphone	Research and Development to aim for Zero Landfills	Research and Development to completely eliminate Hazardous substances
Include the cost of environmental damage due to extraction and manufacturing stage in the iPhone price				
Educate people about the negative environmental Impact				
Mandatory disclosure of and keeping record of every single worker and tier1, 2 and 3 suppliers				
Mandatory environmental impact assessment and making it public. Making sure to include every aspect of environmental degradation as a result of extraction and manufacturing stage of the iPhone on packaging and in instruction guide for users				
EPEAT certification for extraction and manufacturing Stage				
GRI report on extraction and manufacturing				
Include transportation related CO_2 emissions for manufacturing stage and emissions from each and every supplier				

Table 4.5: Packaging and Distribution Phase

Stakeholders			
Indonesia (Paper and Fiber)		**China (Paper)**	**China (Aluminium)**
Permanent Stakeholders			
Federal Government		Federal Government	Federal Government
Greenpeace, Green Electronic Council, EPEAT		Greenpeace, Green Electronic Council, EPEAT	Greenpeace, Green Electronic Council, EPEAT
UNEP		UNEP	UNEP
FOXCON		FOXCON	FOXCON
Other Smartphone Manufacturers		Other Smartphone Manufacturers	Other Smartphone Manufacturers
IPhone Users		IPhone Users	IPhone Users
IPhone Employees		IPhone Employees	IPhone Employees
IPhone Executive Management		IPhone Executive Management	IPhone Executive Management
IPhone Research and Development		IPhone Research and Development	IPhone Research and Development
Stakeholders Based on Location			
Sumatra Local and Provincial Governments		Yunnan Provincial and Local Government	Hunan Provincial and Local Government
Local Communities of Riau, Jambi, and Indigenous People of Orang Rimba and Talang Mamak		Local community from 14 Districts and Yi and Lolo Indigenous people of Yunnan	Local Community from Changde City
Ministry of Environment and Ministry of Forestry		Ministry of Environmental Protection and State Forestry Administration	Ministry of Agriculture, Ministry of Environmental Protection, Ministry of Water Resources
Friends of the Earth		WWF	WWF and WHO and World Bank
Sin Mar Group		Sin Mar (APP),	Chuangyuan Aluminium Co. Ltd Plant
Environmental Needs			
Priority 1	Protect Sumatra Forest	Protect Yunan Forest	Depollute Water
Priority 2	Protect Sumatra Tigers	Control Soil Erosion	Remediation of rice growing land
Priority 3	Protect Soil Fertility	Protect Yunan River	Cleanup of Cadmium Pollution
Priority 4	Restore Farming	Restore Farming	Remediation of Industrial Zone
Actions			
Forest conservation regulatory reforms with input from all stakeholders and according to International Laws			
	Ban on Logging Concessions	Reconstruction of Low-Function Forests	Remove Cadmium from Rivers completely and Remediation of Rice Growing Land
	Remediation of Wetland	Limit Logging (only local communities) Stop conversion of natural forests into plantation	Funding and Education for sustainable farming and fisheries
	Collaborated Continuous Monitoring of Rainforests, wetlands, Rivers and Soil Fertility	Collaborated Continuous Monitoring of Yunan forest	Collaborated Continuous Monitoring of leachate from Chemical factories
	Research and Development minimize the use of virgin paper in smartphone Packaging	Research and Development to minimize the use of virgin paper in smartphone Packaging	Research and Development to minimize the use of Aluminum
Include the cost of environmental damage due to packaging and transportation stage in the iPhone price			
Educate people about the negative environmental Impact			
Mandatory disclosure of and keeping record of every single worker and tier 1, 2 and 3 suppliers			
Mandatory environmental impact assessment and making it public. Making sure to include every aspect of environmental degradation as a result of packaging and transportation stage of the iPhone on packaging and in instruction guide for users			
EPEAT certification for packaging and distribution stage			
GRI report on packaging and transportation			
Include transportation related CO_2 emissions for packaging and distribution stage and emissions from each and every supplier			

Table 4.6: Use Phase

Stakeholders	
Global (CO_2 Emissions)	
Permanent Stakeholders	
Federal Governments	
Greenpeace, Green Electronic Council, EPEAT	
UNEP	
FOXCON	
Other Smartphone Manufacturers	
Global Reporting Initiative (GRI)	
IPhone Users	
IPhone Employees (Customer Services and Marketing)	
IPhone Executive Management	
IPhone Research and Development	
Stakeholders Based on Location	
Ministries of Environment	
Energy Distribution Companies	
Local NGOs	
Environmental Needs	
Priority 1	Reduce CO_2 emissions from indirect energy sources (companies and scope 1, 2 and 3 suppliers)
Priority 2	Reduce CO_2 emissions from direct energy sources (consumers)
Actions	
CO_2 emissions regulatory reforms with input from all stakeholders and according to international laws	
Smartphone manufacturers using collaborative REN sites	
Marketing strategies must include the importance of energy use	
Arrange workshops and seminars in schools and universities	
Research and design team to design chargers that consume no energy even if left plugged	
Smartphone manufacturers must have renewable energy at all the sites	
Include the cost of environmental damage due to use stage in the iPhone price	
Educate people about the negative environmental impact of use of the smartphone	
Mandatory disclosure of and keeping record of Tier 1, 2 and 3 suppliers	
Mandatory environmental impact assessment and making it public. Making sure to include every aspect of environmental degradation as a result of direct and indirect use of the iPhone on packaging and in instruction guide for users	
EPEAT certification for the use stage	
GRI report on the use stage	
Include CO_2 emissions for use stage (direct and indirect) and emissions from each and every supplier	

Table 4.7: End of Life Phase

Stakeholders		
Ghana (e-waste)		**China (e-waste)**
Permanent Stakeholders		
Federal Government		Federal Government
Greenpeace, Green Electronic Council, EPEAT		Greenpeace, Green Electronic Council, EPEAT
UNEP		UNEP
FOXCON		FOXCON
Other Smartphone Manufacturers		Other Smartphone Manufacturers
Global Reporting Initiative (GRI)		Global Reporting Initiative (GRI)
IPhone Users		IPhone Users
IPhone Employees		IPhone Employees
IPhone Executive Management		IPhone Executive Management
IPhone Research and Development		IPhone Research and Development
Stakeholders Based on Location		
Local and Provincial Government of Accra		Guangdong province and Government of Chaoyang district
Local Communities of Riau, Jambi,		Local community from Guiyu
Pure Earth Blacksmith Institute		Pure Earth Blacksmith Institute
Greater Accra Scrap Dealers Association (GASDA), Green Advocacy Ghana		Small Recycling Workshops
Ministry of Environment and EPA Ghana		Ministry of Environmental Protection and Water Resources
Environmental Needs		
Priority 1	Protect Odaw River	Protect Pearl River Peoples Health,
Priority 2	Protect Farm Land	Protect Farm Land
Priority 3	Protect Wetland	Protect Wetland and Cleaning of Pearl River
Priority 4	Air Pollution	Air Pollution Restoration of Farm land
Actions		
E-waste regulatory reforms with input from all stakeholders and according to international Laws		
	Cleaning Water	Depollute Water
	Restoration of vegetation	Restoration of Farming
	Remediation of Land and Cleaning Odaw River	Remediation of Land and Cleaning Pearl River
	Reduce the amount of toxic fumes in air	Reduce the amount of toxic fumes in air
	Collaborated Continuous Monitoring of Odaw River and wetlands and Landfills	Collaborated Continuous Monitoring of Pearl River
	Research and Development must increase the life of IPhone and develop cradle to cradle approach (circular economy), thus eliminating e-waste completely	Research and Development must increase the life of IPhone and develop cradle to cradle approach (circular economy), thus eliminating e-waste completely
Include the cost of environmental damage due to end of life stage in the iPhone price		
Educate people about the negative environmental Impact		
Mandatory disclosure of and keeping record of every single worker and tier 1, 2 and 3 suppliers		
Mandatory environmental impact assessment and making it public. Making sure to include every aspect of environmental degradation as a result of e-waste and recycling stage of iPhone on packaging and in instruction guide for users		
EPEAT certification for end of life Stage		
GRI report on end of life stage		
Include transportation related CO_2 emissions for end of life phase and emissions from each and every supplier		

Once Apple's stakeholders take their decisions based on environmental needs and decide on the actions needed to be taken to mitigate the environmental impact of the iPhone at every stage of its life cycle, than regulations would be reformed accordingly for each stage of life cycle at various local, national and international levels. The "meta strategy" calls for regulatory reforms and considers stringent regulations mandatory.

4.1.4 Regulatory Reforms and Policy Transfer

Regulations are necessary for well-functioning markets, something that became clear during the 2007-08 financial crisis (Porter and Cramer 2011). However, the ways in which regulations are designed and implemented determine whether they benefit the environment or work against it (Porter and Cramer 2011). Therefore, each stakeholder's input is an essential part of regulatory reforms. The environmental degradation was evident from the Indonesian government mining law on minerals and coal which involved no relevant stakeholders, thus, it allowed practically all areas to be mined, including protected forest and the sea (FOE 2012) resulting in environmental degradation as shown in Table 3.4 above. Regulations should inspire innovations but must have straightforward measurable goals towards sustaining the environment (Porter and Crane 2011).

Stakeholders' engagement and actions lead to reforms in domestic environmental regulations, government environmental policy alterations and compliance with international environmental agreements because local, national and international bodies are involved (Chien and Shih 2007). This type of collaboration could even result in policy transfer. Dolowitz and Marsh (2000: 5) define policy transfer as "a process in which knowledge about policies, administrative arrangements, institutions and ideas in one political setting (past or present) is used in the development of policies, administrative arrangements, institutions and ideas in another political setting". Policy transfer can play a pivotal role because environmental problems are complex (Learmonth et al 2011) and need collaborative effort and learning from partners, which can also lead to standard and effective regulations (Dolowitz and Marsh 2000).

Since Apple operates globally and has more than 700 suppliers, its strategy in one city of China will have an impact on another city in China and then it can extend to Peru, Ghana and Indonesia which can result in policy transfer and can have an ultimate effect on other smartphone manufacturers' policies. With respect to gold mining in Peru for instance, as shown in Table 4.4, permanent stakeholders and stakeholders based on location clearly indicate four priority areas to be considered. Every single stakeholder while accomplishing their own goals will still have to work towards achieving the overall goal of protecting Peruvian rainforest, wetlands, soil fertility and rivers which will require collaborative efforts to devise actions based on expertise of the stakeholders according to the reformed regulations.

4.1.5 Performance Standards and Reporting

The "meta strategy" for environmental sustainability begins with a vision of transformation and working towards the same goal. It is based on environmental needs and stakeholder engagement and calls for regulatory reforms. This ultimately results in setting performance standards which firms need to act on and report. According to Porter and Kramer (2011), stakeholders' engagement, actions based on environmental and social needs and regulatory reforms results in putting in place universal measurement and performance reporting systems in collaboration with third credible parties, and with all the stakeholders investing a share in infrastructure for collecting reliable benchmarking data (Porter and Kramer 2011). Therefore, considering Apple's present performance, as shown in Table 4.10, which mostly revolves around defence and isolated strategy, it must change its performance threshold and reporting standard in accordance with the requirement for a transformational strategy. Apple requires comprehensive reporting according to the GRI standard which must include the environmental impacts as shown in Table 4.8. Apple must ensure that its reporting for iPhone is in line with transformational strategy (as shown in Table 4.9).

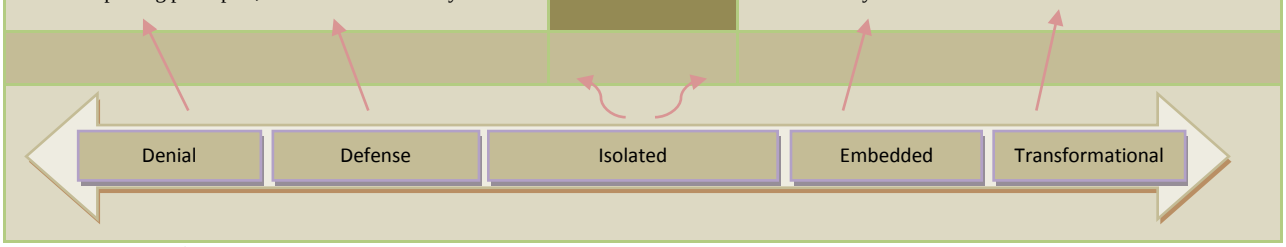
Table 4.8: Global Reporting Initiative Standards for Environmental Sustainability

Global Reporting Initiative Standards for Environmental Sustainability	
What is Included	
Greenhouse gases	Percent of materials used that are recycled as inputs
Hazardous spills	Direct/indirect energy consumption
Material use and water use	Total water withdrawal by source
Mono nitrogen oxide, sulphur oxide,	Direct/indirect greenhouse gas emissions
Volatile organic compounds	Strategies, current actions,
Hazardous waste and other air pollution	Future plans for managing impacts on biodiversity
Biodiversity, energy use and transportation	Environmental impacts of transporting products
All environmental expenditures	Initiatives to mitigate impacts of products/services

Source: Compiled from GRI (2016)

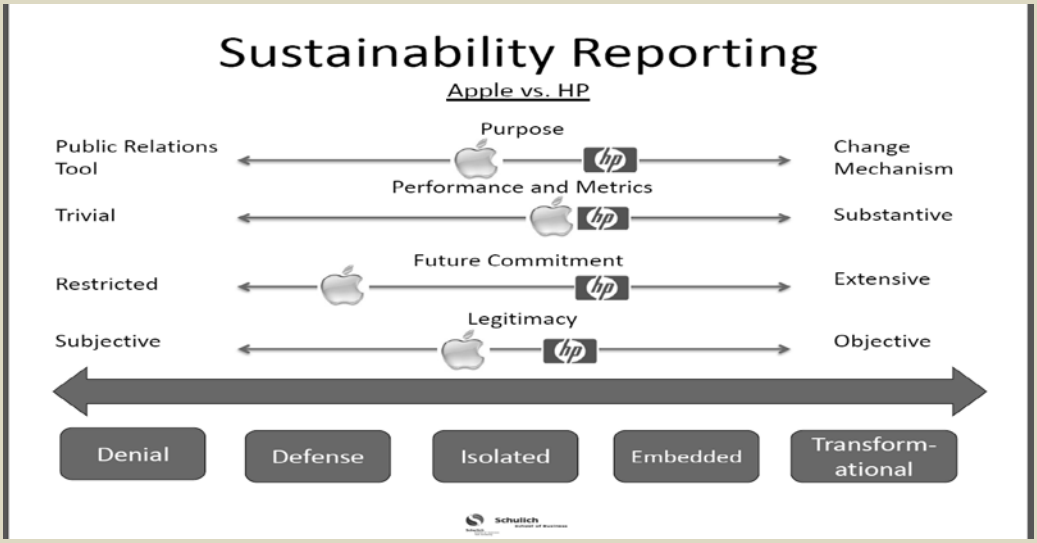
Table 4.9: Environmental Sustainability Reporting for Transformational Strategy

Environmental Sustainability Reporting for Transformational Strategy		
Public relations, appease stakeholders, philanthropic/charity oriented, mask relevant issues (diverting attention), to at least report something, no executives and managers accountable	**Purpose of the Report**	Organizational development, engage stakeholders, tackle/confront relevant issues, comprehensive reporting and must hold executives and managers accountable
Stories, anecdotes, awards, vague/ad hoc measures, feel-good statements, random measures/statistics, firm's link in supply chain, no benchmark measures	**Metrics and Performance**	Comprehensive snapshot, detailed measures (broken down), systematic accounting over years, relevant measures and statistics, entire supply chain, use of benchmarks
Non-existent/trivial future targets, no status or progress on targets, no action plans, non-existent performance tracking, no governance/control mechanisms	**Future Commitment and Progress**	Many stretch targets, progress updates, detailed action plans, performance tracking, integrated control and mutual decision making from all stakeholders
No external oversight, company selects measures, difficult to verify claims (no data), difficult to read/access information, no stakeholder input, no standard metrics/reporting principles, little/no accountability	**Legitimacy**	Independent third party and legitimate measures (GRI), reader can verify claims, easy to read/access information, multiple data sources, standardized metrics/principles, accountability in firm



Source: Compiled from Valente (2015), Schulich Business School

Table 4.10: Apple VS HP



Source: Valente (2015)

Since the “meta strategy” is about transformation, Table 4.9 above indicates that the purpose of the iPhone’s environmental sustainability report should be changing the mechanism rather than appeasing shareholders. The performance and metrics should be completely substantive and not trivial. Moreover, there should be extensive integrated future commitment and legitimate objective measurement and accountability. Interestingly, this kind of reporting and monitoring ultimately highlights inefficiencies of stakeholders (Valente and Crane 2010) which are a vital part of the “meta strategy”. Thus, it can lead to an interesting political role for companies.

4.1.6 Companies’ Political Role and Stimulate Strategy

Once the inefficiencies are highlighted, businesses can then provide an important contribution to public sector resource deficits and inadequacies (Valente and Crane 2010). This means companies can play a political role to a certain level to help reduce environmental impacts. But great care has to be taken in this regard because no one wants companies to revert back to their vintage strategy of becoming governments. One of the examples is the East India Company, founded in 1600 which was initially chartered as the "Governor and Company of Merchants of London trading into the East Indies" and which held half of the world's trade, particularly dealing in basic commodities like cotton, silk, salt, tea and “opium” (Mukherjee 1974). Later the same company also ruled at the start of the British Empire in India where massacres resulted in bringing fortune for the company (Mukherjee 1974).

But in today’s world, the political role of companies bears positive results. For instance, Starbucks’ CEO requested customers to no longer bring firearms into its stores which would make you wonder if democracy has shifted from the ballot box to the checkout till (Klien 2013). But it worked because people drink coffee and must comply with the company’s rules. Valente and Crane (2010) explained and provided some benefits of different types of companies’ political roles or strategies which I have summarised in Table 4.11 with some examples. The purpose is to figure out which strategy is a best fit for transformation.

Table 4.11: Political Role of Companies

Type of Impact			
Focus		Provision of Public Services	Infrastructure for Public Goals
	Non-Core Operations	**Supplement Strategy**	**Support Strategy**
		Direct public service provision Enabling competitive environment Typically philanthropic	Firms build political capacity Influence government policy Intervene in government affairs
		Bamburi Cement Nairobi Massive HIV/AIDs threat to workforce and community They instituted extensive HIV/AIDs programs Built awareness in communities Offered testing and Provided ARVs (HIV Pills)	**Sual Aluminum Company, Russia** Creation of local self-governing bodies to address deteriorating health and education Creation of a public council for self-governance in region of Shelekhov in Russia Supports NGO to facilitate social entrepreneurship
	Core Operations	**Substitute Strategy**	**Stimulate Strategy**
		Privatization of government services Private bodies developing and enforcing regulation	Inform regulation Stimulate governmental action/change
		Equator Principles Providing Industry Self-Regulations Cluster of 76 adopting financial institutions Committed to managing environmental and social risk in project finance transactions	**SEKEM** Created an organic agricultural supply chain Transitioned 800 Egyptian farmers to organic Influenced governmental policy in agriculture Agriculture standards are based on SEKEM model now

Source: Compiled from Valente and Crane (2010)

Since, the "meta strategy" calls for transformation, therefore, stimulate strategy is the best option a company should consider. Companies employing the stimulate strategy consider environmental needs as priority, leverage their products and services or their set of value chain activities to stimulate different forms of economic activity or regulatory behavior that directly or indirectly contributes to the achievement of environmental goals (Valente and Crane 2010). The stimulate strategy can extend beyond individual parts of a firm's value chain and be established in the entire set of activities defining its business model (Valente and Crane 2010). In short, stimulate strategy inform regulations and stimulate governmental actions which can bring change at the system level. Therefore, the "meta strategy" calls for stimulate strategy in regards to firms' political role. Exploring environmental needs and engaging stakeholders to form clusters to eradicate inefficiencies is so important because it can even change international standards and completely redefine the productivity in the value chain as in case of SEKEM (Case 1) and Tata Chemical Magadi (Case 2) presented below.

Case 1 SEKEM

SEKEM is an Egyptian-based company that developed a supply chain based on organic agriculture. SEKEM's business model is distinct from a usual entrepreneurial project that shapes its business within the limitations of the prevailing economic infrastructure of a specified national context. Instead, the SEKEM model stimulated a parallel agriculture system that formed the socio-economic infrastructure of Egypt by incorporating broader public goals related to social equity and ecological conservation. The business gained commitment from over 800 rural Egyptian farmers to transition their land to organic soil while acquiring a market with large customers in Europe. The business model also gave rise to the creation of the Egyptian Biodynamic Association (EBDA), an NGO established to promote organic agriculture in Egypt and to provide cultivation support and funding for farmers. In executing this business model, SEKEM gained the support of new and existing players along this alternative agricultural supply chain. In effect, the transformative nature of SEKEM's model which was based on environmental and social needs created collaborative clusters, reformed regulations and involved all the stakeholders to achieve the goals**,** and thus, it resulted in changing the entire agriculture system.

(Source: Summarised from Valente and Crane 2010)

Case 2 Tata Chemical Magadi

TCM, Africa's largest soda ash manufacturer and one of Kenya's leading exporters, is based in Kenya. Every year they extract hundreds of thousands of tons of sodium sesquicarbonate (a form of salt called double salt) from the surface of Lake Magadi, Kenya which is converted into soda ash (Sodium Carbonate). In order to address and tackle environmental and poverty related issues, TCM created a stakeholder forum which conducted division level SWOT analysis. This analysis resulted in an incredible mechanism providing a holistic approach to resolve the issues. The stakeholder engagement, collective process and holistic approach resulted in taking advantage of the complementary capabilities of stakeholders which not only resolved the issues but it became an ongoing process, and also influenced the entire system. It was so successful that it was replicated by International Organization of Standardization 6000 in 2014. Their collective efforts based on stakeholder engagements and playing a political role became a standard around the world.

(Source: Summarised from Valente 2015, Richard Ivey School)

4.2 Redefining Productivity in the Value Chain

Transformation as a vison and ultimate goal, stakeholders' engagement, actions based on environmental needs, regulatory reforms, reporting standards and companies' political role and a role beyond ordinary corporate social responsibility activities will redefine productivity in the value chain and lead towards innovations. By thinking and designing holistically, innovators are enhancing the environmental performance of products at every phase of their life cycle, reducing impacts from manufacturing to end-of-life (CTA 2016). The Fairphone is a perfect example that did what would otherwise be considered unthinkable in the competitive high-tech sector because it started the process from scratch and redefined the supply chain (Supply Chain Navigator 2016). To create what Fairphone calls a more ethical product, choices at every stage in the process of developing and producing the Fairphone mining, design, manufacturing and the entire life cycle are driven by a commitment to improving the electronics industry's value chain (Supply Chain Navigator 2016, Fairphone Fact Sheet 2016). No one ever thought there would be a social enterprise in the electronics industry, but Fairphone's entrepreneurship is proving to be the act of systems-changing enterprise that generates revenue from products with the primary purpose of resolving social and environmental issues. In order to see how redefining productivity in the value chain helps mitigate environmental degradation, I start with the extraction and manufacturing phase.

4.2.1 Extraction and Manufacturing Phase

Once the supply chain is redefined in the extraction and manufacturing phase, it will be clear which companies must provide the raw material, where it must be sourced from, what laws the suppliers must follow and how the new design of the iPhone would help achieve these goals. For example, according to Nilnawal et al. (2010), redefining productivity in the value chain leads a company to purchase materials or parts only from partners who satisfy environmental quality standards and pass an audit process in the regulations for the environment-related substances. It will consider suppliers who acquire International Organization for Standardization ISO14000 guideline and the restriction of hazardous substances directive (Nilnawal et al 2010). Fairphone's initiative in this regard is incredible, which I present below as case 3.

Case 3: Fairphone's Initiative regarding Extraction and Manufacturing

Fairphone sources responsibly mined minerals and metals that support local economies and environment by partnering with the 'Conflict-Free Tin Initiative' to trace tin directly to its source and support fairer, formal mining practices (Guendic 2014). In October 2012, the first bags of conflict-free tin left the mine in South Kivu, Democratic Republic of Congo to be used in the soldering for the Fairphone (Fairphone Factsheet 2012). The Fairphone is also working with 'Solutions for Hope', an NGO, to source conflict-free tantalum from Katanga province in the Democratic Republic of Congo to be used for the capacitors on the printed circuit boards (Fairphone Factsheet 2014). Most importantly, Fairphone have reached a major landmark with the help of their partners by achieving the first-ever Fair-trade gold supply chain for the consumer electronics industry (Gerritsen 2016). Fairtrade gold and precious metals is a ground breaking initiative that offers a support to poor and subjugated small-scale miners around the world and it links consumers of gold with the source of their purchase (Fairtrade 2016). It is this link, via Fairtrade standards and certification that makes Fairtrade gold the best gold in the world (Fairtrade 2016). According to Gerritsen (2016), there were no prevailing supply chain initiatives that the company could connect to source conflict-free gold from the Democratic Republic of Congo, and to setup supply chain from scratch was simply beyond its scope. Therefore, Fairphone employees travelled from Peru to Switzerland to Hong Kong to China, what they call "the journey of fair-trade" gold, to untangle the gold supply chain to find more responsible sources (Gerritsen 2016). After all the efforts and support from partners, the Fairtrade certified gold arrived in January 2016, and by establishing this model program, Fairphone became the very first Fairtrade-licensed consumer electronics company (Gerritsen 2016, Fairphone Factsheet 2016). This is how Fairphone redefined their supply chain at the extraction and manufacturing phase.

Source: Compiled from Fairphone Fact Sheet (2016), Gerritsen (2016), Fairtrade (2016)

Considering Fairphone's initiative and then referring to the iPhone manufacturing and extraction stage, the "meta strategy" definitely helps Apple to avoid sourcing from finite natural resources and stop using conflict minerals in China, Indonesia and Peru, and thus to sustain the environment. Most importantly, if the iPhone's research and design team is bound by environmental values, they would not only replace materials such as tin, gold and coltan but also all the hazardous substances used in smartphones. The iPhone model 4S and onwards are already completely PVC and BFRs free and they have completely stopped using cadmium in batteries which must be appreciated (Apple Environmental Responsibility Report 2014). Not only would Apple innovate in iPhone's design but responding to the awareness of their stakeholders' needs,

it would also make extraction and manufacturing energy efficient, reducing CO_2 emissions and water use.

Apple has already taken some initiatives and calls it manufacturing a smaller footprint (Apple Resources Report 2015). Apple identified two areas where they can dramatically reduce their impact; one is raw materials production and the other one is electricity used in manufacturing (Apple Resources Report 2015). The electricity Apple uses in its supply chain to process raw materials, make parts and assemble their products is the single biggest source of their carbon footprint (Apple Resource Report 2015). In this regard, Apple has taken few steps to reduce their carbon footprint (summarized in Table 4.12), clearly indicating how important it is to support suppliers and form clusters (discussed in section 4.3).

Table 4.12: Apple's Initiative regarding Energy Projects

In 2015, Apple created a program to help their partners around the world to reduce their energy use, power their facilities with clean energy and build high-quality renewable energy projects.
Apple is building 200 megawatts of solar energy production plants in China, starting with a 170-megawatt solar project in Inner Mongolia, to begin offsetting their manufacturing emissions.
Apple is also working with suppliers to install more than 4 gigawatts of new clean energy worldwide, including 2 gigawatts in China by 2020.
By 2017, Foxconn will install 400 megawatts of solar to cover the energy use of its iPhone final production facility in Zhengzhou, Henan Province, China.

Source: Compiled from Apple Resources Report (2015)

4.2.2 Packaging and Distribution Phase

In the packaging and distribution stage, due to stakeholders' engagement, prioritizing environmental needs and regulatory reform features such as size, shape, and materials, which have an impact on distribution because of their effect on the transport characteristics of the product, would be redesigned (Ninlawan et al. 2010). This could result in better packaging, along with repositioned loading patterns which can reduce materials usage, increase space utilization in the warehouse and reduce the amount of handling required (Ninlawan et al. 2010). The iPhone has already downsized packaging as iPhone 6 takes up 34 percent less volume than the previous iPhones' packaging and over two-thirds of the paper previously used for the iPhone (IPhone 6S Environmental Report (2015). Collaborative efforts and clusters have been able to encourage and

adopt returnable packaging methods and have promoted recycling and reuse programs (Terracycle 2015). The Fairphone also uses "green" packaging materials and cooperates with vendors to standardize packaging (Fairphone Fact Sheet 2015, Fairphone 2016). Fairphone's packaging initiative, presented as Case 4 below and the Coca-Cola Company's Plant-Bottle packaging initiative, presented as Case 5 are perfect example of prioritizing environmental needs and dedication towards continuous innovation.

Case 4: Fairphone's Packaging Initiative

Electronics companies frequently choose to have their final assembly plant handle the individual packaging of the completed products but Fairphone decided to package the individual phones at their distribution center in Eindhoven, the Netherlands because it provided them with advantages of quick delivery. For instance, at the factory in Suzhou, China, the phone can have its own production timeline processes and can be sent as soon as they are completed whereas the back covers follow a different production process and can be sent separately whenever they are done. This approach reduced the overall size, weight and related CO_2 emissions of the packages that are shipped from China. Instead of shipping thousands of individual packages from China to their new owners via different routes, the finished Fairphone 2s are sent in bulk in boxes to Netherlands and the individual phones only need to travel from the Netherlands to their final destinations throughout Europe. This approach reduces the volume by more than fifty percent, and all the extra materials for packaging, for instance user guides, are printed in the Netherlands so they never have to fly long distances. Fairphone also used materials that were more sustainable than regular cardboard. They partnered with the packaging experts to select materials to shape Fairphone packaging design. Instead of cardboard, Paper-Foam was used which is made in the Netherlands from starch, natural fibers and water, and is very lightweight, as well as recyclable, compostable and biodegradable. In addition, it was easy to customize the shape of the packaging, as it is created using an energy-efficient, low-pressure injection molding technique. Once everything is inside, the packaging is sealed with a strip tear-resistant Stone Paper which is a silky, paper-like material made of calcium carbonate and a mix of non-toxic gum, and its production doesn't require any water or bleach, and it can be recycled endlessly. Stone Paper is a Cradle to Cradle (Silver) certified product having huge potential to reduce emissions for printed materials.

Source: Summarised from Ballester (2016)

Case 5: Coca-Cola Plant Bottle Packaging Initiative

PlantBottle packaging is the newest innovation from the Coca-Cola company intended to change the way consumers thinks of plastic bottles. It is the first ever completely recyclable PET (Polyethylene terephthalate which is the most common form of polyester) plastic beverage bottle made partially from plants. Coca Cola's PlantBottle packaging drive is reducing dependency on fossil fuels and also increasing the use of renewable materials. PlantBottle packages are fully recyclable, convenient, lightweight, and does not involve petroleum and other fossil fuels. PlantBottle packaging only uses materials made from plants. Until 2015, more than 35 billion PlantBottle packages were circulated in around 40 countries. This technology has empowered Coca-Cola to eradicate more than 315,000 metric tons of CO_2 emissions which is equivalent to the amount of carbon dioxide emitted from burning more than 743,000 barrels of oil. It also saved more than 36 million gallons of gas. The PlantBottle innovation echoed with consumers, helped boost sales, generated headlines, and earned sustainable and innovation awards. From the beginning, Coca-Cola intended licensing PlantBottle technology to other companies, based on the belief that they have an obligation to work with others on solutions to collective environmental challenges. In 2011, The Coca-Cola company licensed PlantBottle technology to H.J. Heinz for use in its ketchup bottles. In 2013, Ford Motor Company declared plans to use the same renewable material found in PlantBottle packaging in the fabric interior in certain test models of the Fusion Energy hybrid sedan. Dedicated to cooperation, in June 2012, in partnership with Ford Motor company, H.J. Heinz Company, NIKE, and Procter and Gamble, Coca-Cola announced the formation of the Plant PET Technology Collaborative (PTC), a strategic working group focused on accelerating the development and use of hundred percent plant-based PET materials and fiber in their products. Together they are assisting, supporting and championing research as well as expanding knowledge toward technology that will enable commercially feasible, sustainably obtained, 100% plant-based PET plastic while reducing the use of fossil fuels.

Source: Summarised from Anderson (2015)

Moreover, Apple's stakeholders can jointly invest in transportation infrastructure and technology to reduce CO_2 emissions as explained in Case 6 below regarding Tata Chemical Magadi's investment in transportation.

Case 6: Tata Chemical Magadi Transportation Investment

Reducing CO_2 emissions is evident from Tata Chemical Magadi's investment in the extension of a 120-kilometer road from the southern edges of Nairobi to Magadi and in building and operating an extension of the Kenyan railway line to transport soda ash to the Mombasa port. These road and railway lines are now used for transportation by Kenyan citizens, other small suppliers with little or no relationship to the company. This investment by TCM completely eliminated the use of other routes and vehicles by citizens and suppliers. Kids go to school, workers go to their jobs, and more interestingly, it has made monitoring of logging and mining extremely efficient.

(Source: Summarised from Valente (2015), Ivey Business School

Like TCM, Apple, in collaboration with other smartphone manufacturers and stakeholders, can explore not only the most economical and energy efficient routes in and from China, Peru, Indonesia and Ghana but the use of alternative fuel vehicles and distribution of products together, rather than in smaller batches. This could lead to a new way of transportation and would potentially save ample amounts of energy. Moreover, all the information regarding transportation and calculating distance between the suppliers and assembly plants should be included in iPhone's bills of materials in the same way Fairphone does (Fairphone 2015). A bill of materials (BoM) is a list of the parts or components that are required to build a product (Rouse 2016). The bill of materials must be made public and should be mentioned in the Global Reporting Initiative (GRI) reports with all relevant environmental impacts. Apple does not provide such bill for the iPhone at the moment.

4.2.3 Use Phase

As already discussed, the use stage involves both the smartphone manufacturers and the users of the product. Most of the services required by the smartphone user are provided by the infrastructure outside the actual product (Mattila et al. 2014). A radical rethinking of the scope in calculating the environmental impact of the use phase of a smartphone is therefore necessary. If the product is useless without the infrastructure, then the infrastructure is a vital part of the product and should be included, but unfortunately, very few studies have been done on the carbon footprint of server computing and data transfer (Mattila et al. 2014). Since the focus of research in the use stage is CO_2 emissions, environmental needs require the reduction in CO_2 emissions which is not possible without collaboration. By collaboration, it means Apple has to

share its strategy and design of Radio Access Network (RAN) sites and offices which use 100 percent renewable energy and efficient water use. For example, in 2015, 93 percent of Apple energy came from renewable sources and they are constantly looking for ways to get to 100 percent (Apple Resources Report 2015).

In Singapore, Apple is running their facilities with a 32-megawatt solar project spread over 800 roofs whereas in China, they are adding 170 megawatts of solar to start compensating for the energy used to make their products (Apple Resources Report 2015). Apple data centres, globally, run on 100 percent clean energy and power billions of iMessages, answers from Siri and song downloads from iTunes (Apple Resources Report 2015). In collaboration with other smartphone manufacturers and specialized companies, more technological innovations are needed to reduce CO_2 emissions. One example is Energy Floors, a small company that surprised everyone with its innovation. If they can do it, than there is a greater scope for smartphone manufacturers to innovate to reduce CO_2 emissions and use renewable energy. Below is a brief case of Energy floors.

Case 7: Dancing Energy Floors

A group of seven from Rotterdam, Netherland came up with the idea of a sustainable dance club with a vision (People, Planet and Party) and mission of creating awareness and consciousness about the significance of conserving energy. In their pursuit, they successfully launched the world's first energy generating dance floor (SDF) in 2008 in Rotterdam. The more you dance, the more energy is generated. At the end of 2012, Energy Floors counted seventeen permanent SDF installations events in sixty nine different cities in eighteen countries on five continents. This resulted in approximately one million visitors who generated two billion joules of energy within 2012. Their biggest project in 2012 was the installation of SDFs during the Olympics and Paralympics**.** Currently 'Energy Floors' provide kinetic flooring systems and plugins for events, exhibitions and public spaces. By means of an electromechanical system, the 'Sustainable Energy Floor' converts kinetic energy of people's footsteps to electrical power. This technology is patented in Europe and the United States. The 'Sustainable Energy Floor' is a fully recyclable pedestrian floor which can be used in pavements and high footfall areas, such as sport arenas, airports, railway stations, shopping malls, offices and apartment blocks. These floors enable people to generate their own local clean energy to power street lights and signing systems. The 'Sustainable Energy Floor' can be a key element in smart grids, integrated with solar and wind power in the future.

Source: Summarised from Energy Floors (2015)

On the other hand, customers' demands have now become the most important type of external pressure (Doonan et al. 2005). Environmental awareness, once relished only by few within society, has thrived in the last decade so that today it directly initiates changes in consumers' buying behaviors (Kennell 2015). Two-thirds of customers consciously avoid some brands due to environmental apprehensions, a number that has augmented by 26% since 2009 (Kennell 2015). To attain more sustainable solutions, the environmental properties of products and services must meet customer requirements (Zhu and Sarkis 2006). According to Nielson (2015), an estimated 66 percent of consumers claim that their purchasing decisions are influenced by a company's environmental reputation, and they would be willing to pay more for environmentally friendly goods. Consequently, the influence of the firm's environment related organizational decisions not only affects the organization that makes the decision, but also its customers and suppliers (Sarkis, 2003). This is where addressing imperfectly distributed information is needed (Valente 2015). Therefore, Apple must provide ecological information to the iPhone users regarding every phase of iPhone's life cycle in order to be 100% transparent. This transparency can only be achieved through mandatory disclosure of all the activities and suppliers via third party verifications and international bodies.

Digital revolution has led to a world more connected than ever before; according to (Kennell 2015), the number of Americans who possess smartphones doubled in four years. Extensive access to the internet and social media means consumers have better access to information, and companies may be held to greater standards of transparency and accountability (Kennell 2015). Therefore, Apple must design its future iPhones in such a way that consumers know the environmental impact at every stage of its lifecycle and particularly when it is used by the consumers. Investment in new technologies and innovations with efforts from research and design teams based on environmental needs must come up with a design that requires every iPhone user to go through the environmental impact of their phone on screen step by step before activating it. New designs must display on screen the energy used every time the iPhone is charged and should not only keep the record for an entire year but must also inform consumers about the indirect energy used by a particular iPhone every month and every year. This will be the most efficient way of educating consumers and creating awareness. Nokia, in May 2007, became the first mobile manufacturer to put alerts into phones, encouraging people to unplug

their chargers (CEA 2008, Nokia Sustainability Report 2007). Also, Fairphone's Case 8 is a perfect example that can fit in for all the stages of smartphone life cycle including the use stage.

Case 8: Fairphone Design

Designing the Fairphone enabled them to influence the supply chain as well as the lifecycle of the product by emphasizing factors like the longevity and the reparability of Fairphone. Fairphone 2 is designed in a way that change the way people relate to it. Their ambition is to empower buyers to have more control and ownership over their phone. With the help of the skills and abilities of engineering partners (Hu-Do), industrial design experts (Seymourpowell) and production (Hi-P), the Fairphone 2 was built around a one-of-a-kind modular architecture that offers users the unique ability to disassemble and repair their phones without any special technical skills. This repair model, combined with carefully selected components, will lead to a longer lasting phone and will provide users more responsibility for keeping their phone functional. This design is all about transparency, ownership and longevity. To increase durability, the Fairphone 2 also features a special back cover with integrated protection that eliminates the need for an additional case. Fairphone's objective is to create and produce their own design that achieves social and environmental goals while developing their relationships with other stakeholders in the supply chain. The aim is to develop a unique phone with original design features that are in line with Fairphone's longevity and reparability ambitions and must be future resilient to accommodate additional Fairphone innovations and industry developments in the years ahead. Moreover, Fairphone is using open source methods to help achieve their goals. This means their operating system (OS) and its technical codes are available for anyone to use, review, modify and improve. Anyone can use the Fairphone hardware as an open platform which gives developers the tools to own and create software for the Fairphone 2. The aim is also to empower alternative operating system organizations that match Fairphone's open standards. This process also helped Fairphone to identify hotspots (the most evident and dramatic environmental changes due to life cycle of a product) for reducing their environmental impact. This will also help shape future decisions regarding shipping methods, component suppliers, materials, recycling and more.

Source: Summarised from Fairphone Roadmap 2015

4.2.4 End of Life Phase

The end of life of the smartphone is an area which is not typically highlighted in product declarations, with their emphasis on recycling and GHG emissions (Suckling and Lee 2015). The loss of components and materials creates an unnecessary burden, which could be reduced with a suitable enticement to collect the old phones at end of life (Suckling and Lee 2015). Based on

environmental needs and through collaborative efforts of the stakeholders, the negative impact of this stage can be mitigated by adopting a cradle to cradle approach where every output is returned harmlessly to the ecosystem as food, or becomes an input for manufacturing another product (Valente 2015). This goal needs an innovative approach and intensive marketing and educational movements to influence the behaviour of consumers regarding the benefits of recycling (Bollinger and Blass 2012). These kinds of programmes require new competencies and innovations that make it convenient for the end-user (Neira et al. 2006). This is possible and evident from Terracycle's case where a college dropout turns worm poop into millions of dollars, Fairphone's innovative design, and Patagonia's initiative which eliminated the option of landfills for its garments (Case 9, 10 and 11).

Case 9: College Dropouts turns Worm Poop into Million Dollars

A Princeton university dropout, Tom Szaky, with his friends started feeding cafeteria leftovers to an army of earthworms. The worms ate the food, and it was discovered that the worms' waste, poop or liquid compost turned out to be an extremely effective garden fertilizer. They started selling it to Wal-Mart and Home Depot in the bottles which they collected from schools and colleges with the help of primary and secondary students. It was 2001 when Szaky founded Terracycle in the hope of starting an eco-capitalist company built on worms' waste. Now, TerraCycle uses a circular approach when repurposing the waste collected through their programs. TerraCycle recycles and upcycles waste instead of incinerating or landfilling it, which is a significantly better solution for waste than traditional methods. They provide "waste" with a new life, producing usable new goods out of stuff that would have simply been thrown away. Textiles they receive are cleaned, separated, and reused in other countries around the world and electronics are refurbished and redistributed. Partnering with various companies, they stitch juice pouches together into backpacks, chip bags into suit jackets, and even granola wrappers into pencil cases; this is what they call upcycling. TerraCycle's team of scientists have developed a range of closed-loop solutions for many types of waste. This includes making innovative products like the world's first pen product from used pens. TerraCycle's R&D team has found recycling solutions for almost every form of waste.

Source: Summarised from Margery (2012).

Case 10: Fairphone Innovative Way to Minimize E-waste

Fairphone is continuously working and finding innovative ways to minimize e-waste. As mentioned in case 8, it is designed to extend lifespan, increase reparability and reduce e-waste. By considering the whole life cycle, from extraction and manufacturing to repair, Fairphone is ensuring that the phone stays in working order for longer to keep it out of the bin as long as it can. Fairphone does not provide a charger because most people already have these accessories, which eliminated the need to produce thousands of unnecessary chargers, effectively saving close to 40,000 kg of CO_2 emissions that would have been generated by the manufacturing process. Fairphone also offered various spare parts like the battery and screens to encourage people to repair their broken phone instead of upgrading to the latest model or sending it in for repairs, which also reduce CO_2 emissions. Fairphone added a dual SIM feature and expandable storage to make the phones more convenient for primary owners as well as for the second-hand market. Users can replace a broken screen in under a minute without any tools and some commonly broken components with just a simple screwdriver. Users can upgrade their Fairphone in the future with new capabilities or better components without upgrading the whole device. Fairphone's goal is to increase the average time people keep a smartphone from two to five years. In addition, Fairphone is expanding its e-waste initiatives in Africa. Fairphone ensures that the right infrastructure and processes are in place to deal with phones that are no longer usable even if they are not their own. According to Fairphone, despite regulations like WEEE regarding electronics disposal in Europe, the fact is that much of the world's e-waste ends up in countries where recycling facilities are non-existent or improper causing disturbing effects on the health of the local communities and the environment. Fairphone partnered with "Closing the Loop" and "Recell Ghana", and collected three tons of waste phones in Ghana and shipped them to Belgium for safe recycling. The result was the retrieval of a variety of metals that could return to the market. Fairphone has expanded the phone collection program with 'Closing the Loop' to additional countries and is currently collecting phones with the help of local representatives in Rwanda, Cameroon and Uganda. Fairphone, with the help of the Recell Ghana, is setting up an e-repair academy at the end of 2016 to add greater value and introduce different skills and tools to the local repair sector which also helped in addressing e-waste effectively in Africa.

Source: Summarised from Bleekemolen (2016)

Case 11: Patagonia Eliminated the Option of Landfill

Patagonia, an apparel company, conducts its business upside down and inside-out. Everything about it flies in the face of consultants' recommendations. Simply put, it's radical. Patagonia's mission is to build the best product, cause no unnecessary harm to the environment, and use business to inspire and implement solutions to the environmental crisis. Patagonia introduced an amazing program based completely on environmental needs with a philosophy that they have to lead an examined life, they have to clean up their own act, do their penance, support civil democracy and influence other companies. Patagonia came up with the goal of inspiring competitors by sharing its technology and innovation which averted the public good dilemma. Patagonia picked up the tab for competitors and the entire industry internalized benefits while Patagonia remained competitive by constantly innovating. Interestingly, Patagonia increased their market share and helped in mitigating environmental impact. They launched a product life cycle initiative program to reduce use, repair their products for free, and encourage reuse, whereas they introduced a cradle to cradle approach for recycling as a last resort, hence they eliminated their reliance on landfills. They made their products extremely durable, and therefore they encouraged their customers to limit their consumption. They asked customers to repair their products and provide them with tools and instructions. To fully support the reuse initiative, Patagonia established online and physical swap markets, and donation platforms. Finally when they product is of no use and all the options were exhausted, a program was set for customers to return it to Patagonia for recycling. Interestingly, they paid for the postage. Their marketing strategy was based on environmental needs. By 2011, 90% of their products were recycled.

Source: Summarized from Reinhardt et al (2010)

The iPhone, throughout its life cycle, contributes towards resource shortages, environmental pollution, and damage to the environment globally. Therefore, Apple must start its change by adopting a circular economy business model for their new iPhones, with an engagement from stakeholders to eliminate e-waste from places like Ghana and China. Most importantly, Apple should be committed to eliminating waste at its design stage. Through technological advancement and network evolution, they must design products to increase their reliability and maintainability, aiming to lengthen the iPhone's lifespan and also to maximize the value of the iPhone at the use stage. Apple must also provide site reuse solutions to alleviate customers' investment pressure and reduce resource waste and pollution arising from scrapyards in Ghana

and China. Apple must manage its logistics in a way that provides a platform possessing multiple reverse logistics capabilities, including collection, storage, distribution, dismantling, testing, repair, and waste disposal, covering all reverse logistics activities in China, Peru, Ghana, Indonesia, and around the world.

Apple must confine their tier 1, 2 and 3 suppliers to follow a circular economy approach and with their collaboration, it must assess all returned materials, categorize each one by lifecycle stage and quality status, and allocate them to recycling channels for spare parts and manufacturing. Then, materials that cannot be reused must be distributed to the raw materials recycling channel for dismantling and recycling to turn them into useful resources that can be sold to other manufacturers. In collaboration with stakeholders, stringent regulations must be enacted to reduce e-waste's environmental impact. Through these measures, Apple can maximize the value of their materials. Moreover, Apple must built reverse logistics warehouses and centres and must work with local suppliers and specialised e-waste companies to reduce the impact on the environment. Apple must also initiate a smart exchange recycling program like Fairphone to reduce e-waste and encourage environmentally responsible consumer behavior.

Apple must launch a program for the iPhone users which provides not only discounts to consumers looking for a new smartphone, but it should also encourage environmentally responsible consumer behavior with an added social benefit of providing jobs or revenues to those in need in countries like Ghana and China. This will also influence minimum wage issues in countries like Ghana, China and Indonesia where Apple's suppliers are operating. Apple must launch an exchange take-back program which must inform and encourage consumers to trade in old smartphones for recycling or dismantling in exchange for a discounted new smartphone, which reduces e-waste and contributes to a circular economy in the process. Apple must provide iPhone users an online platform to calculate the value of an old smartphone based on its condition, and allow them select a new smartphone to purchase.

Moreover, iPhone users must be then provided with pre-posted packages to mail in their used phones. Lastly, Apple must jointly with other smartphone manufacturers establish global scrap disposal platforms with waste service providers, providing one-stop services to dismantle and recycle telecom equipment that cannot be reused. This strategy would enable e-waste to be handled in an environmentally friendly manner with resources recycled and reused in accordance with regulations and electronic industry standards, thus minimizing the landfill rate. Redefining

the entire supple chain as discussed above will also lead to forming industry clusters extremely essential to mitigate the overall environmental impact, resulting in changing the system.

4.3 Supportive Industry Clusters

Once the entire supply chain is redefined, there would automatically be a development of supportive industry cluster (Porter and Kramer 2011). No company is self-contained. The success of every company is affected by the supporting companies and infrastructure around it (Porter and Kramer 2011, Valente 2015). Productivity and innovation are strongly influenced by clusters, or geographic concentrations of firms, related businesses, suppliers, service providers, and logistical infrastructure in a particular field (Porter and Cramer 2011). Networks of organizations whose competences supplement one another to fill gaps and deficiencies in the new and revised value chain are must (Porter and Kramer 2015). Therefore, the iPhone must build infrastructure and support companies around itself. Tesla took the initiative by declaring to make its patents available to anyone who wishes to see them for zero license fee (Forbes 2014). Tesla Motors was created to accelerate the initiation of sustainable transport; therefore, according to the Tesla's CEO, Musk (2014), its goal will not be achieved, if we clear a path to the creation of compelling electric vehicles, but then lay intellectual property landmines behind us to inhibit others. Kalundborg Eco-Industrial Park and Nexterra's cases are the best examples of supportive industry clusters (cases 12 and 13).

Case 12: Kalundborg Eco-Industrial Park

Kalundborg Eco-Industrial Park in Denmark is an industrial park in which businesses cooperate with each other and with the local community in an attempt to reduce waste and pollution, to share resources, and to help achieve sustainable development, with the intention of increasing economic gains and improving environmental quality. Companies collaborate to use each other's by-products for example surplus heat from power plant heats 3500 homes and fish farm sludge is sold as a fertilizer whereas steam is sold to enzyme manufacturer and fly ash and clinker is used for road building and cement production. The industrial symbiosis evolved gradually and as environmental regulations became stricter, firms were motivated to reduce the cost of compliance, and turn their by-products into economic products.

Source: Summarised from International Institute of Sustainable Development (2013) and Valente (2015)

Case 13: Nexterra and Dockside Green

Nexterra Systems is a global leader in the development and supply of community scale gasification systems that convert non-recyclable organic waste into clean, renewable heat and power. Nexterra has accomplished eight commercial projects in Canada and the US, and has three projects under construction in the United Kingdom. Dockside Green is a 15-acre urban development committed to creating a nice, culturally vital neighbourhood where the mix of people and environment fuels health and a lively local economy. Nexterra announced a biomass gasification system at Dockside Green which is operational and providing heat and hot water to residents of the award-winning $600 million Dockside Green area in Victoria, British Columbia. The Dockside Green development incorporates the newest in environmentally friendly materials and innovative sustainable design, and is anchored by a state-of-the-art renewable energy district heating system. Housed in a building designed to fit into the urban neighborhood, Nexterra's exclusive gasification system enables the Dockside community to self-generate clean, low-cost heat and hot water using locally sourced wood fuel. At peak capacity, the system provides heat and hot water to an estimated 2,500 Dockside residents, enabling the development to be carbon neutral from an energy perspective, and reducing greenhouse gas emissions by approximately 3,460 tonnes per year. This is a significant demonstration of the role that biomass gasification can play in providing clean energy within urban environments. Nextarra fully believes that this proven technology will be adopted as the new standard for biomass energy systems in communities across North America.

Source: Summarised from Nexterra News Release (2009)

Based on the "meta strategy" developed in this paper to mitigate the environmental impact of the smartphone, the scenario presented (in Table 4.4, 4.5, 4.6, 4.7) above regarding the iPhone's supply chain related to specific metals, chemicals and CO_2 emissions would give rise to certain mandatory actions (summarised in Table 4.13). These actions, which are the result of effective stakeholder engagement, regulations and industry clusters, if followed properly, can then be termed as genuine environmentally friendly practices and not the typical corporate social responsibility activities. These mandatory actions will become a threshold for performance and can eventually lead to achieving the overall goal of mitigating the global environmental risks of smartphones.

Overview of Chapter 4

Figure 1 Meta Strategy

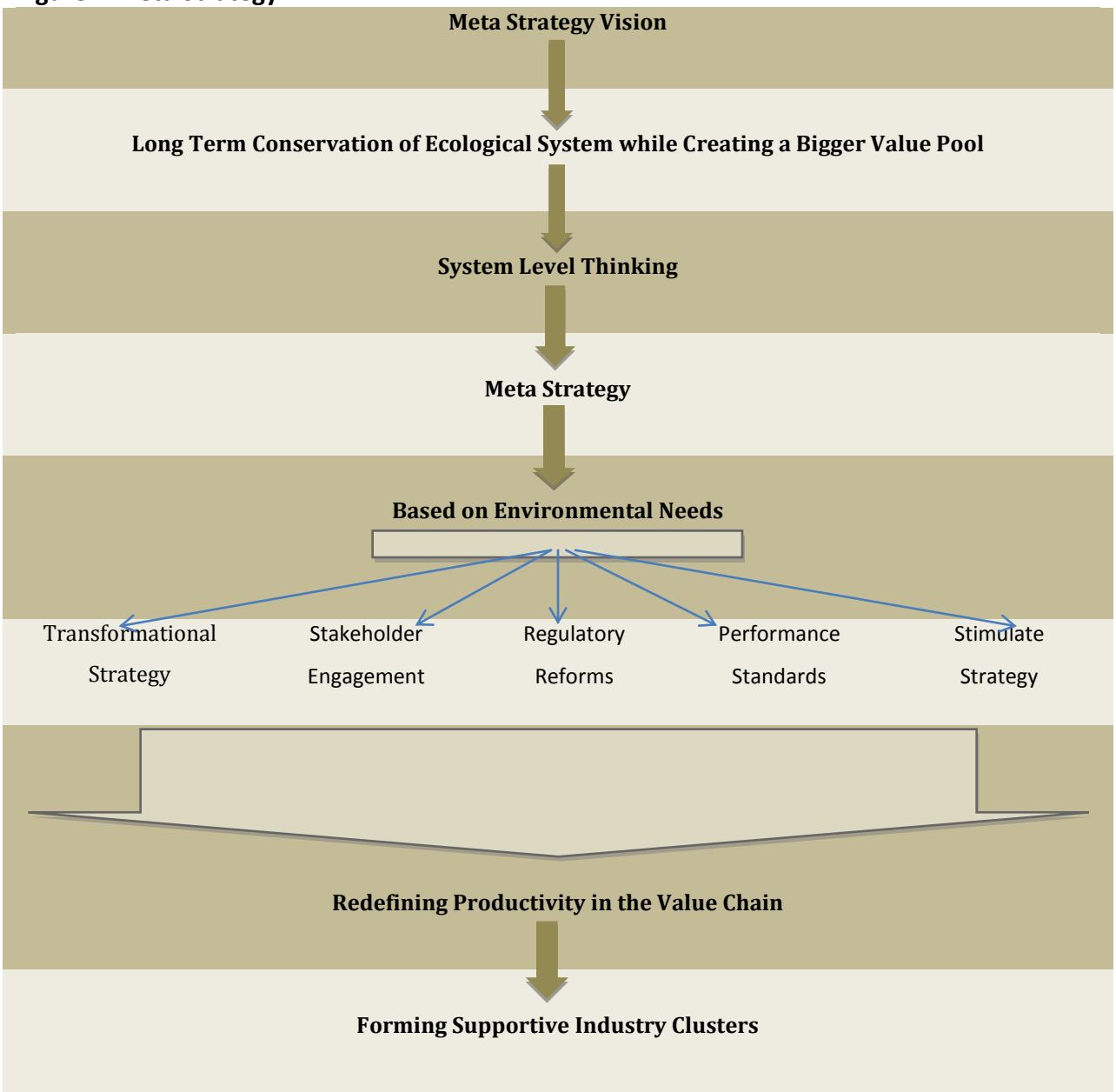
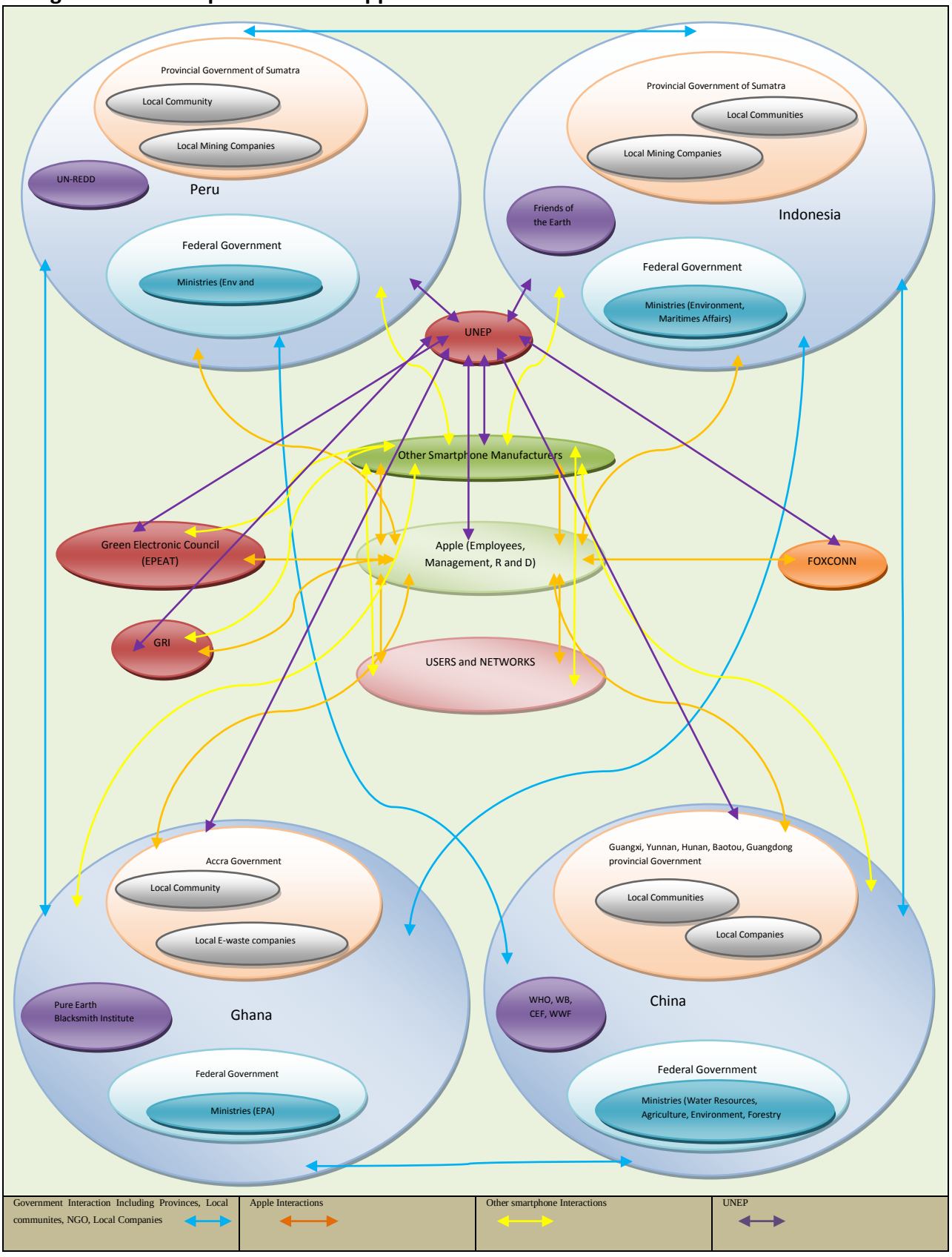


Table 4.13: Mandatory Actions, Threshold Performance and the Global Environmental Risks Mitigation

Mandatory Actions
Inclusion of the cost of environmental damage due to extraction and manufacturing, packaging and distribution, use and end of life stage in the iPhone price.
Educate people about the negative environmental impact of the smartphone.
Mandatory disclosure and keeping record of every single worker and tier 1, 2 and 3 suppliers.
Mandatory environmental impact assessment and making it public. Making sure to include every aspect of environmental degradation, at each stage of IPhone's life cycle, in packaging and instruction guide for users.
EPEAT certification for each stage.
GRI report for each stage with full mandatory disclosures.
Regulatory reforms with input from all stakeholders and according to international laws and protocols for each stage.
Collaborative and continues monitoring of environmental issues.
Threshold Performance
IPhone and its suppliers' operations emit no potentially harmful substances.
IPhone emit no potentially harmful substances when used as intended.
IPhone, all products related to it and packaging, should be designed to be repurposed at end of life.
Customers have access to end-of-life repurposing services for iPhone and all of its accessories and packaging.
IPhone and its tier 1, 2, 3 and other suppliers' operations emit no CO_2 emissions.
IPhone and its related products emit no CO_2 when used as intended.
All energy is from renewable sources.
All water is used in an environmentally responsible and socially equitable way.
All materials are from responsibly-managed sources.
Physical presence of Apple and its suppliers have net zero impact on local ecosystems.
Customers are informed about any aspect of iPhone and its products that may harm people or the environment.
Universal performance standards and regulations, and transparent reporting by third party.
Apple's political role through stimulate strategy to address inefficiencies in public sector to find solutions.
Global Risks Mitigation
Ecosystem degradation
Climate destabilization and Ocean acidification
Energy crisis
Access to mined materials and Access to renewable materials
Biodiversity crisis
Infrastructure Crisis

Image 22 Interdependencies of Apple



CHAPTER 5: Business Benefits and Bigger Value Pool

"The 'environment' is where we live; and development is what we all do in attempting to improve our lot within that abode, and the two are inseparable" (Martino et al 2007: 1). But in recent years, businesses have been criticized for social, environmental and economic problems and they have been seen as prospering at the expense of broader communities (Willard 2009, 2012, 2014). Global inequality is growing, with half the world's wealth now in the hands of just 1% of the population (Oxfam Briefing Paper 2014). There is a growing gap between efforts to reduce the impact of business and industry on nature and the worsening state of the planet (UNEP 2002). I think this misfortune is because the corporate sector thinks there are more incentives to destroy the ecological system than there are to preserve it. The more businesses have tried to embrace corporate (social and environmental) responsibility, the more they have been criticized because companies are trapped in an outdated approach of trying to accomplish environmental and economic goals simultaneously (Porter and Kramer 2011).

One of the reasons business and society has been opposed for too long is because economists have legitimized the idea that to provide environmental benefits, companies must sacrifice their economic success (Davidson 2000, Porter and Kramer 2011, Carroll and Buchholtz 2014). In neoclassical thinking, environmental improvement imposes a constraint on the corporation and raises costs and reduces profits, and interestingly many of these economists are aware of the negative impacts of economic activities but they seek to minimize them only if (and after) profit margins are increased (Nadeau 2015). A related concept, with the same conclusion, is the notion of environmental externalities which arise when firms create environmental costs that they do not have to bear, such as pollution (Porter and Kramer 2011, Nadeau 2015). These perspectives have also shaped the strategies of companies themselves, which have largely excluded environmental considerations from their economic thinking and are unaware of the science-based system – the understanding that earth is a system and when left to its own devices, it achieves sustainability automatically; therefore we need to understand these conditions and ways to sustain it (Natural Step 2015). Unless science-based system conditions are honored by all the actors in a sustainable human society that is nested in a sustainable environment, environmental degradation will continue (Willard (2014).

For Victor E. Frankl, an Australian neurologist, there is a space between stimulus and response and in that space is our power to choose our response. Clearly, economic gain is the stimulus and companies' responses are the accumulation of brainy strategies to achieve those gains at any cost, including environmental degradation. Yet, we are still left with some space to think and respond in an innovative way to have sustainable growth and a pollution-free environment. This can happen by employing environmentally friendly business practices, where companies could reap business benefits, gain competitive advantage and create and an overall bigger value pool (Overeem 2009, Atkin et al. 2012, Porter and Kramer 2011, Berzengi and Linbom 2008). We should move beyond the trade-offs and unleash a wave of innovation and growth through collaboration (Van den Bergh 2013, Porter and Kramer 2011). But in order to achieve this goal, 'the purpose of a corporation must be redefined'.

5.1 Redefining the Purpose of the Corporation

In order to redefine the purpose of the corporation, the primordial question is to ask if the product is good for environment or not. Thus, the answer is that environmental needs, not conventional economic needs, should define markets. This is the starting point of the "meta strategy". Society's needs are numerous and one of those is environmental protection. Moreover, the opportunities are not static but change constantly as technology evolves, economies develop, and societal priorities shift – and continuous innovation is therefore inevitable (Porter and Kramer 2011). An ongoing exploration of environmental needs would lead companies to discover new opportunities for differentiation and repositioning in traditional markets, and to recognize the potential of new markets they previously overlooked (Poldner 2010). With an increasing demand for organizations to be environmentally responsible, the scope of environmental management meaning – the entire product life cycle, including eco-design, extraction and manufacturing, packaging and distribution, use of product and end of life, become the focus on minimizing the expenses associated with each stage of the product (Wong et al. 2016). Keeping this scope in mind, if the "meta strategy" is employed, it will not only result in economic benefits for the smartphone manufacturers but it will also increase the entire value pool. That is where system level thinking comes in. The starting point for creating a bigger value pool is to identify all the environmental needs, benefits, and harms that are or could be embodied in smartphones, as explained in chapter 3.

5.2 Value Pool

In order to understand the value pool, I will refer to the "Tripartite model" of Farouk Jiwa (MES graduate 2003), who turned rural Africans into honey-making entrepreneurs (YorkU Magazine 2008, Branzie and Valente 2009).

Case 14: Honey Making Entrepreneurs: A Tripartite Model for Sustainable Beekeeping

First of all, we need to know what Farouk Jiwa challenged, which was the traditional system of expanding the profit pool for firms only. He introduced a new system that creates a bigger value pool for beekeeping business in Kenya in which every involved actor prospers. Firstly his Honey Care strategy expanded the value pool for the farmer by understanding and then addressing problems they were facing. Due to farmers' engagement, problems like financing, low technology, market access, and government extension service were highlighted. Farmers' problems were solved by reducing their costs with a collaborative effort from government, financial institutions and NGOs. The following actions resulted in increasing farmers' value pool because their costs decreased:

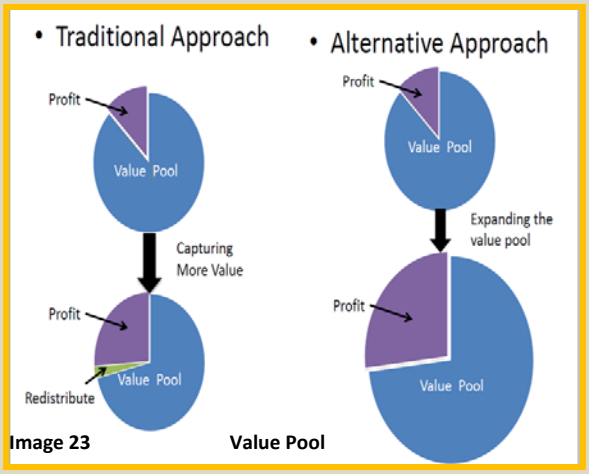


Image 23 Value Pool

- Financing the hives
- Ownership of super Hive Boxes (High Tech)
- Challenge of reaching rural areas solved with camps set by Honey Care and NGOs.
- Training and collection resources provided by NGOs and Honey Care
- Purchased honey at guaranteed prices and Paid farmers on time
- Honey care and NGO partnership created trust among farmers
- Elimination of Government corrupt system of dealing with farmers

Secondly, Honey Care expanded the value pool for government by addressing their need for long-term self-sufficiency of projects. Due to stakeholders' engagement, problems of implementation of agricultural projects; sourcing the right technology and access to training and issues with information dissemination and awareness creation were identified. But the biggest challenge was with ensuring some level of continuity and long-term sustainability after NGOs' projects completion. Honey Care designed a strategy of providing a full package to farmers, NGOs and government. The following actions resulted in increasing the government value pool because their deficiencies were covered:

- NGOs vehicles and offices were used
- Government employees were given tasks to monitor the projects with NGOs employees
- Government offices were used by NGOs
- Training were provided by NGOs

Thirdly, Honey Care increased their own value pool because as the result of the collaborations, reduced costs, they charged a good price with good profit margins:

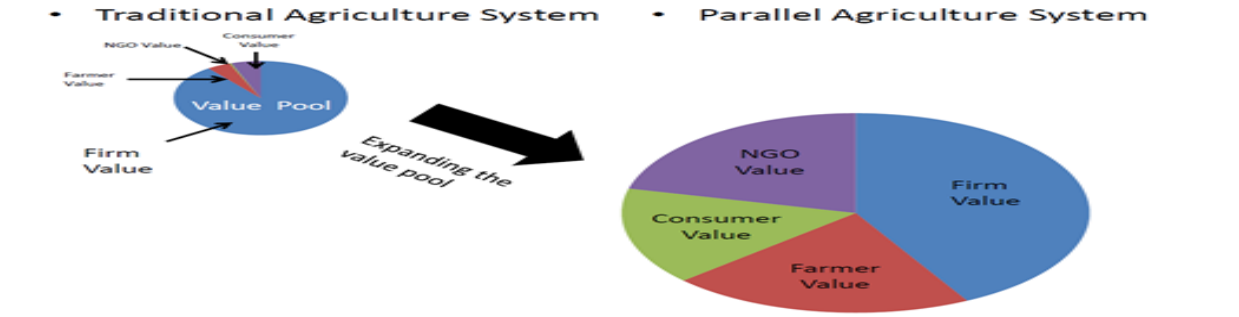
- Beehives were owned by farmers
- Efficient production of honey
- Training and technical support
- Managed collection and distribution
- Manufacturing scale increased
- Farmer loyalty increased and they helped other farmer in manufacturing
- Relationships with NGOs developed and they provide social capital with farmers
- Operational resources and expertise increased

Lastly, they created value for retailers and consumers who were willing to pay the price because of the following reasons:

- High quality Kenyan honey was introduced which has no competition
- Marketing pull strategy of selling the story made a difference
- Relationships with supermarkets became strong
- Packaged it in environmentally friendly local recycled marketable containers

Thus by increasing every actor's value, Honey Care changed the system that benefited everyone.

Image 24 **Honey Care Africa**



Source: Summarised from Branzie and Valente (2009)

It is evident from the Honey Care case that through a transformational strategy, companies can gain competitive advantage and create economic value, mitigate environmental impact by exploring environmental needs, redefine productivity in the value chain, and build supportive industry clusters at the company's locations, keeping in mind that each of these is part of the virtuous circle of shared value because improving value in one area gives rise to opportunities in the others (Valente 2015). Better connecting companies' success with environmental

improvement opens up many ways to serve new needs, gain efficiency, create differentiation, and expand markets (Bockstette and Stamp 2011). The Tripartite model of Honey Care was so successful that it expanded to other African countries and some new products were introduced.

5.3 Examples of Companies Benefiting from Environmental Friendly Strategies

There are hundreds of companies which have re-examined their strategies from a perspective of mitigating environmental impacts and creating a bigger value pool while enjoying business benefits. For instance, a Dow Chemical water recycling initiative in Brazil saved the company millions of dollars after it invested 600,000 in providing quality water for community and agriculture (Dow Sustainability Report 2014). Dow Chemical also managed to reduce consumption of fresh water at its production site in Michigan by one billion gallons, which is enough water to supply nearly 40,000 people in the United States for a year, resulting in savings of $4 million (Dow Sustainability Report 2014). Also, India's Jain Irrigation, a leading global manufacturer of complete drip irrigation systems for water conservation, has used water-saving technology to achieve a 41% annual growth rate in revenue over the past five years (Porter and Kramer 2011).

Cisco Systems, a leader in creating partnerships for clean delivery of their products, realizes that they cannot do this alone (CEA 2008). Therefore, "Cisco worked with a packaging supplier and its customers to design a multi-pack (packaging several products together) that is 77% lighter and takes up 84% less space than the original, in addition to using more environmentally benign materials. The result was improvement in customer convenience, mitigation in environmental impact, and saving money which each partner could not have done alone" (CEA 2008; 23). General Electric (GE), a United States-based multinational conglomerate, initiated the "Ecomagination" project which shows GE's commitment to imagine and build innovative solutions to today's environmental challenges by investing more in research and development and adhering to third party standards while driving economic growth by lowering costs, improve value proposition and competitive position (Randby and Chia 2011). As a part of their strategy, GE is investing in cleaner technology and business innovation, developing solutions to enable economic growth while avoiding emissions and reducing water consumption (Randby and Chia 2011). Moreover, they are developing strategic partnerships to solve some of the toughest environmental challenges at scale to create a "cleaner, faster, smarter tomorrow". Due to their

strategy, sales of GE's Ecomagination products reached $18 billion in 2009, equivalent to the size of a Fortune 150 company (Randby and Chia 2011).

5.4 Companies Creating a Bigger Value Pool

To present a broad-spectrum, I will discuss Patagonia's model of mitigating environmental impact (Case 15) creating value and remaining competitive while achieving both goals of mitigating environmental impact and achieving business benefits simultaneously. Patagonia's heightened environmental awareness and advances in technology are catalyzing new approaches at each stage of their product's life cycle. These strategies reveal that the connection between environmental progress and productivity in the value chain is far greater than what was conventionally believed.

Case 15: Patagonia: An Upside Down and Inside-out Business

Patagonia was known as the worldwide leader of environmentally responsible business; therefore, Forbes Magazine named it the "the do-no-evil' company. Patagonia donates certain portion of its revenue to environmental causes, provide donations to environmental groups and invest big chunk of revenue in research and development to mitigate its products' environmental impact. Patagonia's cost increased due to purchase of environmental friendly raw materials, investment in RandD for innovation and careful auditing of suppliers. But they offset it with low advertising and low defect rates due to durability of their product. They increased the prices which were higher than competition and were based on quality, innovative designs and material, authentic environmental commitment, and guarantee on products. Due to their new product life cycle and innovation, they reduced the environmental damage and decreased their own demand, but selling less per person was offset by increase in the market share. They successfully embedded sustainability which resulted in $55 million in additional revenue. They invested $17 million to achieve that revenue. Most importantly they inspired competitors by sharing technology while remaining competitive by constantly innovating. Last but not the least, through its innovative approach; Patagonia incurs the costs for competitors thereby overcame the commons problem of public good dilemma. At the moment, Patagonia started on product collection and 90% of it is recycled. Moreover, Patagonia also assisted Wal-Mart mainly on the clothing side, helping Wal-Mart buyers figure out things like how much water is consumed in the manufacture of garments and whether pesticides are used. The Patagonians helped Wal-Mart come up with questions regarding things like climate, energy and efficiency that the company will use to evaluate its suppliers (Burke 2010).

Source: Summarised from Reinhardt et al (2010), Burke 2010, and Valente (2015)

5.5 Redefining productivity in Value Chain and Business Benefits

Effective supply chain management is not only crucial to environmental stewardship but it also reduces costs (Ninlawan et al. 2010, Porter and Kramer 2011, Hsu and Hu 2008, Chien and Shih 2007). Teamwork by stakeholders and companies throughout the supply chain results in efficient shipping, meeting the standards for clean, non-hazardous materials in their components or subassemblies and at the same time it lowers the costs of all the suppliers, including the parent company (Porter and Kramer 2011). The complexity of a sophisticated supply chain is made simpler when the overall goal is saving time, energy and materials (Porter and Kramer 2011). Simply planning the routes efficiently makes a big difference and there is evidence from companies that reduced their fuel use by 90% by restructuring assembly processes to eliminate trans-Pacific flights (Porter and Kramer 2011). In the light of the above discussion, Apple must go even further by working with their suppliers, competitors and customers to choose environmentally efficient means at each phase of the iPhone's life cycle. As explained in Chapter 3, the iPhone, throughout its life cycle, has a negative impact on environment. I, therefore begin with the extraction and manufacturing phase in outlining solutions.

5.5.1 Extraction and Manufacturing

No doubt Apple's iPhone extraction and manufacturing phase inevitably affects and is affected by environmental issues and can create economic costs in the firm's value chain. Interestingly, many so-called externalities actually inflict internal costs on the firm and the environment, even in the absence of regulation or resource taxes (Porter and Kramer 2011). This means that regulation is not the culprit for increases in the costs of firms as some suggest. This is a clear indication that Apple must work with all its stakeholders; including, governments in China, Indonesia, Ghana and Peru to reform regulations because it will help all the companies to pursue shared value and avoid trade-offs between economic and environmental goals.

Through collaborative efforts based on environmental needs, Apple should explore ways to reconfigure iPhone's value chain to reduce ecological issues that increase costs at the extraction and manufacturing phase. Apple must understand that marginalized suppliers in China, Indonesia and Peru cannot remain productive, and remain environmentally sustainable and much less able to improve their quality by themselves. Sharing technology and providing financing to Apple's tier 1, 2 and 3 suppliers, it can improve supplier quality and productivity and also bound them to

act according to the standards set by all stakeholders which are exactly what Porter and Kramer (2011) mentioned for other companies. Therefore, improving productivity of iPhone's tier 1, 2 and tier 3 suppliers will trump lower prices, increase iPhone's profits, gain competitive advantage and will help in monitoring their activities. As suppliers get stronger, their environmental impact often falls dramatically that further improves their efficiency and create a bigger value pool (Bockstette and Mike 2015, Valente 2015). A good example of such thinking can be found in the case of Nespresso, one of Nestlé's fastest growing divisions.

Case 16: Nespresso's Growth

Most coffees are grown by small farmers in impoverished rural areas of Africa and Latin America who are trapped in a cycle of low productivity, poor quality, and environmental degradation that limits production volume. To address these issues, Nestlé redesigned its strategy for its extraction and manufacturing stages. It worked intensively with its growers, providing advice on farming practices, assuring bank loans, and helping secure inputs such as plant stock, pesticides, and fertilizers. Nestle established local facilities to measure the quality of the coffee at the point of purchase, which allowed it to pay a premium for better beans directly to the growers and thus improve their incentives. Greater yield per hectare and higher production quality increased growers' incomes, and the environmental impact of farms shrank. Meanwhile, Nestlé's supply of coffee grew significantly while they monitored their suppliers with the help of stakeholders. Embedded in the Nestlé example is a far broader insight, which is the advantage of buying from capable environmental friendly local suppliers. Nestle realised that outsourcing to other locations and countries creates transaction costs and inefficiencies that can offset lower wage and input costs. Identifying capable local suppliers with the help of stakeholders, helped them to avoid these costs and reduced cycle time, increased flexibility, fostered faster learning, identified inefficiencies and enabled innovation. Buying local includes local companies plus local units of national or international companies. With local buying, their suppliers got stronger, increased their profits, hired more people, and paid better wages; all of which benefited other businesses in the community as well. They shared wet-milling facilities and supported an extension program to advise all farmers on growing techniques. It also worked in partnership with the Rainforest Alliance, a leading international NGO, to teach farmers more-sustainable practices that make production volumes more reliable. The International finance corporation (IFC) measured the impact of this project between 2007 and 2010, confirming that net income for farms was 27% higher than for farms not part of the Nespresso's sustainable quality program. Due to their strategy, Nespresso has expanded the market for premium coffee which has enjoyed annual growth of 30% since 2000**.**

Source: Summarized from Nespresso Sustainability MBA Challenge (2015)

5.5.2 Packaging and Distribution

The iPhone's logistical systems should be redesigned to reduce shipping distances, streamline handling, improve vehicle routing, and the like. All of these steps will reduce Apple's cost and would create a bigger value pool, as happened in the case of TCM (Case 2). Apple should overhaul its supply chain involving steps as simple as stopping the purchase of paper and fiber from one part of the earth to ship to another, hence reducing carbon emissions. Apple's re-examining logistics and eliminating costly transportation would also revise their locations in the same way as the British retailer Marks & Spencer did. Marks & Spenser's ambitious overhaul of supply chain resulted in stopping the purchase of supplies from one hemisphere to ship to another, which saved them £175 million by fiscal year 2016, while hugely reducing carbon emissions (Marks & Spenser Commitments Report 2015).

On the other hand, packaging is highly associated with deforestation. The only way Apple can help the Indonesian government to save their forests is to invest and play a political role (Stimulate strategy) which will inspire other big players as well. The inspiration will result in joint efforts which will share the cost of saving Indonesian forests. For instance, Epson, a leading manufacturer of printers, makes its packaging out of trees specifically grown for that purpose, and plants 20% more trees than are consumed with the help of NGOs (CEA 2008). Moreover, packaging very much depends on the manufacturing stage as well. When the product's package is designed to be as small and light as possible, materials are further reduced and shipping and shelf-space is optimized even more (CEA 2008).

Apple must introduce smaller accessories and main products which will require fewer raw materials to extract, less energy to transport the raw materials and fabricated components. Smaller accessories will also require smaller floor space in manufacturing, fewer trucks and ships for transporting finished products, less energy during product use and reuse, and less to recycle at end of life. All of these efforts would reduce Apple's cost, hence resulting in more profits. Apple must eliminate paper product manuals and distribute it electronically. All of these steps will save resources and money and result in less carbon emission. Wal-Mart, for example, was able to mitigate environmental impact of its product while reaping business benefits by reducing its packaging and rerouting its trucks as shown in case 17.

Case 17: Walmart Reaping Business Benefits with Environmental Friendly Practices

Wal-Mart was persuaded in 2004 by an outside consultant to begin thinking of sustainability not as a cost and a risk, but as a business opportunity. Back then; this was radical crazy talk. Yet that was the pitch that the clean, green, less wasteful way of doing business could be the most profitable. They designed a strategy and Wal-Mart shaved a few inches off the cardboard packaging of a toy truck it sold for millions. Over the course of one year, this saved 4,000 trees, eliminated the need for 497 shipping-container loads, and saved a million gallons of oil in getting the products from China to Wal-Mart shelves. That led to $2.4 million in savings for the retailer. Wal-Mart would have to sell $60 million in toys to earn that same amount in profits. The idea of a more sustainable Wal-Mart went viral. Wal-Mart managers and divisions began competing with one another on green initiatives; a perfect example of embedding sustainability. Since 2005, Wal-Mart has lowered the carbon footprint of its stores by more than 10 percent and it's trucking fleet by several times as much. The idea that lowering carbon emissions amounts to lowering costs has become norm at the company, which is why Wal-Mart executives have repeatedly testified before Congress in favor of climate legislation. Most importantly, the retailer is showing its suppliers in China and the U.S. how to lower their carbon emissions and energy bills by 20 to 60 percent; a perfect example of influence and monitoring. The effort has cut emissions and energy use at 119 Chinese factories so far, with help from the Environmental Defense Fund; a perfect example of collaborative effort.

Packaging reduction has saved hundreds of millions in shipping and materials costs as well as lowered the carbon and resources footprint of products. The most familiar example of this effort was the industry-wide shrinking of laundry detergent bottles which arose from a Wal-Mart demand to manufacturers, which, in three years, saved 400 million gallons of water, 95 million pounds of plastic, 125 million pounds of cardboard, and a half million gallons of diesel fuel due to reduced shipping weight and bulk; a perfect example of influencing actors. An initiative to shrink all product packages on the retailer's shelves by 5 percent and make what's left more recyclable saved the company an estimated $3.4 billion in annual packaging and transportation costs. Moreover, with the help of stakeholders, Wal-Mart identified undisclosed suppliers in their supply chain which removed the potential impact of illegal and unethical environmental practices and they were able to effectively monitor undisclosed subcontracting and enhanced standards for Suppliers, audit reporting and training processes. Wal-Mart cut 100 million miles from its delivery routes in 2009, saving $200 million even as it shipped more products.

Source: Summarised from Humes (2012), Schneider (2010), Porter and Kramer (2011)

5.5.3 Use Phase

The use phase is also closely connected to the manufacturing stage and depends on the product design (CEA 2015). Apple must design the iPhone to be more energy-efficient, use less electricity from outlets and run longer before needing recharging or new batteries. It is revealed after investigating 20 electronics companies that energy efficiency reduces greenhouse gas emissions and hazardous waste and saves money (CEA 2008). As with the cost reduction mentioned in the last section, energy efficiency should be a goal of Apple whether for physical design, cost, or competitive considerations. Continuous improvement is seen in the iPhone regarding energy use without sacrificing their product performance, features or functionality for the consumer (Apple Environmental Reports 2013-2015). But the iPhone must improve its battery life and alternatives to batteries, which could serve as a differentiation point and could also, bring the additional environmental benefit of producing, using and properly disposing of fewer batteries while saving them more money. As far as indirect energy use is concerned, the iPhone must share its technology of 100% renewable energy with other smartphone manufacturers, design a strategy to run collaborative radio access network (RAN) sites and partner with companies like Nexterra (Case 13) which could reduce their costs. Apple can benefit from Nexterra's state-of-the-art technology which has shown a significant demonstration of the role that biomass gasification can play in providing clean and low cost energy (see case 13).

Moreover, the iPhone must create lifecycle analysis tools that measure the energy consumption of every aspect of the product's life and are known to all consumers. Using this tool, iPhone could select the raw materials, components, manufacturing processes, delivery methods, energy draw during use, and reuse-recycling strategies that minimize energy consumption. But all of these energy-saving factors have to be decided before the product's design is completed (CEA 2015). IPhone must follow Nokia's footsteps in reducing energy use of its product. Nokia, over the last nine years, reduced the amount of no-load energy in its chargers by 90% (CEA 2008). Electricity that is consumed by mobile phone chargers that are left plugged in after the phone is charged is called "no-load" energy (CEA 2008).

Nokia's newest chargers go even farther, using up to 94% less energy than the "Energy Star" requirements in the United States, and also meeting the highest European Union standards

(Nokia Sustainability Report 2008). As said earlier, in May 2007, Nokia became the first mobile manufacturer to put alerts into phones, encouraging people to unplug their chargers (Nokia Sustainability Report 2007). The energy that could be saved globally if all Nokia phone users unplugged their chargers when not in use would power 100,000 average-size European homes (CEA 2008). Just imagine how effective it could be if the 6.1 billion chargers, that are likely to be in the market by 2020, would use Nokia's technology. Panasonic and Best Buy have also reduced their costs with their innovations as explained in case 19.

Case 18: Panasonic and Best Buy Reducing Costs

Panasonic has reduced the standby power consumption in its plasma televisions by 96% since 2000, contributing to customer energy savings of around 3.6 billion kilowatt-hours of electricity that is enough to power more than 300,000 households for a year (CEA 2008). In 2007, Best Buy sold seven million units of 'Energy Star' products. According to EPA calculations, consumers saved $100 million on their utility bills with these products, and the atmosphere avoided 1.4 billion pounds of carbon emissions which is the equivalent of removing 128,000 cars from the road (CEA 2008). In 2012, Best Buy reduced their annual emissions by 26% which is an annual reduction of 250,000 metric tons of CO2 and equivalent to taking 52,000 cars off of the road for one year. The bulk of this energy savings came from their Energy Management System, lighting retrofits in their stores and transportation. Best Buy transitioned the stores from high-wattage, high-bay metal halide fixtures to more efficient, lower-wattage fluorescent fixtures and reduced lighting energy usage by nearly half, which is the equivalent of removing more than 12,000 households from the grid. It saved the company money on their monthly utility bills, plus they were able to take advantage of one-time rebates from their utility partners. Best Buy also started using smaller vehicles as often as possible, and mapping out the most efficient routes to destinations to reduce fleet carbon emissions by 10 percent in calendar year 2014. They downsized from a 24-foot truck to a 12-foot. In the fiscal year 2015, Best Buy deployed a telematics technology to enhance the efficiency which allows the tracking of key vehicle performance metrics, which can be used to potentially route, monitor, locate and service vehicles within their fleet. Due to this program Best Buy is reducing "empty miles," (miles driven with no products in the truck), by backhauling e-waste to the distribution centers, where it is collected by their recycling partners or Best Buy themselves. Moreover, the purchase of Renewable Energy Credits (RECs) helps them to offset the impact of their emissions. In calendar year 2014, Best Buy offset approximately nine percent of their U.S. electricity through RECs. All of their efforts saved the company millions of dollars while mitigating environmental impact.

Source: Summarised from CEA 2008, Best Buy Corporate Responsibility and Sustainability Report (2013, 2014, 2015)

5.5.4 End of life

Apple must follow TerraCycle's footsteps by redefining a waste stream as a resource stream. This means "TerraCycle was moving beyond environmentally friendly capitalism where waste was no longer something to write off; instead it was an asset" (Margery 2012; 157). Therefore, I emphasize innovation and eco-design which means starting off right. Starting off right means creating products from environmentally friendly materials, using efficient designs that require fewer materials and energy, and maximizing reusability, reparability and recyclability (Li and Stevels 2015). IPhone's end of life phase is the area of great concern. Apple must divert 100% of its material from landfills.

Apple's Research and Development team, in collaboration with stakeholders and other smartphone manufacturers, must find creative uses such as recycling the materials or selling them to partners who used them as feedstock in their own businesses. Landfills will be free of nearly 50 million metric tons of waste in 2017 (UNEP Report 2014) if all the smartphone manufacturers eliminate sending their products and accessories to landfills. An astonishing 140 million phones (4 phones per second) ended up in landfills in 2011, leaching 80,000 pounds of lead into the earth and wasting 4.7 tonnes of gold worth $56 million and 49 tonnes of silver worth $8.4 million (Lerner 2011). Just imagine how much smartphone manufacturers can reduce their cost by recovering these precious metals with the estimated 6.1 billion smartphones by 2020. IPhone must come with a full ecology profile that includes recycling information about all components and accessories. Best Buy saved millions of dollars by its recycling strategy through collaboration and investments, and inspired Wal-Mart to do the same.

Case 19: Best Buy Recycling Saved them Millions

Best Buy makes recycling consumer electronics products easy. Its take-back program, launched at 117 stores in 2009, allows consumers to bring in monitors, TVs, and similar devices for free recycling, no matter where the items were purchased. This is the first ongoing program of such broad scope at a retail store in the United States. In addition, every store has a kiosk that takes items such as rechargeable batteries, cell phones, ink cartridges, and DVDs. When customers buy a new TV or appliance, they can return the old one for recycling, which has brought in more than 9,000 tons of electronics and 32,000 tons of appliances. Non-profits and community organizations can apply for grants to host recycling events. Best Buy has spent $96,000 to

support 77 events that brought in 1,300 tons of electronics. Best Buy also recycles other materials from its own distribution centers and in 2008 alone, 79,000 tons of cardboard, 10,000 tons of wood, 4,400 tons of plastic, and 3,600 tons of metal were recycled, pushing Best Buy to the number one spot among retailers. Innovation in disposing of plastic used in stores has saved millions in lower disposal costs to landfills. In 2009, Best Buy set a goal to collect 1 billion pounds of consumer electronics and appliances for recycling in USA by the end of 2014. In June 2014, this goal was met and in the same year, Best Buy was awarded the EPA's Sustainable Materials Management (SMM) Electronics Challenge Champion and Gold Level Participant Awards. Best Buy's steps were followed by Wal-Mart which cut its waste going to landfills by 81 percent in California between 2008 and 2010, thanks to a pilot program that's now going nationwide. Recycling, composting, and reusing materials (such as converting used plastic hangers into dog beds) has turned the waste stream from a cost into a modest profit center for Wal-Mart.

Source: Summarised from CEA (2008), Best Buy CSR and Sustainability Report (2014)

In the light of the above information, it is clear that gone are the days when companies' success and environmental progress was dealt with through narrow management approaches, short-term thinking, and deepening divides among institutions. Redefining the purpose of the corporation based on environmental needs focuses on the sustainable kind of profits that create environmental benefits rather than diminish them. No doubt, capital markets will undoubtedly continue to pressure companies to generate short-term profits, and some companies will surely continue to reap profits at the expense of societal needs (Porter and Kramer 2011). But such profits will often prove to be short lived and far greater opportunities will be missed (Porter and Kramer 2011).

Therefore, Apple must build infrastructure and support companies around at each stage of the iPhone's life cycle. Apple should not only include businesses but institutions such as academic programs, trade associations, and standards organizations in China, Indonesia, Peru, and Ghana. Apple, in order to play a political role, must draw on the broader public assets in the surrounding community, such as schools and universities, clean water, fair competition laws, quality standards, and market transparency. Apple's stakeholder engagement and building clusters will

play a crucial role in driving productivity, innovation, and competitiveness as was evident in the examples given earlier. Capable local suppliers will foster greater logistical efficiency and ease of collaboration, as we have discussed. Apple must take advantage of stronger local capabilities in such areas as transportation services and must help local suppliers that will boost their own productivity. Conversely, without a supporting cluster, conversely, Apple's productivity would likely suffer because deficiencies in the framework conditions surrounding the cluster would create internal costs for Apple. Furthermore, poor transportation infrastructure inside China, Indonesia, Peru and Ghana drives up the costs of logistics for the iPhone and therefore needs to be redefined. Apple's 'meta strategy' of environmental sustainability to build clusters would make its new practices far more effective. It can set out to build technical, financial, and logistical firms and capabilities in each region, to further support efficiency and high-quality local production. Apple can also help in non-core operations related activities such as providing poor farmers in Indonesia with fertilizers and irrigation equipment.

Moreover, if Apple employs a "meta strategy" for its iPhone, it would end up with numerous benefits. The "meta strategy" would position Apple to thrive in a circular economy and it will end up reducing the cost of processing e-waste. It would not only help in reducing the cost of transportation and packaging but would also increase the productivity of Apple's suppliers, thus increasing Apple's profits. It would also reduce the cost of Apple's philanthropic activities due to input from other stakeholders, whereas Apple will be prepared for more stringent future regulations on emissions and other environment related issues. Employing a "meta strategy" would eliminate Apple's exposure to volatility in fossil fuel markets and position Apple to thrive in a water constrained economy. Not only would a "meta strategy' reduces costs but it will secure the supply of critical resources. Besides fostering a culture of learning resulting in identification of new opportunities for innovation, it would improve decision-making through more diverse perspectives by involving stakeholders. It would also result in protecting the infrastructure, services and suppliers upon which Apple depend. Last but not the least, the "meta strategy" would increase sales to people who value environmentally responsible companies and products and at the same time they will avoid reputational and financial costs due to law suits and regulatory breaches.

Overview of Chapter 5

Environmental externalities are not myths and they create environmental costs. Therefore, understanding the magnitude of the company's environmental impacts, prioritizing which ones to tackle first, and incorporate this information into decision-making is inevitable. This will not only make the company profitable but can also create a bigger value pool for all connected stakeholders. Therefore, the "meta strategy" calls for redefining the purpose of the corporation. Apple must respond in innovative ways and create environmental friendly energy efficient design of the iPhone which is only possible through an ongoing exploration of environmental needs. The "meta strategy" can result in minimizing the expenses of entire life cycle of the iPhone, phase by phase, by taking advantage from others' competencies and creating clusters or partnerships. Sharing technology including renewable energy sites and radio access networks, building clusters and partnerships, can in turn, redefine productivity in the value chain and would also boost investments in the development of tier 1, 2, 3 and other lower suppliers. Redefining productivity in the value chain would result in redesigning logistical system and also in redefining waste stream. The overall result is business benefits for the company and creating a bigger value pool for all the stakeholders, while reducing product's environmental impact.

Figure 2 Meta Strategy and Bigger Value Pool

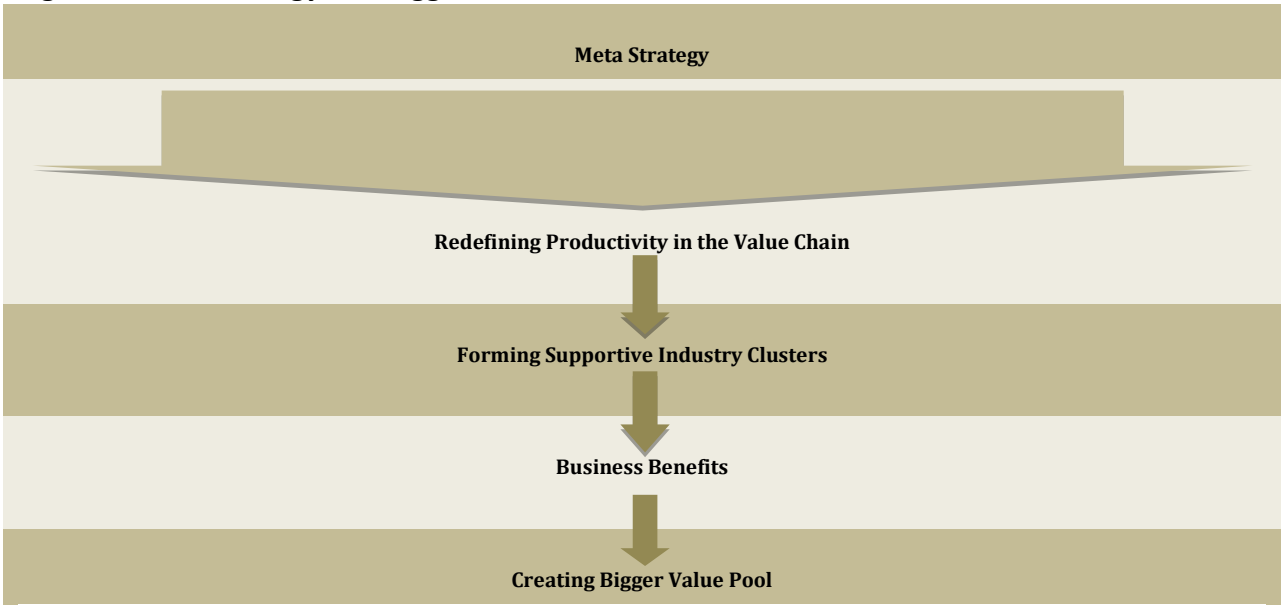


Table 5.1: Chapter 5 at Glance

Environmental externalities create environmental costs
Redefine the purpose of the corporation
Response in innovative ways and create environmental friendly design of the iPhone
Ongoing exploration of environmental needs
Minimizing the expenses of entire life cycle of the iPhone phase by phase
Advantage from others' competencies and creating clusters or partnerships
Redefine productivity in the value chain
Invest in the development of tier 1, 2 and 3 suppliers
Share technology
Logistical system redesigning
Energy efficient iPhone design and complete renewable energy at sites, plants and networks
Measurement of direct and indirect energy consumption
Redefining waste stream
Creating bigger value pool

Food For Thought

By investing in employee wellness programs, Johnson and Johnson has saved $250 million on health care costs. The focus on holding down wage levels, reducing benefits, and offshoring is beginning to give way to awareness of the positive effects that a living wage, safety, wellness, training, and opportunities for advancement for employees have on productivity. Many companies, for example, traditionally sought to minimize the cost of "expensive" employee health care coverage or even eliminate health coverage altogether. Today leading companies have learned that because of lost workdays and diminished employee productivity, poor health costs them more than health benefits do. Take Johnson and Johnson. By helping employees stop smoking (a two-thirds reduction in the past 15 years) and implementing numerous other wellness programs, the company has saved $250 million on health care costs, a return of $2.71 for every dollar spent on wellness from 2002 to 2008. Moreover, Johnson and Johnson has benefited from a more present and productive workforce. If labor unions focused more on shared value, too, these kinds of employee approaches would spread even faster.

Source: Summarised from Wien (2013), Lotharius (2013), Porter and Kramer (2011)

Food for Thought 5: Employees' Productivity

CHAPTER 6: Concluding with a Starting Point: The Beginning

Mahatma Ghandi once said, “earth provides enough to satisfy every man’s needs, but not every man’s greed”. In today’s world, corporate greed has created a system in which corporations function as a superorganism capable of generating massive profits while creating ecological bankruptcy. This system does not allow us to think that the wealth and economies of countries and the entire world are the water, air, soil, forests, minerals, rivers, lakes, oceans, wildlife habitats and biodiversity. Natural ecosystems and habitats is where all the economic activity and jobs come from, and now is the time for our ultimate test of conscience that develops our willingness to sacrifice our greed today for future generations’ needs and, more precisely, environmental sustainability.

Therefore, this is the starting point. To mitigate the environmental impact, there is a need for implementing whole-system design with a vision of transformation and strategies based on collaboration and innovations. Effective environmentally friendly practices can be employed through the “meta strategy” because it encompasses actions based on environmental needs by industry clusters and collaboration which defies game theory predictions because actors involved do not defect at the expense of collective efforts. These results in creating a bigger value pool that could not have been possible while remaining independent.

Society and Business are wholly owned subsidiaries of the environment, therefore collaborative effort, holistic approach and system level solutions are inevitable (Willard 2014). This is inevitable, as according to Willard (2014), nature is neither subject to systematically increasing concentrations of substances extracted from the Earth's crust and produced by society, nor is it subject to systematically increasing degradation by physical means. Therefore, there is no other way than to compel business to protect the environment from physical degradation and to ensure no potentially harmful substances escape into the environment. And, at the same time, business sector must ensure that everyone it depends upon has a voice and the opportunity to learn and grow which one can term as genuine innovation

Image 25 Nested Interdependencies

Source: Willard 2014

(Willard 2014). This innovation would provide thresholds of performance that together would define the minimum that every company must do to be sustainable and ultimately address environmental and social issues whose impacts are mitigated by performing well on the goals (Willard 2014).

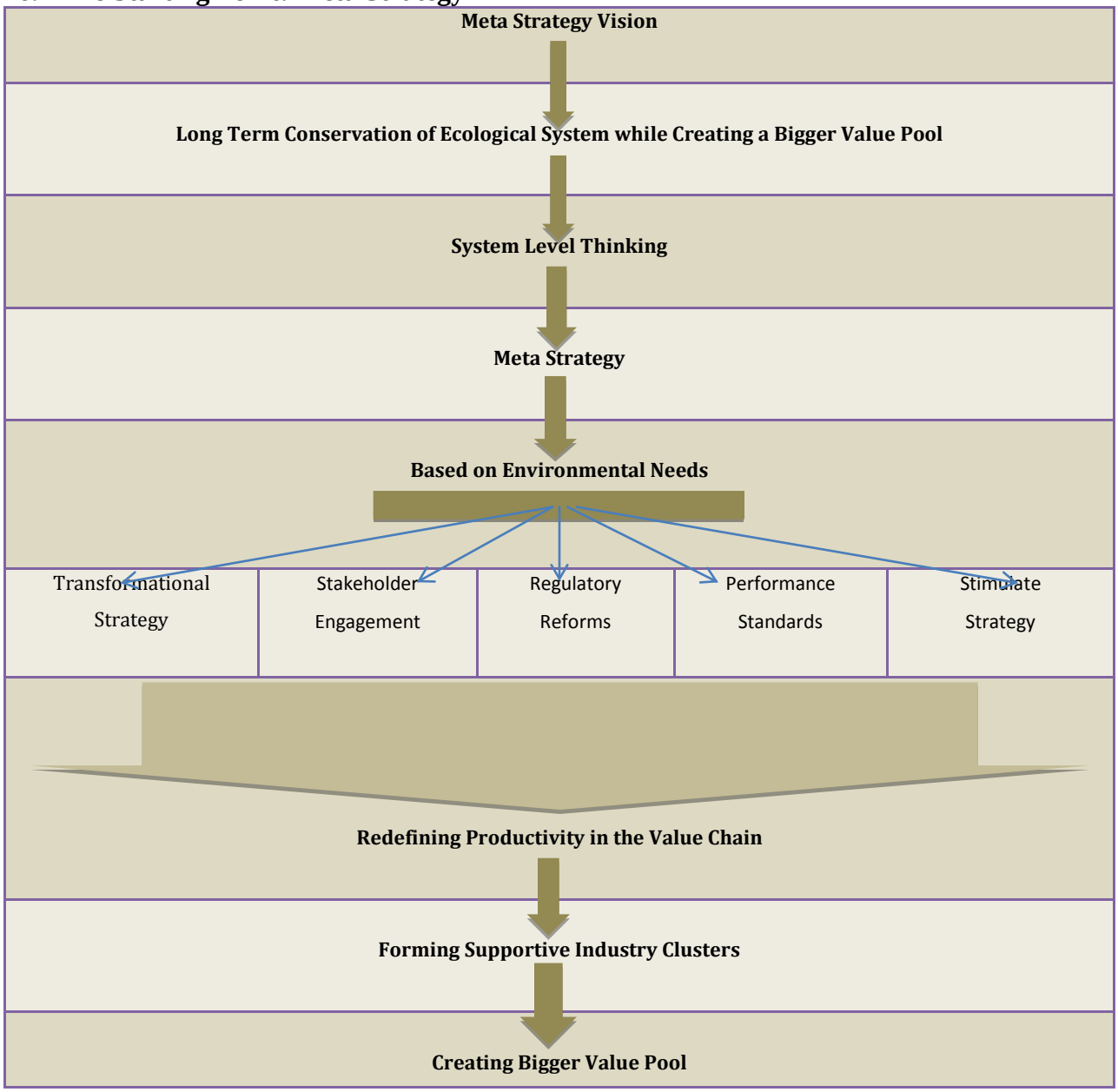
As said earlier, this research has focused on smartphone manufacturers with emphasis on iPhone and Fairphone. I did not choose the smartphone industry randomly. It is the smartphone's extremely complex supply chain and its environmental impacts that make it an important product for further research. Moreover, as mentioned in the beginning, I wanted to research something that could result in influencing large amounts of actors and individuals and smartphone will serve the purpose. Therefore, I repeat my starting point that this helps to convey the inconceivable environmental impact of the entire electronics industry and corporate sector as a whole because it will be one of the necessities by the year 2020 to be chained to 6.1 billion people living on the planet earth.

A 'meta strategy' of environmental sustainability not only creates awareness among 6.1 billion people but it could have the most potentially transformative impact on companies, suppliers, media, governments and not-for-profit organisations which will encourage taking decision based on environmental needs. The reason is that Apple has more than 700 suppliers around the world, and transforming its strategies, developing culture based on creating bigger value pool based on environmental needs would expand into different countries which could ultimately influence other smartphone manufacturers. Interestingly, since Apple and other smartphone manufacturers are into other electronics products as well, it could potentially influence the entire electronic industry and could eventually expand to each and every industry thus creating a system change where companies' purpose is redefined and reproductively in supply chain is redesigned.

Moreover, deploying a 'meta strategy' of environmental sustainability with an outreach to 6.1 billion people would not only earn companies social currency enabling them to connect to all stakeholders but would also compel companies to act in accordance with regulations and standards prescribed by stakeholders in all the issues related to environment, society, child labour, economy, living standard, fair wages, and human rights. Therefore, my conclusion is "it is smart, only if it is sustainable" and my starting point is to offer a 'meta strategy' to mitigate environmental impacts of smartphones which could become a threshold for industries to create a

bigger value pool while employing smart environmentally-friendly business practices thus breaking the shackles of the polluting and unjust present evil system. To begin our journey to preserve nature, let's recap on our vehicle, the 'Meta Strategy' briefly in Table 6.1, 6.2 and 6.3.

6.1 The Starting Point: Meta Strategy



6.2 The Starting Point: Actions, Performance and Global Environmental Risks Mitigation

Mandatory Actions
Inclusion of the cost of environmental damage due to extraction and manufacturing, packaging and distribution, use and end of life stage in the iPhone price.
Educate people about the negative environmental impact of the smartphone.
Mandatory disclosure and keeping record of every single worker and tier 1, 2 and 3 suppliers.
Mandatory environmental impact assessment and making it public. Making sure to include every aspect of environmental degradation at each stage of the iPhone life cycle in packaging and instruction guide for the users.
EPEAT certification for each stage of iPhone's life cycle.
GRI report for each stage iPhone's life cycle with full mandatory disclosure.
Regulatory reforms with input from all stakeholders and according to international laws and protocols for each stage of the iPhone's life cycle.
Provision of services due to inefficiencies of other stakeholders, particularly the governments.
Collaborative and continues monitoring of the environmental issues.
Threshold Performance
IPhone and its suppliers' operations emit no potentially harmful substances.
IPhone emit no potentially harmful substances when used as intended.
IPhone and all products related to it and packaging are designed to be repurposed at end of life.
Customers have access to end-of-life repurposing services for iPhone and all of its accessories and packaging.
IPhone and its suppliers' operations emit no CO2 emissions.
IPhone and its related products emit no CO2 when used as intended.
All energy is from renewable sources.
All water is used in an environmentally responsible and socially equitable way.
All materials are from responsibly-managed sources.
Physical presence Apple and its suppliers have net zero impact on local ecosystems.
Customers are informed about any aspect of iPhone and its products that may harm people or the environment.
Universal performance standards and regulations, and transparent reporting by third party
Apple's political role through stimulate strategy to address inefficiencies in public sector to find solutions.
Global Environmental Risks Mitigation
Ecosystem degradation
Climate destabilization and Ocean acidification
Energy crisis
Access to mined materials and Access to renewable materials
Biodiversity crisis
Deforestation
Infrastructure Crisis
Bigger Value Pool makes living standard better

6.3 The Starting Point: Business Benefits and Bigger Value Pool

Business Benefits and Bigger Value Pool
It would position Apple to thrive in a circular economy.
It would reduce the cost of processing e-waste.
It would reduce the cost of transportation and packaging
It would increase the productivity of Apple's suppliers, thus increasing Apple's profits
It would reduce the cost of Apple's philanthropic activities due to input from other stakeholders
It would prepare Apple for more stringent future regulations on emissions.
It would eliminate Apple's exposure to volatility in fossil fuel markets.
It would position Apple to thrive in a water constrained economy.
It would reduce the cost and will secure the supply of critical resources.
It would foster a culture of learning resulting in identification of new opportunities for innovation.
It would improve decision-making through more diverse perspectives and by involving stakeholders
It would Protect the infrastructure and services upon which Apple depends.
It would increase sales to people who value environmentally responsible companies and products.
It would avoid reputational and financial costs due to law suits and regulatory breaches.
Bigger Value Pool
Apple's productivity and profit would increase while costs would decrease.
Suppliers' productivity would increase while costs would decrease.
Government's resources and services deficit would be reduced.
NGO's would operate smoothly due to collaborative investments and more funding.
Consumers would get durable and environmentally friendly products.
Uniform standards, regulations and reporting would increase overall transparency.
Companies' gains from competencies and collaboration from Stakeholders in different sectors would lead to innovations resulting in overall global environmental risks mitigation.

References:

Abota, C. A. (2012). Recycling of plastics waste in Ghana: a way to reduce environmental problems/pollutions. Degree Thesis. Arcada University. Finland.

Alaee, M., and Wenning, R. J. (2002). The significance of brominated flame retardants in the environment: current understanding, issues and challenges. Chemosphere, 46(5), 579-582.

Aldred, J. (2008). Sumatran deforestation driving climate change and species extinction. [Online] http://www.theguardian.com/environment/2008/feb/27/climatechange.forests

Amnesty International (2016). Exposed: Child labour behind smart phone and electric car batteries. Amnesty International Charity Limited. [Online] https://www.amnesty.org/en/latest/news/2016/01/Child-labour-behind-smart-phone-and-electric-car-batteries/

Anderson, M. (2015). Great Things Come in Innovative Packaging: An Introduction to Plant Bottle Packaging. [Online] http://www.coca-colacompany.com/stories/great-things-come-in-innovative-packaging-an-introduction-to-plantbottle-packaging/

Apple Environment Responsibility Report (2015). Progress Report. [Online] https://www.apple.com/environment/pdf/Apple_Environmental_Responsibility_Report_2015.pdf

Apple Environmental Reports (2008-2016). [Online] http://www.apple.com/ca/environment/reports/

Apple Environmental Responsibility Report (2014). Progress Report. [Online] https://www.apple.com/environment/pdf/Apple_Environmental_Responsibility_Report_2014.pdf

Apple Inc. Resources Report (2015). We can't manufacture natural resources. So we invent ways to make the most of them. [Online] http://www.apple.com/ca/environment/renewable-resources/

Apple Resource Report (2015). Environment. [Online] http://www.apple.com/ca/environment/resources/

Apple Supplier List (2015). Supplier List 2015. [Online] https://www.apple.com/anzsea/supplier-responsibility/pdf/Apple_Supplier_List_2015.pdf

Apple Supplier Responsibility Report (2015). Supplier Responsibility 2015 Progress Report. [Online] https://www.apple.com/supplier-responsibility/pdf/Apple_SR_2015_Progress_Report.pdf

Arruda-Filho, E. J., Cabusas, J. A., and Dholakia, N. (2010). Social behavior and brand devotion among iPhone innovators. *International Journal of Information Management*, 30(6), 475-480.

Atkin, T., Gilinsky Jr, A., and Newton, S. K. (2012). Environmental strategy: does it lead to competitive advantage in the US wine industry? *International Journal of Wine Business Research*, 24(2), 115-133.

Babayemi, J. O., Osibanjo, O., and Weber, R. (2016). Material and substance flow analysis of mobile phones in Nigeria: a step for progressing e-waste management strategy. Journal of Material Cycles and Waste Management, 1-12.

Ballester, M. (2016). From the factory to you: Packaging the Fairphone 2. [Online] https://www.fairphone.com/2016/04/22/from-the-factory-to-you-packaging-the-fairphone-2/

Bastawrous, A., Hennig, B., and Livingstone, I. (2013). mHealth possibilities in a changing world. Distribution of global cell phone subscriptions. *Journal of Mobile Technology in Medicine*, 2(1S), 22-25.

Berzengi, R., and Linbom, A. (2008). Competitive Advantage of Environmental Sustainability. Dissertation. University of Halmstad, Sweden.

Best Buy Corporate Responsibility and Sustainability Report (2013). [Online] https://corporate.bestbuy.com/wp-content/uploads/2015/05/fy-13-full-report.pdf

Best Buy Corporate Responsibility and Sustainability Report (2014). [Online] https://corporate.bestbuy.com/wp-content/uploads/2014/06/csr-2014-final.pdf

Best Buy Corporate Responsibility and Sustainability Report (2015). [Online] https://corporate.bestbuy.com/wp-content/uploads/2015/06/fy15-full-report-final.pdf

Bleekemolen, B. (2016). How we're tackling e-waste with the Fairphone 2. [Online] https://www.fairphone.com/2016/02/25/tackling-e-waste-with-fairphone-2/

Bockstette, V., and Stamp, M. (2011). Creating Shared Value: A How-to Guide for the New Corporate (R) evolution. [Online] https://sharedvalue.org/sites/default/files/resource-files/Shared_Value_Guide.pdf

Bockstette, V., and Stamp, M. (2011). Creating Shared Value: A How-to Guide for the New Corporate (R) evolution. [Online] https://sharedvalue.org/sites/default/files/resource-files/Shared_Value_Guide.pdf

Bodeen, C. (2007). In 'e-waste' heartland, a toxic China. The New York Times. [Online] http://www.nytimes.com/2007/11/18/world/asia/18iht-waste.1.8374259.html?_r=0

Bollinger, L. A., and Blass, V. (2012, June). Export, metal recovery and the mobile phone end-of-life ecosystem. In CESUN 2012: 3rd International Engineering Systems Symposium, Delft University of Technology, The Netherlands, 18-20 June 2012.

Boren, Z.D. (2015). There are officially more mobile devices than people in the world. Independent. [Online] http://www.independent.co.uk/life-style/gadgets-and-tech/news/there-are-officially-more-mobile-devices-than-people-in-the-world-9780518.html

Bradford, A. (2015). Deforestation: Facts, Causes and Effects. Livescience. [Online] http://www.livescience.com/27692-deforestation.html

Branzei, O. and Valente, M. (2009). Honey Care Africa: A tripartite Model for Sustainable Beekeeping. Case Study 9B07M060. Richard Ivey School of Business. University of Waterloo.

Buchert, M., Manhart, A., Bleher, D., and Pingel, D. (2012). Recycling critical raw materials from waste electronic equipment. Freiburg: Öko-Institut eV.

Buckley, S. (2014). Apple says most iPhone metal suppliers conflict-free. Engadget. [Online] http://www.engadget.com/2014/02/13/apple-supplier-responsibility-2014/

Bull, J. G., and Kozak, R. a. (2014). Comparative life cycle assessments: The case of paper and digital media. Environmental Impact Assessment Review, 45, 10–18.

Burke, M. (2010). Wal-Mart, Patagonia Team To Green Business. Forbes Magazine. [Online] http://www.forbes.com/forbes/2010/0524/rebuilding-sustainability-eco-friendly-mr-green-jeans.html

Burrell, L. (2016). 44 Reasons To Believe Cell Phones Can Cause Cancer. Global Research. [Online] http://www.globalresearch.ca/44-reasons-to-believe-cell-phones-can-cause-cancer/5420118

Butsic, V., Baumann, M., Shortland, A., Walker, S., and Kuemmerle, T. (2015). Conservation and conflict in the Democratic Republic of Congo: The impacts of warfare, mining, and protected areas on deforestation. *Biological Conservation*, 191, 266-273.

Byrne, D. S. (1998). Complexity theory and the social sciences: an introduction. Psychology Press.

Carroll, A., and Buchholtz, A. (2014). *Business and society: Ethics, sustainability, and stakeholder management.* Nelson Education.

Casey, L. (2011). Asia Pacific region forecasted to lead global luxury packaging market growth. Packing Digest. [Online] http://www.packagingdigest.com/pharmaceutical-packaging/asia-pacific-region-forecasted-lead-global-luxury-packaging-market-growth

CBC NEWS (2011). Canada pulls out of Kyoto Protocol. CBC Politics. [Online] http://www.cbc.ca/news/politics/canada-pulls-out-of-kyoto-protocol-1.999072

CBC NEWS (2015). VW intentionally violates clean air standards, U.S. EPA says. [Online] http://www.cbc.ca/news/business/vw-epa-emissions-software-1.3234307

Cecere, G., Corrocher, N., and Battaglia, R. D. (2015). Innovation and competition in the smartphone industry: Is there a dominant design? *Telecommunications Policy,* 39(3), 162-175.

Chan, J. K., Xing, G. H., Xu, Y., Liang, Y., Chen, L. X., Wu, S. C., ... and Wong, M. H. (2007). Body loadings and health risk assessment of polychlorinated dibenzo-p-dioxins and dibenzofurans at an intensive electronic waste recycling site in China. *Environmental science and technology*, 41(22), 7668-7674.

Chang, L., Li, W., and Lu, X. (2015). Government engagement, environmental policy, and environmental performance: evidence from the most polluting Chinese listed firms. *Business Strategy and the Environment,* 24(1), 1-19.

Chatterjee, R. (2007). E-waste recycling spews dioxins into the air. *Environmental science and technology,* 41(16), 5577-5577.

Cheng, J. (2014). Carbon footprint of the smartphone. Gbtimes. [Online] http://gbtimes.com/life/carbon-footprint-smartphone

Chien, M. K., and Shih, L. H. (2007). An empirical study of the implementation of green supply chain management practices in the electrical and electronic industry and their relation to organizational performances. *International Journal of Environmental Science and Technology*: (IJEST), 4(3), 383.

Tianjie, M. (2012). Before there can be clear water there must be clear data. China river pollution. [Online] http://www.greenpeace.org/eastasia/news/blog/before-there-can-be-clear-water-there-must-be/blog/38892/

Chow, L. (2015). Stunning Photos Capture Devastating Worldwide E-Waste Problem. EcoWatch. [Online] http://ecowatch.com/2015/04/14/bellini-electronic-waste/

Cisco (2016). Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015–2020. White Paper. [Online]. http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/mobile-white-paper-c11-520862.html

Claussen, H., Ho, L. T., and Samuel, L. G. (2008). An overview of the femtocell concept. Bell Labs Technical Journal, 13(1), 221-245.

Congressional Research Service Report (2013). Rare Earth Elements: The Global Supply Chain. CRS Report for Congress. [Online] http://www.fas.org/sgp/crs/natsec/R41347.pdf

Consumer Electronic Association Report (2008). Environmental Sustainability and Innovation in the Consumer Electronics Industry (CEA). [Online] http://www.cta.tech/CorporateSite/media/Government-Media/Green/Environmental-Sustainability-and-Innovation-in-the-Consumer-Electronics-Industry.pdf

Cormier, Z. (2012). All that glitters is not gold: Precious metal mining in Congo should stay small for the sake of the forest: Scaling up mining operations also means scaling up deforestation in the Congo Basin. Forest News. [Online] http://blog.cifor.org/7559/all-that-glitters-is-not-gold-precious-metal-mining-in-congo-should-stay-small-for-the-sake-of-the-forest?fnl=en

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

CTA (2015). Innovating a Better World. [Online] http://content.ce.org/SReport2016/CTA_SR_2016/report-builder/_pdf/CTA_2015_SR.pdf

Davidson, C. (2000). Economic growth and the environment: alternatives to the limits paradigm. *BioScience,* 50(5), 433-440.

Democracy Now (2015).Exxon's Climate Cover-Up Just Got Bigger: Docs Suggest All Major Oil Giants Have Lied Since 1970s. Independent Global News. [Online] http://www.democracynow.org/2015/12/31/exxons_climate_cover_up_just_got

Deng, W. J., Louie, P. K. K., Liu, W. K., Bi, X. H., Fu, J. M., and Wong, M. H. (2006). Atmospheric levels and cytotoxicity of PAHs and heavy metals in TSP and PM 2.5 at an electronic waste recycling site in southeast China. *Atmospheric Environment*, 40(36), 6945-6955.

Dimantchev, E. (2013). Sustainable Smartphones: Galaxy S4 vs. Fairphone. Tripple Pundit. [Online] http://www.triplepundit.com/2013/10/sustainable-smartphones-galaxy-s4-fairphone/

Doelle, M. (2012). CEAA 2012: The End of Federal EA as We Know It? [Online] Journal of Environmental Law and Justice. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2104336

Dolowitz, D. P., and Marsh, D. (2000). Learning from abroad: The role of policy transfer in contemporary policy-making. *Governance,* 13(1), 5-23.

Dow Sustainability Report (2014). Valuing Ecosystems. [Online] file:///C:/Users/Ayesha/Downloads/Valuing-Ecosystems-2013-2014%20(1).pdf

Earthsky (2015). Plastic bits in 90% of seabirds. EARTH, HUMAN WORLD, SCIENCE WIRE. [Online] http://earthsky.org/earth/plastic-bits-in-90-of-seabirds

EC. (2011). EC Guidance on undertaking new non-energy extractive activities in accordance with Natura 2000 requirements. *European Commission* (EC). [Online] http://ec.europa.eu/environment/nature/natura2000/management/docs/neei_n2000_guidance.pdf

Eimer, D. (2012). 20 tons of cadmium poisoning vital Chinese river. The Telegraph. [Online] http://www.telegraph.co.uk/news/earth/environment/9053671/20-tons-of-cadmium-poisoning-vital-Chinese-river.html

Elgan, M. (2014). Why I Support China's 'Scam' Frankenstein iPhones. Cult of Mac. [Online] http://www.cultofmac.com/268377/support-chinas-scam-frankenstein-iPhones/

Elon, M. (2014). All our Patent Are Belong To You. [Online] https://www.teslamotors.com/en_CA/blog/all-our-patent-are-belong-you

Energy Floors (2015). How we started. [Online] http://www.sustainabledanceclub.com/about/how_we_started/

Environmental Protection Branch Report (2012). EPB 433- Health and Environmental Effects of Burning Waste Plastics. [Online] http://www.saskh2o.ca/PDF/epb433.pdf

EPA. (2011). Electronics Waste Management in the United States Through 2009. U.S. Environmental Protection Agency (EPA). [Online] http://www.epa.gov/waste/conserve/materials/ecycling/manage.htm

Ercan, E. M. (2013). Global Warming Potential of a Smartphone: Using Life Cycle Assessment Methodology.

Ericsson Mobility Report (2015). On the pulse of the networked society. [Online] http://www.ericsson.com/res/docs/2015/mobility-report/ericsson-mobility-report-nov-2015.pdf

Fagge, N. (2015). Exclusive picks, pans and bare hands: How miners in the heart of Africa toil in terrible conditions to extract the rare minerals that power your iPhone. [Online] http://www.dailymail.co.uk/news/article-3280872/iPhone-mineral-miners-Africa-use-bare-hands-coltan.html

Fagotto, M. (2014). Death metal: the island that's paying the price for your tablet. Wired Magazine. [Online] http://www.wired.co.uk/magazine/archive/2014/03/features/death-metal

Fairphone (2014). Next step in Life Cycle Assessment: Inventory Analysis. [Online] https://www.fairphone.com/2014/06/20/next-step-in-life-cycle-assessment-inventory-analysis/

Fairphone Cost Breakdonw Report (2015). Cost breakdown of the Fairphone 2. [Online] https://www.fairphone.com/wp-content/uploads/2015/09/Fairphone2-Cost-Breakdown.pdf

Fairphone Fact Sheet (2015). Fairphone fact sheet. [Online] https://www.fairphone.com/wp-content/uploads/2015/06/150702-English-factsheet.pdf

Fairphone Press Release (2015). Fairphone 2: World's first long-lasting, modular smartphone hits the market. [Online] https://www.fairphone.com/wp-content/uploads/2015/12/Press-release.-Fairphone-2-World%E2%80%99s-first-long-lasting-modular-smartphone-hits-the-market.pdf

Fairphone Press Release (2015). Fairphone 2: World's first long-lasting, modular smartphone hits the market. [Online] https://www.fairphone.com/wp-content/uploads/2015/12/Press-release.-Fairphone-2-World%E2%80%99s-first-long-lasting-modular-smartphone-hits-the-market.pdf

Fairphone Report (2015). Integrating gold from responsible sources. [Online] https://www.fairphone.com/projects/gold/

Fairphone Roadmap (2015). Design. [Online] https://www.fairphone.com/roadmap/design/

Fairtrade (2016). About Fairtrade Gold and Precious Metals. [Online] http://wordpress.p20126.webspaceconfig.de/about-us/

Fehske, A., Fettweis, G., Malmodin, J., and Biczok, G. (2011). The global footprint of mobile communications: The ecological and economic perspective. *Communications Magazine*, IEEE, 49(8), 55-62.

Fisher, B. (2012). How Much Energy a Smartphone Uses in a Year (And What it Means for Your Budget). [Online] http://lifehacker.com/5948075/how-much-energy-a-smartphone-uses-in-a-year-and-what-it-means-for-your-budget

Font, R., Aracil, I., Fullana, A. and Conesa, J. A. (2004). "Semivolatile and volatile compounds in combustion of polyethylene". Chemosphere, 57, 615-627.

Forbes (2013). How To Replace The iPhone 5's Battery. Forbes Tech. [Online] http://www.forbes.com/sites/antonyleather/2013/10/31/how-to-replace-the-iPhone-5s-battery/#389cf02f2b51

Forbes (2014). What Tesla Stands To Gain From Sharing Its Patents. [Online] http://www.forbes.com/sites/greatspeculations/2014/06/16/what-tesla-stands-to-gain-from-sharing-its-patents/#7bf2261138f9

Forrest, W., and Morison, A. (1991). A government role in better environmental management. *Science of the total environment,* 108(1), 51-60.

FOXCONN Social and Environmental Responsibility Report (2014). [Online] http://www.foxconn.com/Files/index/Foxconn_SER_Report_EN.pdf

Fraser, B. (2011). High gold price triggers rainforest devastation in Peru. Mongabay. [Online] http://news.mongabay.com/2011/10/high-gold-price-triggers-rainforest-devastation-in-peru/

Friedman, M. (2007). *The social responsibility of business is to increase its profits* (pp. 173-178). Springer Berlin Heidelberg.

Friends of the Earth Report (2012). Mining for smartphones: the true cost of tin. [Online] https://www.foe.co.uk/sites/default/files/downloads/tin_mining.pdf

Gaidajis, G., Angelakoglou, K., and Aktsoglou, D. (2010). E-waste: environmental problems and current management. *Journal of Engineering Science and Technology Review*, 3(1), 193-199.

Galindo, G.R. (2012) Latin America Forest News Updates.[Online] http://blog.cifor.org/4685/latin-america-forest-news-updates-october-2011/

Garlapati, V. K. (2016). E-waste in India and developed countries: Management, recycling, business and biotechnological initiatives. *Renewable and Sustainable Energy Reviews*, 54, 874-881.

Gayle, D. (2012). Chemical breakdown: The toxic substances inside your mobile phone. MailOnline. [Online] http://www.dailymail.co.uk/sciencetech/article-2213366/Chemical-breakdown-What-really-goes-new-iPhone.html

Gerritsen, L. (2016). How we got Fairtrade certified gold in the Fairphone 2 supply chain. Fairphone. [Online] https://www.fairphone.com/2016/01/27/how-we-got-fairtrade-certified-gold-in-the-fairphone-2-supply-chain/

Gold Mine Congo Image (2015) National Geographic. [Online] http://ngm.nationalgeographic.com/2013/10/conflict-minerals/bleasdale-photography#/09-workers-sufferance-mine-ituri-670.jpg

Goldhill, O. (2015). Why smartphones are making you ill. The telegraph. [Online] http://www.telegraph.co.uk/technology/news/11532428/Why-smartphones-are-making-you-ill.html

Google Images (2016). Smartphone Dependency. Image 1. [Online] https://www.google.ca/search?q=smartphone+dependency+pictures&biw=1238&bih=874&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi2itef44XOAhUCxoMKHR_YAfYQ_AUIBigB#tbm=isch&q=cell+phone+dependancy+&imgrc=Yo8MA9TAgSM6bM%3A

Google Images (2016). Tech Health Effects. Image 16. [Online] https://www.google.ca/search?q=smartphone+dependency+pictures&biw=1238&bih=874&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi2itef44XOAhUCxoMKHR_YAfYQ_AUIBigB#tbm=isch&q=cell+phone+health+effects&imgrc=EUjwNZ2Dgmr_lM%3A

Google Images (2016). Dystopian Lake. Image 19. [Online] https://www.google.ca/search?q=smartphone+dependency+pictures&biw=1238&bih=874&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi2itef44XOAhUCxoMKHR_YAfYQ_AUIBigB#tbm=isch&q=dYSTOPIAN+lAKE&imgrc=JRKcbvD-NuF-YM%3A

Goutier, N. (2014). E-waste in Ghana: where death is the price of living another day. *Ecologist*. [Online] http://www.theecologist.org/News/news_analysis/2503820/ewaste_in_ghana_where_death_is_the_price_of_living_another_day.html

Green Electronic Council (2016). About Green Electronic Council. [Online] http://greenelectronicscouncil.org/about/

Green Works News Letter (2003) Recycling Saves Money. 42. [Online] https://your.kingcounty.gov/solidwaste/business/documents/GWvol42.pdf

Greene, J. (2012). Digging for rare earths: The mines where iPhones are born. [Online] http://www.cnet.com/news/digging-for-rare-earths-the-mines-where-iPhones-are-born/

Greene, J. (2012). The environmental pitfalls at the end of an iPhone's life. CNET. [Online] http://www.cnet.com/news/the-environmental-pitfalls-at-the-end-of-an-iphones-life/

China, G. (2004). Investigative report on APP's forest destruction in Yunnan. Hong Kong: November.

Greenpeace Report (1997). What's wrong with PVC? The science behind a phase-out of polyvinyl chloride plastics. Greenpeace. [Online] http://www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/5575.pdf

Greenpeace Report (2010). Why BFRs and PVC should be phased out of electronic devices. [Online] http://www.greenpeace.org/international/en/campaigns/detox/electronics/the-e-waste-problem/what-s-in-electronic-devices/bfr-pvc-toxic/

Greenpeace Report (2011). Sinar Mas under investigation: How APP is toying with extinction. Greenpeace International. [Online] http://www.greenpeace.org/international/en/publications/reports/Sinar-Mas-under-investigation/

Greenpeace Report (2013). Yunnan: Only 9% of the Forest Is Primary Forest. Greenpeace East Asia. [Online] http://www.greenpeace.org/eastasia/press/releases/forests/2013/yunnan-forests-primary-greenpeace/

Greenpeace Report (2014). Green Gadgets: Designing the future. The path to greener electronics. [Online] http://www.greenpeace.org/international/Global/international/publications/toxics/2014/Green%20Gadgets.pdf

GRI (2015). The GRI Sustainability Reporting Guidelines. [Online] https://www.globalreporting.org/resourcelibrary/GRIG4-Part1-Reporting-Principles-and-Standard-Disclosures.pdf

GSMA Intelligence Report (2015). The Mobile Economy. [Online] http://www.gsmamobileeconomy.com/GSMA_Global_Mobile_Economy_Report_2015.pdf

GSMA Intelligence Report (2016). Definitive data and analysis for the mobile industry. [Online] https://gsmaintelligence.com/

Gualandris, J., Klassen, R. D., Vachon, S., and Kalchschmidt, M. (2015). Sustainable evaluation and verification in supply chains: Aligning and leveraging accountability to stakeholders. *Journal of Operations Management*, 38, 1-13.

Guangwei, He. (2014). In China's Heartland, A Toxic Trail Leads from Factories to Fields to Food. Environment360. [Online] http://e360.yale.edu/feature/chinas_toxic_trail_leads_from_factories_to_food/2784/

Guvendik, M. (2014). From smartphone to futurephone: assessing the environmental impacts of different circular economy scenarios of a smartphone using LCA (Doctoral dissertation, TU Delft, Delft University of Technology).

Hardin, G. (2001). Carrying capacity as an ethical concept. *The Social Contract* XII (1), 48-57.

Hawken, P., Lovins, A. B., and Lovins, L. H. (2013). *Natural capitalism: The next industrial revolution*. Routledge.

Herat, S. (2008). Environmental impacts and use of brominated flame retardants in electrical and electronic equipment. *The Environmentalist*, 28(4), 348-357.

Hilpert, H., Thoroe, L., and Schumann, M. (2011). Real-time data collection for product carbon footprints in transportation processes based on OBD2 and smartphones. In System Sciences (HICSS), 2011 44th Hawaii International Conference on (pp. 1-10). IEEE.

Hodal, K. (2012). Death metal: Tin mining in Indonesia. The Guardian. [Online] https://www.theguardian.com/environment/2012/nov/23/tin-mining-indonesia-bangka

Hsu, C. W., and Hu, A. H. (2008). Green supply chain management in the electronic industry. *International Journal of Environmental Science and Technology*, 5(2), 205-216.

Hu, W. C. (Ed.). (2012). *Sustainable ICTs and management systems for green computing*. IGI Global.

Humes, H. (2012). Walmart's biggest green feat: Putting sustainability on the corporate agenda. Grist. [Online] http://grist.org/business-technology/walmarts-biggest-green-feat-putting-sustainability-on-the-corporate-agenda/

Huo, X., Peng, L., Xu, X., Zheng, L., Qiu, B., Qi, Z. and Piao, Z. (2007). Elevated blood lead levels of children in Guiyu, an electronic waste recycling town in China. *Environmental Health Perspectives*, 1113-1117.

IFC (2012). Performance Standards on Environmental and Social. International Finance Corporation. World bank. [Online] http://www.ifc.org/wps/wcm/connect/115482804a0255db96fbffd1a5d13d27/PS_English_2012_Full-Document.pdf?MOD=AJPERES

International Institute for Sustainable Development (2013). Kalundborg. BSD Global. [Online] https://www.iisd.org/business/viewcasestudy.aspx?id=77

International Telecommunication Union Report (2015). Measuring the Information Society Report 2015. http://www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2015/MISR2015-w5.pdf

IPEN (2015). China chemical safety case study: Qihua PVC plant in Qiqihar, Heilongjiang Province. [Online] http://ipen.org/sites/default/files/documents/Case%20Study%20Report%20Qihua%202015r.pdf

IPhone 6S Environmental Report (2015). Apple and the Environment. [Online] https://www.apple.com/environment/pdf/products/iPhone/iPhone6s_PER_sept2015.pdf

Irimia-Vladu, M. (2014). “Green” electronics: biodegradable and biocompatible materials and devices for sustainable future. *Chemical Society Reviews*, 43(2), 588-610.

Jones, E. (2012). Cell Phone and the Environment. Greeniac Nation. [Online] http://www.greeniacs.com/GreeniacsArticles/Consumer-Products/Cell-Phones-and-the-Environment.html

Kaiman, J. (2014). Chinese government investigates 'cancer village' pollution case. The Guardian. [Online] http://www.theguardian.com/environment/2014/dec/10/chinese-government-investigates-cancer-village-pollution-case

Kaiman, J. (2014). Rare earth mining in China: the bleak social and environmental costs. Guardian Sustainable Business. [Online] http://www.theguardian.com/sustainable-business/rare-earth-mining-china-social-environmental-costs

Kay, M. (2015). The Dark Side of the Digital Age: E-Waste. The Huffington Post. [Online] http://www.huffingtonpost.com/mary-kay/the-dark-side-of-the-digi_b_7140120.html

Kennell, B. (2015). Environmental Concern Empowers the People. *The Huffington Post*.[Online] http://www.huffingtonpost.com/brian-kennell/environmental-concern-emp_b_8105580.html

Klein, J. T. (1990). *Interdisciplinarity: History, theory, and practice*. Wayne State University Press.

Klein, N. (2007). *The shock doctrine: The rise of disaster capitalism*. Macmillan.

Klein, P. (2013). Starbucks' gun letter: are companies assuming political roles? The Guardina. [Online] http://www.theguardian.com/sustainable-business/starbucks-gun-letter-companies-political-role

Knight, C. L. (2004). U.S. Patent No. 6,738,645. Washington, DC: U.S. Patent and Trademark Office.

Koetsier, J. (2013). Mining your iPhone: Recycling iPhones yields gold, silver, platinum, and more (infographic). [Online] http://venturebeat.com/2013/04/03/mining-your-iPhone-recycling-iPhones-yields-gold-silver-platinum-and-more-infographic/

Learmonth, G., Smith, D. E., Sherman, W. H., White, M. A., and Plank, J. (2011). A practical approach to the complex problem of environmental sustainability: The UVa Bay Game. *The Innovation Journal*: The Public Sector Innovation Journal, 16(1), 2011.

Lee, M. (2015). Indonesia's biggest paper firm back in the spotlight. The Straits Times. Asia. [Online] http://www.straitstimes.com/asia/se-asia/indonesias-biggest-paper-firm-back-in-the-spotlight

Leigh, E. (2010). What Aluminum Extraction Really Does to the Environment. Recycle Nation. [Online] http://recyclenation.com/2010/11/aluminum-extraction-recycling-environment

Lerner, M. L. (2011). Cash for Clunkers, Dimes for Duracells: An Effective Model to Motivate the Proper Disposal of Household Toxic Waste. *Jurimetrics*, 141-179.

Leung, A. O., Duzgoren-Aydin, N. S., Cheung, K. C., and Wong, M. H. (2008). Heavy metals concentrations of surface dust from e-waste recycling and its human health implications in southeast China. *Environmental science and technology*, 42(7), 2674-2680.

Li, J., Zeng, X., and Stevels, A. (2015). Ecodesign in consumer electronics: past, present, and future. *Critical Reviews in Environmental Science and Technology*, 45(8), 840-860.

Li, X., Ortiz, P., Kuczenski, B., Franklin, D., and Chong, F. T. (2012). Mitigating the environmental impact of smartphones with device reuse'. *Sustainable ICTs and management systems for green computing*.

Loria, K. (2014). Smartphones Ruin More Than Your Sleep — They May Also Be Destroying Your Vision. Business Insider. [Online] http://www.businessinsider.com/smartphones-effect-on-vision-and-health-2014-9.

Lotharius, P. (2013). Impressive results from a leading wellness program. Health Fitness, A Trust Mark Company. [Online] http://healthfitness.com/blog/impressive-results-from-a-leading-wellness-program/

Louv, R. (2008). *Last child in the woods: Saving our children from nature-deficit disorder*. Algonquin Books.

Lunden, I. (2015). 6.1B Smartphone Users Globally By 2020, Overtaking Basic Fixed Phone Subscriptions. TechCrunch (TC). http://techcrunch.com/2015/06/02/6-1b-smartphone-users-globally-by-2020-overtaking-basic-fixed-phone-subscriptions/

Luo, X. J., Zhang, X. L., Liu, J., Wu, J. P., Luo, Y., Chen, S. J., ... and Yang, Z. Y. (2008). Persistent halogenated compounds in waterbirds from an e-waste recycling region in South China. Environmental Science and Technology, 43(2), 306-311.

MandS Commitments Report (2015). Our Plan A Commitments 2010 – 2015. [Online] http://corporate.marksandspencer.com/plan-a/85488c3c608e4f468d4a403f4ebbd628

Maboeta, M. S., Claassens, S., Van Rensburg, L., and van Rensburg, P. J. (2006). The effects of platinum mining on the environment from a soil microbial perspective. *Water, Air, and Soil Pollution*, 175(1-4), 149-161.

Mack, L. (2010). The philosophical underpinnings of educational research. Polyglossia, 19, 5-11.

Malthus, T. R. (1809). An essay on the principle of population, as it affects the future improvement of society (Vol. 2).

Mamiit, A. (2015). Mobile devices now outnumber humans: Report. Tech Times [Online] http://www.techtimes.com/articles/17431/20141008/mobile-devices-now-outnumber-humans-report.htm

Margery, P. (2012). Terracycle: Outsmarting Waste. Case Study IMD-3-2311. IMD, Lausanne, Switzerland.

Marshal, J. (2014). Why rare earth recycling is rare (and what we can do about it). Ensia. [Online] http://ensia.com/features/why-rare-earth-recycling-is-rare-and-what-we-can-do-about-it/

Martino, D., Zommers, Z., Bowman, K., Brown, D., Comim, F., Kouwenhoven, P. and De Oliveira, T. (2007). Environment for development. UNEP: Global Environment Outlook, 4, 3-36. [Online] http://www.unep.org/geo/geo4/report/01_Environment_for_Development.pdf

Matten, D., and Crane, A. (2005). Corporate citizenship: Toward an extended theoretical conceptualization. *Academy of Management review*, 30(1), 166-179.

Mattila, T., Judl, J., and Seppälä, J. (2014). Carbon Footprint of Mobile Devices: Open Questions in Carbon Footprinting of Emerging Mobile ICT Technologies. In Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1 (pp. 151-166). Springer Singapore.

Maughan, T. (2015). The Dystopian Lake filled by the World tech lust. BBC News. [Online] http://www.bbc.com/future/story/20150402-the-worst-place-on-earth

McAllister, L. (2013). The Human and Environmental Effects of E-Waste. Population Reference Bureau. [Online] http://www.prb.org/Publications/Articles/2013/e-waste.aspx

Medwechuk, C. (2016). iWaste: The iPhone Environmental Impact. Orchard. [Online] https://www.getorchard.com/blog/iphone-environmental-impact/

Medwechuk, C. (2016). iWaste: The iPhone Environmental Impact. Orchard. [Online] https://www.getorchard.com/blog/iPhone-environmental-impact/

Mertens, D. M. (2008). *Transformative research and evaluation*. Guilford press.

Mickoleit, A. (2010). Greener and smarter: ICTs, the environment and climate change (No. 2010/1). OECD Publishing.

Minter, A. (2013). How effective are Apple's recycling programs? Macworld. [Online] http://www.macworld.com/article/2068823/apple-phone/how-effective-are-apples-recycling-programs.html

Mitchell, D. (1999). *Ghostwritten*. Novel. Hodder and Stoughton. London, United Kingdom.

Morgan, D. L. (2007). Paradigms lost and pragmatism regained methodological implications of combining qualitative and quantitative methods. *Journal of mixed methods research*, 1(1), 48-76.

Mortillaro, N. (2015). Electronic waste is piling up. Here’s why you should care. Global News. [Online] http://globalnews.ca/news/2194391/electronic-waste-is-piling-up-heres-why-you-should-care/

Mortillaro, N. (2015). Electronic waste is piling up. Here's why you should care. Global News Canada. [Online] http://globalnews.ca/news/2194391/electronic-waste-is-piling-up-heres-why-you-should-care/

Mukherjee, R. (1974). *Rise and Fall East India*. NYU Press.

Mullikin, J. (2009). What does One Ton of CO2 Really Mean? aashe. [Online] http://www.aashe.org/blog/what-does-one-ton-co2-really-mean

Nadeau, R. L. (2015). The unfinished journey of ecological economics. *Ecological Economics*, 109, 101-108.

Namibia Rare Earths Inc. (2016). How Are Rare Earths Used? [Online] http://www.namibiarareearths.com/rare-earths-industry.asp

Navazo, J. M. V., Méndez, G. V., and Peiró, L. T. (2014). Material flow analysis and energy requirements of mobile phone material recovery processes. *The International Journal of Life Cycle Assessment*, 19(3), 567-579.

NBC NEWS (2015). "Peru's rainforest turns to wasteland from illegal gold mining" in NBC News, on December 2nd, 2015. [online] http://www.nbcnews.com/news/latin-america/perus-rainforest-turns-wasteland-illegal-gold-mining-n260006

Neil Hunt (2010). Carbon Footprint. [Online] http://nhunt.org/Blog/2010/02/carbon-footprint-online-habit/

Neilson (2015). Consumer-Goods' Brands that Demonstrate Commitment to Sustainability Outperform Those that Don't. [Online] http://www.nielsen.com/ca/en/press-room/2015/consumer-goods-brands-that-demonstrate-commitment-to-sustainability-outperform.html

Neira, J. (2006). End-of-life management of cell phones in the United States. Doctoral dissertation, University of California, Santa Barbara.

Nespresso MBA Challenge (2015). How should nespresso capitalize on the opportunities of the circular economy to build a premium proposition for aspirational consumers? INCAE Business School. [Online] http://sustainabilitymbachallenge.com/wp-content/uploads/2012/12/Backgrounder2015final.pdf

Nexterra News Release (2009). Nexterra biomass gasification system fires up at dockside green. [Online] http://www.nexterra.ca/files/pdf/System%20Fires%20Up%20at%20Dockside%20Green.pdf

Nick, T. (2014). Did you know there was actual gold inside your smartphone? Phone Arena.com. [Online] http://www.phonearena.com/news/Did-you-know-there-was-actual-gold-inside-your-smartphone_id51779

Ninlawan, C., Seksan, P., Tossapol, K., and Pilada, W. (2010). The implementation of green supply chain management practices in electronics industry. *In Proceedings of the international multi conference of engineers and computer scientists*. 3, (pp. 17-19).

Nokia (2015). Footprint of our Product. [Online] http://www.microsoft.com/about/csr/environment/sustainable_devices/footprint/

Nuwer, R. (2014). What is the world's scarcest material? BBC News. [Online] http://www.bbc.com/future/story/20140314-the-worlds-scarcest-material

OECD. (2011). A Sustainable Materials Management Case Study: Critical Metals and Mobile Devices. Working Group on Waste Prevention and Recycling (WGWPR). [Online] http://www.oecd.org/env/waste/49805008.pdf

Oliver, M. (2015). Rate of environmental degradation puts life on Earth at risk, say scientists. The Guardian. [Online] http://www.theguardian.com/environment/2015/jan/15/rate-of-environmental-degradation-puts-life-on-earth-at-risk-say-scientists

Ongondo, F. O., and Williams, I. D. (2011). Greening academia: Use and disposal of mobile phones among university students. *Waste management*, 31(7), 1617-1634.

Overeem, P. (2009). Reset. Corporate social responsibility in the global electronics supply chain. Amsterdam, The Netherlands: GoodElectronics and MVO Platform.

Oxfam Briefing Paper (2014). Working for the few: Political capture and economic inequality. [Online] https://www.oxfam.org/sites/www.oxfam.org/files/bp-working-for-few-political-capture-economic-inequality-200114-summ-en.pdf

Paiano, A., Lagioia, G., and Cataldo, A. (2013). A critical analysis of the sustainability of mobile phone use. *Resources, Conservation and Recycling*, 73, 162-171.

Partridge, K., Jackson, C., Wheeler, D., & Zohar, A. (2005). From words to action: the stakeholder engagement manual Vol. 1: the guide to practitioners' perspectives on stakeholder engagement.

Plenke, M. (2015). 14 Shocking Photos Show What Your Smartphone Is Really Doing to the World. Tech.Mic. [Online] http://mic.com/articles/118620/14-powerful-photos-show-what-your-smartphone-is-really-doing-to-the-world#.ZtHlPjwTW.

Poldner, K. (2010). VEJA: Sneakers with a Conscience. Case Study 9B10M089. Richard Ivey School of Business Foundation.

Porter, M.E. and Kramer, M. R. (2011). Creating shared value. *Harvard business review*, 89(1/2), 62-77.

Pure Earth Project (2015). E-Waste Recycling, Agbogbloshie,Ghana. [Online] http://www.pureearth.org/project/agbobloshie-e-waste/

Rainforestalliance.com (2015). The Sumatran Tiger. [Online] http://www.rainforest-alliance.org/kids/species-profiles/sumatran-tiger

Randby, C. and Chia, S. (2011). Ecoimigination: Imigination at Work. General Electronics Case Study. Scribd. [Online] https://www.scribd.com/doc/71335647/ecomagination-Case-Study

Reed, D. (1999). Stakeholder management theory: A critical theory perspective. *Business Ethics Quarterly*, 9(03), 453-483.

Reinhardt, F., Casadesus-Masanel, R. and Kim, H.J. (2010). Patagonia. Case Study 9-711-020. Harvard Business School. Boston.

Renee, C. (2012). Rare Earth Metals: Will We Have Enough? State of the Planet Earth Institute, Columbia University. [Online] http://blogs.ei.columbia.edu/2012/09/19/rare-earth-metals-will-we-have-enough/

Robinson, B. H. (2009). E-waste: an assessment of global production and environmental impacts. *Science of the total environment*, 408(2), 183-191.

Rodrigue, J. P. (2013). The environmental impacts of transportation. The geography of transport systems. New York: Routledge. [Online] https://people.hofstra.edu/geotrans/eng/ch8en/conc8en/ch8c1en.html

Rodriguez, E., Carrasquillo, O., Lee, C., Lee, J., and Zhou, A. (2015). iGo Green: A Life Cycle Assessment of Apple's iPhone. iConference 2015 Proceedings.

Ross, D. F. (2016). *Introduction to supply chain management technologies*. CRC Press.

Rouse, M. (2016). Bill of materials (BoM). Tach target Magazine, [Online] http://searchmanufacturingerp.techtarget.com/definition/bill-of-materials-BoM

Ryan, R. (2015). Baotou is the world's biggest supplier of rare earth minerals and it's hell on Earth. [Online] http://www.news.com.au/travel/world-travel/asia/baotou-is-the-worlds-biggest-supplier-of-rare-earth-minerals-and-its-hell-on-earth/news-story/371376b9893492cfc77d23744ca12bc5

Satariano, A. (2013). The iPhone's Secret Flights From China to Your Local Apple Store. Bloomberg. Global Tech. [Online] http://www.bloomberg.com/news/2013-09-11/the-iPhone-s-secret-flights-from-china-to-your-local-apple-store.html

Saylam, G. (2015). The Environmental Impact Of Cell Phones. [Online] http://visual.ly/environmental-impact-cell-phones

Schischke, K., Deubzer, O., Griese, H., and Stobbe, I. (2002). Green Electronics K. Schischke, O. Deubzer, H. Griese, I. Stobbe. [Online] from http://www.lcacenter.org/lca-lcm/pdf/Electronics.pdf

Schneider, K.D. (2010). Logistics News: WalMart's inbound freight move could be a game changer. *Supply Chain Digest*. [Online] http://www.scdigest.com/ASSETS/ON_TARGET/10-08-12-1.php?cid=3647

Segev, O., Kushmaro, A., and Brenner, A. (2009). Environmental impact of flame retardants (persistence and biodegradability). *International journal of environmental research and public health*, 6(2), 478-491.

Smith, T. J., and Mayfield, M. M. (2015). Diptera species and functional diversity across tropical Australian countryside landscapes. *Biological Conservation*, 191, 436-443.

Snelgrove, F.M. C. (2015) Gold Mining Deforestation Rapidly Advancing along Upper Malinowski River (Madre de Dios, Peru). MAAP: 19. [Online] http://maaproject.org/2015/maap19-malinowski2eng/

Somheil, T. (2014). Study: global PVC demand to grow 3.2% annually through 2021. Plastics Today. [Online] http://www.plasticstoday.com/study-global-pvc-demand-grow-32-annually-through-2021/196257501821043

Statista Report (2015a). Rare earth reserves worldwide as of 2015, by country (in 1,000 metric tons REO). *The Statistic Portal*. [Online] http://www.statista.com/statistics/277268/rare-earth-reserves-by-country/

Statista Report (2015b). Statistics and facts about Smartphones. Statista. [Online] http://www.statista.com/topics/840/smartphones/

Suckling, J. and Lee, J. (2015).Redefining scope: the true environmental impact of smartphones? *The International Journal of Life Cycle Assessment*, 20(8), 1181-1196.

Sullivan, D.E. (2006). Recycled Cell Phones—A Treasure Trove of Valuable Metals. USGS: Science for a changing world. [Online] http://pubs.usgs.gov/fs/2006/3097/fs2006-3097.pdf

Supply Chain Navigator (2016). Fairphone answers the call for more sustainable electronics. Supply Chain Navigator, An Avnet Publication. [Online] http://scnavigator.avnet.com/article/winter-2016/fairphone-answers-the-call-for-more-sustainable-electronics/

Sustainability Report (2015). Environment Special Report. http://www.samsung.com/us/aboutsamsung/sustainability/sustainabilityreports/download/2015/SAMSUNG%20SUSTAINABILITY%20REPORT%202015_ENG%20-%20ENVIRONMENT.pdf

Szilágyi, A. (2013). Introduction to Fairphone's LCA project (pp. 1–14). Amsterdam. [Online] http://szilagyiartur.files.wordpress.com/2014/03/5.pdf

Tashakkori, A., and Teddlie, C. (Eds.). (2010). *Sage handbook of mixed methods in social and behavioral research*. Sage.

Thavalingam, V., and Karunasena, G. (2016). Mobile phone waste management in developing countries: A case of Sri Lanka. *Resources, Conservation and Recycling*, 109, 34-43.

The Guardian (2014). Agbogbloshie: the world's largest e-waste dump – in pictures. [Online] http://www.theguardian.com/environment/gallery/2014/feb/27/agbogbloshie-worlds-largest-e-waste-dump-in-pictures

The Natural Step (2015). The Four System Conditions of a Sustainable Society. [Online] http://www.thenaturalstep.org/sustainability/the-system-conditions/

The Washington Post Getty images (2009). Ghana Burn site at Agbogbloshie scrapyard. Wire is being burned to free the copper from its plastic casing. [Online] http://www.gettyimages.ca/detail/news-photo/ghana_tz-inputdate-13-12-43-213-credit-karin-brulliard-news-photo/102976069

Theoharidou, M., Mylonas, A., and Gritzalis, D. (2012, June). A risk assessment method for smartphones. *In IFIP International Information Security Conference* (pp. 443-456). Springer Berlin Heidelberg.

Thornton, J. (2002). Environmental impacts of polyvinyl chloride (PVC) building materials. Briefing paper for the Healthy Building Network. [Online] https://www.healthybuilding.net/uploads/files/environmental-impacts-of-polyvinyl-chloride-building-materials.pdf

Tippayawong, K. Y., Tiwaratreewit, T., and Sopadang, A. (2015). Positive Influence of Green Supply Chain Operations on Thai Electronic Firms' Financial Performance. *Procedia Engineering*, 118, 683-690.

Trading Economics Report (2015). Indonesia: Economic Indicators. *Trading Economics*. [Online] http://www.tradingeconomics.com/indonesia/indicators

UNEP (2002). The state of the planet is getting worse but for many it's still "business as usual". Environment for Development. [Online] http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=248andArticleID=3049

UNEP (2015). Illegally Traded and Dumped E-Waste worth up to $19 Billion Annually Poses Risks to Health, Deprives Countries of Resources. UNEP News Centre. [Online] http://www.unep.org/newscentre/default.aspx?DocumentID=26816andArticleID=35021

UNEP (2015). Waste crime – waste risks gaps in meeting the global waste challenge. [Online] file:///E:/Semester%206%20ENVS/E%20WASTE%20Crime_-_Waste_Risks_Gaps_in_Meeting_the_Global_Waste_Challenge__a_Rapid_Response_As.pdf

US Census Bureau (2015). International Data Base. [Online] http://www.census.gov/population/international/data/idb/informationGateway.php

Valavanidid, A., Iliopoulos, N, Gotsis, G. and Fiotakis, K. (2008). "Persistent free radicals, heavy metals and PAHs generated in particulate soot emissions and residual ash from controlled combustion of common type of plastics". *Journal of Hazardous Materials*, 156, 277-284.

Valente, M. (2014). Complexity Theory. Class 3 Notes. Schulich Business School. 24/09/2015.

Valente, M. (2015). 5 Business Strategies for Sustainability: Business in Sustainable Society. [Online] http://valentemike.blogspot.ca/2015/09/5-common-strategies-for-sustainability.html

Valente, M. (2015). Sustainable Business Strategies. Note from class 2. Schulich Business School. 18/09/2015.

Valente, M. (2015). TATA Chemicals MAGADI: Confronting Poverty in Rural Africa. Case Study 9B15M008. Richard Ivey School of Business Foundation.

Valente, M., and Crane, A. (2010). Public responsibility and private enterprise in developing countries. *California Management Review*, 52(3), 52-78.

Van den Bergh, J. C. (2013). Environmental and climate innovation: Limitations, policies and prices. *Technological Forecasting and Social Change*, 80(1), 11-23.

Veronese, K. (2012). Tantalum is the most important element you've never heard of. Blog: Io9, we come from the future. [Online] http://io9.gizmodo.com/5906833/tantalum-is-the-most-important-element-youve-never-heard-of

Wang, Z.,Richter, H., Howard, J. B., Jordan, J., Carlson, J. and Levendis, Y. A. (2004). “Laboratory investigation of the products of the incomplete combustion of waste plastics and techniques for their minimization. *American Chemical Society*, Ind. Eng. Chem. Res., 43, 2873-2886.

Watson, I. (2013). China: The electronic wastebasket of the world. CNN News. [Online] http://www.cnn.com/2013/05/30/world/asia/china-electronic-waste-e-waste/

Weber, C. L. (2012). Uncertainty and variability in product carbon foot printing. *Journal of Industrial Ecology*, 16(2), 203-211.

Wein, D. (2013). Measuring Wellness Program ROI. Benefits Magazine. [Online] http://www.ifebp.org/inforequest/0163137.pdf

Westervelt, A. (2015). Flame retardants may be coming off of furniture, but they're still in your TV sets. The Guardian. [Online] https://www.theguardian.com/sustainable-business/2015/may/19/flame-retardant-chemicals-tvs-electronics-hazard

Wilcox, C., Van Sebille, E., and Hardesty, B. D. (2015). Threat of plastic pollution to seabirds is global, pervasive, and increasing. *Proceedings of the National Academy of Sciences*, 112(38), 11899-11904.

Willard, B. (2009). *The sustainability champion's guidebook: How to transform your company*. New Society Publishers.

Willard, B. (2012). *The new sustainability advantage: seven business case benefits of a triple bottom line.* New Society Publishers.

William, E. F. (2016). Doomsday Seed Vault" in the Arctic: Bill Gates, Rockefeller and the GMO giants know something we don't. Global Research. [Online] http://www.globalresearch.ca/doomsday-seed-vault-in-the-arctic-2/23503

Wong, C. W., Lai, K. H., Lun, Y. V., and Cheng, T. C. E. (2016). Environmental Management Practices with Supply Chain Efforts. *In Environmental Management* (pp. 29-72). Springer International Publishing.

Wooddell, D.W. (2008). E-Waste. National Geographic. [Online] http://ngm.nationalgeographic.com/geopedia/E-Waste

World of Chemical (2014). Chemicals in your Smartphone. [Online] http://www.worldofchemicals.com/media/chemicals-in-your-smartphone/7593.html

WWF (2015). The Sumatran Tiger. Overview. [Online] http://www.worldwildlife.org/species/sumatran-tiger

WWF Deforestation Report (2015). Threats: Deforestation. [Online] http://www.worldwildlife.org/threats/deforestation

WWF Report (2008). Destruction of Sumatra forests driving global climate change and species extinction: WWF. [Online] http://www.worldwildlife.org/press-releases/destruction-of-sumatra-forests-driving-global-climate-change-and-species-extinction-wwf

Yin, J., Gao, Y., and Xu, H. (2014). Survey and analysis of consumers' behaviour of waste mobile phone recycling in China. *Journal of Cleaner Production*, 65, 517-525.

YORKU Magazine (2008). Sweet Deal. Farouk Jiwa turns rural Africans into honey-making entrepreneurs. [Online] http://fes.yorku.ca/files/2015/08/Jiwa-Farouk-MES-03-York-U_-Magazine-Extract.pdf