Re'fitting the Task to Man': Activating Open Source Methodologies for Industrial Design

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Abstract

Both, market forces and public systems are unable to provide remote rural communities of developing countries with contextually relevant and appropriate technologies. This is because the number of people and their incomes are too low, to constitute either a market or a political constituency. Consequently, development aid and development projects emerge as the primary means of introducing new technologies to these regions. However developmentalism is heavily inscribed with economic determinism resulting in the conception of technologies that are focused at the level of the nation state and whose primary objective is to increase its productive and consumptive capacity in an attempt to jumpstart economic growth. This results in mass technologies that are inherently violent, ecologically damaging and which restrict individual freedoms. Furthermore, these technologies end up replacing rather than building upon the only resource in which the poor are rich; traditional knowledge and the ability to innovate and contextualize technologies to their own local worlds. How can we disembled the conception of technologies from development aid and build upon the resources of the poor instead of seeking to replace them? How can we create a knowledge network that assists in taking the technological innovations of the poor from concept to market and which protects intellectual property rights and allows follow-on innovation.

The emergence of networked computing accompanied by new paradigms of production such as peer to peer and open source along with a rethinking of the ‘commons’ which not only reduces development costs but also geographic barriers to collaboration presents us with a unique opportunity to satisfy these conditions. This thesis will therefore explore the feasibility of engaging with Open Source methodologies for facilitating user led technology innovations in developing countries. This includes the many operational and disciplinary challenges that must be addressed before seeking to contextualize Open Source methodologies for the Industrial Design process. It will investigate the intrinsic character of computer software and its development process for insights that can help determine if the open source methodology can be extended to Industrial Designers and the Industrial Design discipline. If yes, what forms of contextualization would be required? Finally, this study will conclude by outlining guidelines and an architecture for the conception of an Open source Community that facilitates user led technology development.
Statement of Authentication

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

Gaurang Desai
March 2009
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And finally I dedicate this thesis to my daughter Vishakha in the sincere hope that it changes her firm opinion that 'daddy knows nothing'.
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1 Introduction

What are contextually relevant and appropriate forms of technology for developing countries and how do we facilitate their design? This statement outlines not only the research intent but also implies a criticism of the existing forms of technologies that are being introduced in developing countries and by extension, the development discourse which informs their conception. The view that human development automatically follows economic growth and that this growth progresses in definite and pre-defined stages culminating in the modern world is at the core of the development discourse. This promotes the simplistic notion that alternate modes of human existence represent a form of ‘underdevelopment’ that must be ‘treated’ by accelerating economic growth through the application of global technologies.

The conception of technologies being pushed into remote and rural locations of developing countries is therefore informed by ethnocentric notions of human development which assume that the poor in developing countries have no knowledge and therefore no means of helping themselves. In doing so, development strategies seek to replace rather than build upon the only resource in which the poor are rich; traditional knowledge and the ability to innovate and contextualize technologies to their own local worlds. How can we disembed technology conception from development aid and build upon the resources of the poor instead of seeking to replace them? How can we create a knowledge network that assists in taking these technological innovations from concept to market and which protects intellectual property rights while allowing follow-on innovation? The emergence of networked computing accompanied by new paradigms of production such as peer to peer and open source along with a rethinking of the ‘commons’ which not only reduces development costs but also geographic barriers to collaborative product development present us with a unique opportunity to satisfy these conditions. This thesis therefore explores the feasibility of
engaging with Open Source methodologies for facilitating user led innovations in developing countries.
Having broadly introduced the research topic I now conclude this introduction. The remaining sections of this chapter will outline the research logic and the research challenges of this study followed by a summarization of the chapters.

**Economic determinism as development**

In 1972 the tiny Himalayan Kingdom of Bhutan after years of persistent criticism from the World Bank for its poor economic performance and hesitation in implementing its prescribed remedial measures, decided to shut off all external influences including foreign measures of development such as the Gross Domestic Product (GDP), Gross National Product (GNP), etc. Instead, it instituted its own measure, the Gross National Happiness (GNH) index. That is, the country stopped measuring how productive its citizens were and instead merely measured how happy they were. The GNH index was based on the notion that true development of a country requires both, material as well as spiritual development. Accordingly, the GNH index measures:

- The preservation and promotion of cultural values
- The promotion of equitable and sustainable socio-economic development,
- Conservation of the natural environment; and
- Establishment of good governance.

According to a global survey on happiness published in Business Week 2006, Bhutan was the happiest country in Asia and the eighth happiest country in the world. In the same survey, it’s much larger neighbour India with a much stronger economy was ranked only 125th. The Bhutanese example represents a working model of the theories proposed by the Nobel laureate and development economist Amartya Sen who proposed a shift away from economic growth as a measure of development to one that is centered on building people’s capacities and creating societies where an individual’s potential can be realized. To him, poverty is the deprivation of basic rights rather than a representation of low income. Development must therefore be concerned with advancing human well-being and human freedom over all else. This includes a guarantee of political freedom, economic facilities,
social opportunities and protective security in an overall sense of freedom that allows people
to live their lives the way they would like to (Sen 2000). Sen’s inclusive definition of
development however introduced several ‘place based variables’ such as varying cultural
values and social and political means of organization. This required a flexible and
heterogeneous mix of development policies whose specifics are unique to each location and
decided by its contextual dimensions, thereby requiring policy makers to have a holistic
understanding of the unique ways in which peoples worlds are constituted.

Appropriate Technology
Sen (2000, p. 162) alludes to the role technologies play in enriching and sustaining these
worlds as well as identifies the contextual dimensions that must inform their conception
when he suggests that;

"Available technology influences the economic entitlements of people by
determin(ing) the production possibilities, which are influenced by available
knowledge as well as the ability of the people to marshal that knowledge and to
make actual use of it".

In other words, appropriate technologies for people of developing countries are those that are
preferably a product of their own knowledge. Following Sen, this thesis will argue that
instead of seeking to apply newer forms of global technologies to developing countries, we
must find ways to identify, promote and transfer these innovations from one location in
developing countries to another. However, there are many barriers to the evolution and
diffusion of these user-led innovations. This is primarily due to the way in which science, its
knowledge validation processes and its interface with industry is structured. There is a huge
emphasis on large scale industry led Research and Development which completely overlooks
small scale innovators and their innovations. For example, small scale innovators often
suffer from a lack of access to formal scientific institutions resulting in a lack of peer review
process that prevent innovators from optimizing their solutions which in many cases is
instrumental to securing venture funding. Innovators in the formal sector also benefit from
social networking through conferences, symposiums and industry events which fosters
collaborative learning. This is unavailable to small scale innovators. Furthermore, the
rewards for innovators and the diffusion of innovations are severely restricted by the lack of appropriate intellectual property mechanisms for small scale innovations.

Therefore the research challenges can be summed up as:

- Defining and identifying user developed technologies. What are their key features and how do we facilitate their conception?
- How can we create a knowledge network that assists in taking innovations from concept to market and protects intellectual property rights while allowing others in developing countries to benefit from it?

**Appropriating the Open Source for the design process**

The emergence of networked computing accompanied by new paradigms of production such as peer to peer and open source along with a rethinking of the ‘commons’ present us with a unique opportunity to address these conditions. According to Raymond (1998), there are many benefits that can be derived from following 'open systems’ of product development. Open Systems are based on peer review and contributions made by participants from diverse disciplinary backgrounds who view the problem space from his/ her own perspective, thereby enriching the collective solution as well as reducing the costs of development by foregoing personal rights over the artifact in favor of collective rights. This augurs well for our research question which implies that solutions are needed from multiple disciplines and institutional settings. However, while the Internet lowers the technical and economic barriers for distributed collaboration, there are several operational and disciplinary challenges that must be addressed before seeking to contextualize Free and Open Source methodologies for the Industrial Design process. Therefore, this thesis will also investigate the intrinsic character of computer software and its development process for insights that can help determine if the open source methodology can be extended to Industrial Designers and the Industrial Design discipline. If yes, what form of contextualization would be required? This study will conclude by outlining guidelines and an architecture for the conception of an Open Source Community that facilitates user led technology development.
Thesis Summary:

This thesis begins with the research methodology to be adopted for addressing the research questions (chapter 2). Given that development aid and the development discourse are the primary modes of introducing mainstream technologies into developing countries, it is important to first investigate if they are appropriate for developing countries and if not, why they are being persisted with. Therefore, we first investigate the ideological influences that shape the specific features and characteristics of various technologies introduced by the development discourse (chapter 3). This is followed by an investigation of a particular technology not merely as theory but embedded within its practices which include its political, economic and cultural contexts (chapter 4). The outcomes of chapters 3 and 4 help in generating a hypothesis which is then explored in a Case Study Analysis (chapter 5). Based on the rejection of global technologies as inappropriate for developing countries, Chapter 6 investigates alternate technologies that are appropriate for developing countries and sets the parameters for their conception. It also identifies the Open Source movement as a possible way of conceiving these technologies. Chapter 7 investigates the key concepts, features and characteristics of Open Source projects in response to a widespread ignorance of the Open Source movement within design. Open Source is a methodology conceived primarily for the development of dematerialized software which has little relevance to place based contexts. Therefore we need to investigate how it can be contextualized for the design of physical artifacts (chapter 8). Based on the outcomes of this investigation we formulate a possible architecture and guidelines that can assist in the conception of an open source community dedicated to the facilitation of technology design for developing countries (chapter 9). Finally, I conclude by identifying the future work within this domain (chapter 10).
2 Research Methodology

The French philosopher Gaston Bachelard opposed the pervasive view of science as continuously cumulative knowledge. On the contrary, he argued, passed through sharp ruptures or breaks in its history, with each new practice of science requiring the abandonment of previous epistemologies. He demonstrated how the progress of science and technology could be blocked by certain patterns of thinking and social behaviours that he termed 'epistemological obstacles' (Marshall 2005). This is the tendency to import agendas derived from existing paradigms uncritically into the study of science and technology and to see research agendas and questions defined in advance by others, as self evident. That, in the context of this study, is to say that the development discourse presents itself as an epistemological obstacle as it is embedded with uncritical and pre-reflective notions of global technologies as inherently good and socially neutral thereby linking its spread/presence in developing countries to human development and allowing its conception to be delinked from the very context in which it will be used.

Following Bachelard, this study seeks to depart from the preconceived assumptions about the nature, character and use of technologies in developing countries. In seeking to do so it first investigates the role of the development discourse in influencing the conception of technologies. Next, it focuses on a specific technology viz., Information Communication Technologies (ICT) in an attempt to identify the ICT phenomenon as a whole, that is, not merely as technology but as the practices in which it is implicated including their political, economic and cultural contexts. Consequently, the multiple influences that shape the conception of ICTs in developing countries such as the ICT for development (ICT4D) discourse, digital divide and, the networked economy are critically analyzed and the
outcomes from the two investigations in chapters 3 and 4 respectively are used as theoretical constructs that inform the analysis of the selected case studies in chapter 5.

Given the broad definitions of the research topic, the need to rely on multiple sources of evidence and cover several variables combined with the financial and geographic limitations imposed on the study, a Case Study methodology was considered to be the most appropriate. Case studies have long been used for public policy research and especially in the context of this research it is important to note that case studies of specific programs, projects, initiatives, or sites have become an integral part of evaluation research, with evaluations analyzing the implementation processes and the outcomes of such initiatives (Yin 2003). Furthermore, the importance that this study attaches to contextual analysis is shared by the case study methodology (Yin 2003).

Case studies are usually categorized as explanatory, exploratory or descriptive. Explanatory case studies present data bearing on cause-effect relationships. When key variables and the relationships between them are unclear, exploratory case studies, that define analytical questions and establish hypotheses, or descriptive case studies, that present complete descriptions of phenomena within their context, are used. Furthermore, any of these categories may involve single or multiple case studies.

Given the relative novelty of ICT’s in developing countries and the ICT for development discourse, this research study is exploratory and descriptive by nature and involves multiple cases to generate general hypotheses. The selected cases are polar opposites in terms of scale, ownership/participation, and models of operation thereby allowing a broad understanding of the ICT phenomenon. Researching these cases is particularly important as both have been in existence for at least a year, are well publicized in the local and international press, and there are plans to replicate their models across the country where they are currently installed, suggesting that they are perceived to represent successful cases of ICT conception and implementation. This provides crucial insights into the priorities and contexts that informed their development.
Cases can be studied using different methodological approaches. For explanatory case studies, data collection aimed at establishing the validity of a relationship, for example, in statistical terms, is essential. However, for descriptive and exploratory case studies, that seek to identify which variables to measure, what relationships to examine, what questions to ask, or what community groups to survey, qualitative research methods including personal interviews and ethnographies would be the most appropriate. However, due to geographic limitations an extensive literature review involving qualitative research studies, along with an examination of archival sources and statistical information from multiple sources has been undertaken. Through the triangulation of multiple data, this thesis develops a theoretical framework explaining developmentalism’s motives, logic and processes for the conception of technologies for developing countries. This then enables the identification of alternate technologies and methodologies.

Having identified appropriate forms of technology for developing countries, this study will finally seek to address how Open Source Methodologies developed by hacker communities for software development can be repurposed towards the conception of these technologies. It does so by identifying the core characteristics of free software and open source hacker communities and using these characteristics as an analytical framework to study two non-hacker collaborative communities seeking to develop physical artifacts. Insights gained from undertaking such an exercise will assist in the development of an appropriate architecture and mechanisms for an open source community involved in the conception and design of appropriate technologies for developing countries.
3 Development discourse: Its influence on technology and design

This chapter identifies the various political and economic ideologies that operate under the broad rubric of the term ‘development’ and analyses their role in informing the conception of various technologies as well as design’s instrumental role in articulating specific characteristics and functions. As mentioned in the research methodology, the outcomes of this chapter inform the analysis of the selected case studies.

3.1 Developmentalism

The origins of the development discourse are commonly associated with the end of the Second World War and the formation of the United Nations (UN) as a means of avoiding future conflicts. The forerunner of the United Nations was the League of Nations, an organization conceived in similar circumstances\(^1\). The failure of the League to prevent the Second World War was widely attributed, among other things, to its exclusive membership consisting of colonial powers (and/ or their colonies) and their entrenched economic interests. Consequently, after World War 2, Asia, Africa and parts of the Pacific were decolonized by European powers under immense American pressure in the hope that adequate representation would make the UN a truly plural and therefore effective organization for peace and human development. The newly independent nations on the other hand, joined the UN in the hope that they would gain access to modern technologies and aid which could help transform their colonial resource centered economies into competitive industrial economies. The development discourse evolved as a response to these expectations

\(^1\) [http://www.un.org/aboutun/history.htm](http://www.un.org/aboutun/history.htm)
and exchanges and was promoted by the UN as a means of shaping the complex interactions between member states. However, the conception of this discourse was heavily influenced by colonial thought.

The primary aim of colonialism was to graft a capitalist society based on the Western model of laws, private ownership and European culture, in the colonies. Founded in force, as opposed to free will, and ignorant of the unique social structures and modes of production within indigenous societies, the colonial state failed to establish a bourgeois society. This failure gave rise to the belief that indigenous societies lacked the knowledge and ability to self-constitute and self-regulate. Consequently, it declared indigenous societies as dysfunctional or absent and quickly reinterpreted the colonial effort as the great ‘civilizing mission’ (Prakash 2002). The naming of this project had a powerful effect on how indigenous peoples were visualized. It allowed colonisers to designate them as sub-human, disregard their social structures, cultures, ways of being-in-the-world, means of sustenance and how they constituted their geographic habitus (Fry 2005). Besides education, an important innovation of the civilizing mission was the introduction of the concept of community as distinct to society (Prakash 2002). This community consisted of privileged indigenous people who were ‘civilized’ through western education so that they could mediate relations between state and capital as well as state and society. It was these western educated elites who inherited political, scientific and economic power post independence and continue the ‘shaping of their societies’ using modern technologies (including ICTs), to date.

Echoing the colonial beliefs, modernization theory which shaped the development discourse in its early years suggested that developing countries did not have the ability to break out of traditional and outdated modes of production as they lacked the knowledge and resources to do so (Pieterse 2001). To become developed then, they had to merely follow the lead of the West which had perfected the accumulation of capital and directed it into the development of new technologies through the cultivation of an entrepreneurial class to achieve rapid economic growth. This perspective was built on the assumption that all countries progress through similar stages of economic growth with Western industrial capitalism and the consumer society representing its most contemporary moment (Rostow 1960). This promoted the simplistic notion that alternate modes of human existence represented a form
of ‘underdevelopment’ that could be ‘treated’ by accelerating economic growth through the application of global technologies. Modernization theory therefore proposed the provision of economic aid and technologies to developing countries in an attempt to equip them with the necessary ‘knowledge and resources’ that would enable them to achieve rapid economic growth.

However, by the late 1950’s, Raul Prebisch who was studying the trickle down effects of economic activity in rich developed countries on poorer developing economies for the UN Economic Commission on Latin America, proposed that these policies had resulted in a global economic architecture which consisted of rich industrialized countries in the center and developing countries producing and exporting raw materials at the periphery (Prebisch 1984). Prebisch’s dependency theory blamed poverty in the periphery to skewed patterns of exports and imports and therefore prescribed protectionist and import substitution driven regimes for its economic development. Here, it is important to note that Prebisch retained the core ideologies of modernization theory and merely sought to regulate the exchange between the developing and the developed nations by advocating import substitution.

Both, modernization theory and dependency theory can be classified as non-evaluative development ideologies. That is, both equated human development with economic growth and in both cases the focus was on transcending the problems of underdevelopment by seeking to fundamentally or structurally alter the national economy, irrespective of its social consequences. So for example, the prescribed response to the massive slowdown in Nigeria’s Gross Domestic Product (GDP) by the IMF in the early 1980s, induced by reckless external borrowings and corrupt practices under a military dictatorship were structural adjustment programs that required the Nigerian government to open its oil resources to foreign investments, sell off public sector utilities and eliminate vital subsidies for the poor in an attempt to shore up revenues and reduce ‘non-core expenses’ (Husain & Faruque 1994). The hardships that such programs place on the poorest sections of society or, that local communities derive little benefit from the exploitation of natural resources by state and foreign corporations, are of little or no consequence to these two theories so long as GDP targets and revenue surpluses are achieved. Consequently, the focal unit for economic growth was always the nation-state and the principal objective was to increase its productive and consumptive capacity which it was assumed would trickle down to society and redress
the problems of poverty. The individual was never a focus of attention for the two theories and the conception of technology progressed at the level of the nation-state resulting in the rollout of mass technologies such as dams, roads, ports etc.

*Neo-liberalism* arrived on the global stage by the late 1980s, in response to the deepening slump in the developed economies of the West. It called for radical structural readjustments, deregulation, liberalization and privatization which essentially entailed the roll back of Governments in favor of markets. At the core of neo-liberal thought was the belief that what mattered most in an economy was to get the prices right and that markets were the best mechanisms for discovering it (Pieterse 2001). The intervention by governments/ welfare states distorted this discovery mechanism due to their “large bureaucracy, top down methods and inherent tendency for corruption” (Byres 2004). Therefore neo-liberalism recommended that governments restrict themselves to policy making and make the economy more efficient by privatizing public sector enterprises, and deregulating financial and commodity markets to allow newer players into the market towards spurring competition. It also called for the liberalization of foreign trade so that the core competencies of an economy could be realized. The emergence of China as the factory of the world and India as its service provider are therefore, according to neo-liberal thought, a consequence of their core competence in cheap and/ or skilled labour while their outsourcing by western economies represent their competence as pioneers in the new economy.

Under this new prescription, development aid and projects were also considered as price distorting influences. Consequently, the role of multilateral agencies such as the UN and the World Bank were limited to policy making while implementation was left to market intermediaries and/ or private investors. In summation, neo-liberalism retained the core values, ideologies and goals of modernization theory whilst significantly differing from it in terms of how these goals were to be achieved (Simon 1997).

Neo-liberalism is a non-evaluative development ideology like modernization and dependency theory. However, in the case of neo-liberalism the principal actors are market functionaries as it is set in a world system of globalization which is dominated by transnational corporations and non governmental organizations. Therefore, what is important in a neo-liberal world is how well the smaller markets get integrated into global markets and
therefore it requires individuals of diverse communities to align themselves to universal global goals (Prakash & De 2007). Here again technology conception progressed at a global scale leading to the introduction of ICTs in developing countries.

While a number of World Bank reports (Milanovic 1999; Shaohua and Ravallion 2000) documented how initiatives based on the above policies had helped to reduce poverty, improve healthcare and provide access to the most basic necessities of life in developing countries, the evidence on the ground did not seem to match up. This is not to suggest that this study questions the authenticity of those reports but that there is a problem of measure and method in development practice. In his seminal article ‘Planet of Slums’, Mike Davis (2004) identified the limitations within the current approach and the resulting economic underclass that these very policies had helped to create. The rapid rise of an alternate ‘informal economy’ operating out of urban slums must be seen as a response by the poor to collectively secure their future in the absence of formal economic and political help (Desai & Yadav 2007). By emphasizing ‘economic growth’ over all else as a measure for development and relying heavily on quantitative methods, development aid fails to reach the ones who need it the most. In response, the Nobel Laureate and welfare economist Amartya Sen suggested a shift from economic growth as a measure for development to one that was centered on building people’s capacities and creating societies where an individual’s potential could be realized. To him, poverty was the deprivation of basic rights rather than a representation of low income. Development must therefore be concerned with advancing human well-being and human freedom over all else (Sen 2000). This includes a guarantee of political freedom, economic facilities, social opportunities and protective security that provides people with the freedom to choose and live their lives in the way that they would like to.

Human centered development can therefore be classified as an evaluative development ideology. That is, development is perceived as an improvement in the quality of life of each individual. According to Sen (2000), while free markets may be efficient instruments for the delivery of development aid, the absence of appropriate and fair regulatory mechanisms might result in many intended beneficiaries being left out of development programs. He therefore advocated a shift in the emphasis of development to its principal beneficiaries that is, the individual, rather than the state as in the case of non-evaluative ideologies.
Having identified the various political and economic ideologies that operate under the broad rubric of the term ‘development’, the next section analyses their role in informing the conception of various technologies as well as design’s instrumental role in articulating the specific characteristics and functions of technological development.

3.2 Development: Informing the conception of technology design

Before we proceed to an analysis of the relationship between developmentalism, technology and design, we must provide a context of how technologies are perceived and therefore conceived. Technology is commonly perceived as a set of tools, equipment, machines and processes that help to solve human problems. Therefore, what constitutes a ‘problem’ in a particular context ends up informing the conception of technologies. In the case of developmentalism, if the problem is perceived to arise from a lack of economic growth then technologies are geared towards increasing productive capacity.

According to Prakash and De (2007), industrialization was the primary vehicle for development in both modernization and dependency theories. The former was concerned with introducing productivity enhancing technologies in primary export sectors of developing countries such as agriculture and mining activities. In the case of the latter, technology was to be used for manufacturing high-value finished goods, which were earlier imported from the countries of the center (Prebisch 1984). Therefore, large technical projects and mass production capabilities, in most cases controlled by the state, became primary vehicles for the transformation of under-developed low income countries into developed countries under both, the modernization and dependency theories of development. Therefore, technology took the shape of large dams that helped produce electricity, tractors and farm equipment that improved agricultural output and mass transportation systems that helped make raw materials, finished goods and labor more mobile.

During developmentalism’s early years from 1950s to the early 1970s, many designers attached themselves blindly to mainstream developmentalism. Product designers developed national ergonomic standards and anthropometric databases to fit modern mass technologies to local workers while graphic designers and filmmakers developed appropriate typography, culturally relevant symbols and documentaries respectively in an attempt at mass
communicating with both, literate and illiterate end users about the appropriate and efficient use of these technologies. Many also participated in UNESCO’s functional literacy programs aimed at helping end users better utilize mass technologies as in the case of farmers being able to read tractor operation and maintenance manuals so that they could ‘modernize agriculture’, increase farm outputs and reduce their nation’s dependence on foreign food imports.

In the case of human centered development, the distributional concerns and individual capabilities were not considered inferior to the aggregative economic ones espoused by the dominant development ideologies. Consequently, human centred development found mass technologies to be “inherently violent, ecologically damaging, and contemptuous of the individual” (Schumacher 1973, p. 128), and sought technologies that assisted manufacturing by the masses as opposed to mass manufacturing. The focus was therefore on technologies that build on local technological traditions, blending with and enhancing local cultures in the process (Diwan & Livingston 1979).

Designers’ response during this period from the early 1970’s to 1980 was informed by E.F. Schumacher’s applied economic theory. Schumacher believed that modern economic policies, devised in the name of profit and technological progress had created rampant inefficiencies, environmental degradation and dehumanized labour conditions. In response, he proposed the introduction of ‘intermediate technologies’, that is, technologies between the advanced yet capital-intensive technologies of the ‘West’ characterized by large scale production and profit, and the traditional subsistence technologies of developing countries. According to Schumacher, cheap locally developed solutions would be far more effective than imported technologies as they could be more easily integrated into the local economies and cultures of developing countries. Some of the interesting outputs of the intermediate technology movement included a radio receiver (Figure 1), mechanical wind-up powered torch and portable radio transistor. The radio receiver (Papanek 1976), for example, was made up of a used juice can and paraffin wax as a power source. Once the wax was used up it could be replaced by more wax, paper, dried cow dung or anything else that was combustible.
While the approach of human centred development was well meaning, it had its origins in western technical rationalism. According to Fry (2005) it posited a faith in technology as a means to instrumentally or economically solve problems. Thus, it was blind to the problems created by the introduction of those technologies such as: the displacement of local economies and the cultures they sustained; changing the symbolic status of craft skills and the people who possessed them. In many ways, it represented an effort to induct the local economy into global order of capital.

Finally, neo-liberalism, sought to augment globalization by calling for the roll back of governments in favor of market intermediaries such as transnational corporations and private market participants. The problem here was defined in terms of the lack of appropriate information to make markets more efficient as well as the unwieldy and inefficient influence of the state in various sectors that distort the price discovery mechanisms of markets. Technology therefore had to facilitate the provision of critical information that made
government interactions with private intermediaries and society more efficient and in certain cases provide the state with suitable exit opportunities through technology substitutes (Prakash & De 2007). The rise of information communication technologies and various initiatives such as e-governance as well as the ongoing process of digitizing citizen information through national identity cards, e-passports etc in recent times must be seen in the light of these ideologies and global processes. However, as information technologies are capital intensive and built on assumptions of specific forms of literacy, their diffusion in developing countries remains restricted. Consequently, the design effort has focused primarily on reducing the cost of access devices as in the case of the One Laptop Per Child\(^2\) and Intel Classmate PC\(^3\) or relying on shared computing services (Pawar & Toyoma 2007), while interaction designers have sought to bridge the literacy and linguistic divide by developing text-free user interfaces (Prasad et al 2008; Medhi & Toyama 2007) and typefaces that allow the input of regional texts (Joshi et al 2004).

To conclude, the conception of technologies for developing countries is invariably informed by specific notions of development which can be broadly classified into the economic and the human centered. Economic perspectives which include modernization theory, dependency theory and neo-liberalism are focused at the level of the nation state and the principal objective is to increase its productive and consumptive capacity. Consequently, it results in aggregative mass technologies focused at the scale of the nation state and towards enhancing mass production. Mass technologies are inherently violent, ecologically damaging and restrict individual freedoms. On the other hand, the human centered approach despite attaching significant importance to an individual’s context and freedom, results in solutions that are merely ‘system inductive’.

In both cases however, design betrays a complete lack of self belief tending to subordinate itself as a blind functionary to the development agenda, inheriting its ethics, values and worldviews. Design solutions are invariably premised on the ethnocentric notion that the modern world is desirable and superior as compared to local cultures and therefore

\(^2\) [http://laptop.org/en/]

\(^3\) [http://www.classmatepc.com/]

necessitates an erasure of the past. That is, modern technologies do not have to consider local cultures, modes of production and indigenous ways of being in the design of new technologies.
4 Technology, Practices and Contexts

The preceding chapter outlined a historical, linear and causal relationship between the development discourse and the conception of technology. However, it does not adequately describe the ‘technological phenomenon’ as a whole, that is, the practices in which technologies are implicated including its political, economic and cultural contexts. This chapter will therefore seek to investigate the characteristics of one particular form of technology: ICTs. Accordingly, this chapter is split into two components. First, it identifies the unique characteristics of ICTs which are instrumental to how the networked economy is constituted and operates. This includes the perceived human, political and economic advantages of the networked economy over the industrial economy, and which inform the logic of the development discourse in seeking its spread to developing countries. This is followed by an investigation of the ground realities in developing countries and the implications of introducing ICTs there.

4.1 Part 1: The Networked economy

The contemporary global economy or, the networked economy as it is known, is a product of two mutually reinforcing processes; globalization and the development of information technology. In its early stages, globalization was driven by the collapse of communism, the privatization of public sector enterprises and the creation of a global market facilitated by the liberalization of trade, labour and financial markets. The arrival of digital tools and ICTs at the turn of the century helped to reinforce and accelerate this process by dematerializing products, services and resources into easily tradable and transmittable information. Globalization, in turn, provided information technology corporations with ready markets that were in constant need of inter-operable and therefore standardized digital tools. Once these
technologies had achieved sufficient penetration, intense competition among businesses drove the development of even more efficient forms of information technology. This virtuous spiral of efficiency chasing the expansion of markets and vice versa was often credited with the increase in global productivity, innovation and employment (UNDP 2001).

**Technology induced Innovation and Productivity**

Unlike the industrial economy, corporations in the networked economy face negligible transportation, information access and communication costs. The price for e-mailing a 40-page document from Chile to Kenya in 2001, for example, cost just 10 cents while faxing and couriering it could cost as much as $10 and $50 respectively (UNDP 2001). The introduction of ICTs therefore facilitated a horizontal and flatter organizational structure that was far more conducive to innovation and operational flexibility in comparison to the compact and vertical structures that were evolved towards conserving costs during the industrial era. The outsourcing of critical business functions to external agencies as well as the proliferation of small and specialized service providers such as design research agencies, management consultants and market research firms among many others, was a direct consequence of the introduction of ICTs. Furthermore, their complex interactions, with each playing a niche role, created the value chains that drove the technology-based global economy. When globally mobile scientists and technologists moved, for example, they carried with them valuable networks of finance, business contacts and skill transfer that furthered greater cooperation between the two locations as evidenced in the case of Bangalore and the Silicon Valley (UNDP 2001).

Information communication technologies were also credited with increasing productivity and economic growth. According to a document published by the Office of the President of the USA (2001), the use of computers and the Internet raised productivity in the manufacturing sector of the USA, from 1% in the preceding 20 years to 3% a year since 1995 while, the computer sector, including hardware, software and the Internet, accounted for about a quarter of the overall economic output during the 1990s.
Political and Cultural benefits of ICTs

However, the benefits of ICTs extended well beyond the economic to include the political and the cultural. According to the UNDP (2001), the two-way communications facilitated by ICT’s helped to spread and reinforce democracy. In the Philippines for example, an electronic advocacy network was set up in early 2001 in response to the impeachment trial of former President Joseph Estrada, collecting more than 150,000 petition signatures and coordinating a letter-writing campaign that targeted senators to vote with their consciences, not with their vested interests.

In Honduras, an organization of small-scale fishermen sent Congress a video of the illegal destruction of their mangroves by politically powerful commercial farmers, raising awareness and protesting against the loss of their livelihoods and habitat. According to the same UNDP report, virtual committee rooms could, in the future, allow citizens to testify on various issues, further expanding the Internet’s possibilities for enhancing participation (UNDP 2001)

Furthermore, the internet helped a globally mobile workforce keep in touch with developments in their homeland. Consequently information technologies were seen as having both, the potential to advance human development as well as spread the capabilities to benefit from that potential. Not surprisingly, ICT’s were considered vital for economic growth as well as human development with some suggesting that they could even transform social, political and cultural practices in the not-too-distant future. (UNDP 2004)

Scalability in technology

At the heart of these projected transformations was the dramatic increase in computing and communications power ensured by the emergence and rapid evolution of microprocessor and fiber-optic technology. According to Moore’s law (Figure 2) computing power doubled every 18–24 months due to the rapid evolution of microprocessor technology while Gilder’s law predicted the doubling of communications power every six months, due to advances in fiber-optic network technology (Gilder 2007).
This growth in computing power triggered a veritable race among hardware vendors for developing digital devices that could exploit that power and offer peripherals that could further extend its capability. This intense competition and the ensuing technological obsolescence of devices resulted in very fast yet cheap devices which could record, organize, retrieve, display and disseminate information at a fraction of the price it used to, in the
industrial era. For example, the cost of a megabit of storage had fallen from $5257 in 1970 to 17 cents in 1999 while the cost of transmitting a trillion bits of information from Boston to Los Angeles has fallen from $150,000 in 1970 to 12 cents. A three minute phone call from New York to London that cost more than $300 (in today’s prices) in 1930, cost less than 20 cents in 2001 (Chandrasekhar 2001). The unleashing of this cheap yet enormous processing, storage and distribution power has resulted in more people having access to more information at a lower cost (Figure 4). For example, Internet users grew from 16 million users worldwide in 1995 to more than 400 million users in 2000 and were expected to rise to 1.5 Billion by 2007 (Reid 2000). While, Internet World Stats a reputed internet statistics organization reported that this figure was only achieved in June 2008, it nevertheless represented an astounding rate of growth. Furthermore, there were about 2.5 billion unique, publicly accessible web pages on the internet in 2004 (University of California 2001) which by July 2008 had grown to one trillion (Google 2008).

![Figure 4: More People Have Access to More Information at Lower Cost](http://www.internetworldstats.com/stats.htm)

So what does the future hold? According to the World Information Technology and Services Alliance (WITSA), an organization representing some of the largest technology corporations, global spending on ICTs had grown to $3.7 trillion dollars in 2008 which was

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4 http://www.internetworldstats.com/stats.htm
further projected to rise up to $4 trillion by 2011 (WITSA 2008). Furthermore, internet usage was expected to sustain its growth rates of upwards of 300% per year, well into the second decade of the new millennium, feeding the huge wave of optimism about the future of the networked economy.

**Technology induced Human Development**

The ability of ICT’s to influence not only the economic but also the social and cultural resulted in the belief that human development and technological advance were mutually reinforcing processes. According to the UNDP Human Development Report of 2001, ICTs create a virtuous circle whereby technological innovations enhance human capabilities by improving people’s health, nutrition, knowledge and living standards, and increasing their ability to participate more actively in the social, economic and political life of a community. This in turn, created the conditions that fed the conception of new forms of technology. Furthermore, technological innovation was also seen as the means of progressing human development because of its impact on economic growth through the productivity gains it generated. It created new activities and industries contributing to economic growth and employment creation (Figure 5).

![Mutually Re-enforcing: Human Capabilities and Technological Change](UNDP 2001, p. 28)
Digital Divide

However, like any other form of market centered innovation, information technology did not go where profit margins were low such as rural areas and developing countries, giving rise to the problem of the digital divide. Consider for example, the following statistics; by 2004, 88 percent of Internet hosts were in North America and Europe and 0.25 percent in Africa - half of which were concentrated in South Africa (Ya’u 2004); half the world population had yet to make its first phone call or the fact that telephone line density in Tokyo exceeded that of the entire continent of Africa (Campbell 2001).

Figure 6 Digital Divide – Fixed Line Densities (ITU 2009)
On the other hand, the economic indicators for these locations during this period were also worrisome with 46% of Sub-Saharan Africa and 40% of the overall population in South Asia (India, Nepal, Pakistan, Bangladesh and Sri Lanka) living under the poverty line (living on less than $1 a day) as compared to less than 15% in the Pacific and Latin America (World Bank 2001). Furthermore, 35% of the total global populations living under the poverty line lived in Africa, 28% in South Asia and 32% in East Asia (Kandachar et al 2007). These stark figures reinforced the proposition that human development and technological advance were mutually reinforcing processes, and that the digital divide if left unattended could exacerbate existing social and economic disparities. Consequently, bridging the digital divide took on an urgency towards the turn of the century leading to the inclusion of ICTs in development policies, giving rise to the ICT for development (ICT4D) discourse. The ICT4D discourse then sought to bridge the digital divide, accelerate human development and make the process of globalization more equitable.
Millennium Development Goals

While ICT’s were included in development programs as a means of overcoming limitations of the market-based model, developmentalism itself was heavily influenced by neoliberalism. Under the banner of this new economic rationalization “donor countries” of the West found it increasingly difficult to finance development in developing countries. By the year 2000, disturbed by the slow pace of development programs, the UN Secretary General Mr. Kofi Annan consented to voluntary and unmonitored initiatives led by the private sector in development projects. Private sector investments, arranged through public-private partnerships became a substitute for development funding and a means for corporations to exhibit ‘corporate social responsibility’.

At around the same time, 189 heads of State (the largest gathering of world leaders in history) met at the Millennium Summit in September 2000 and adopted the UN Millennium Declaration \(^5\) committing their nations to a new global partnership to reduce extreme poverty and setting out a series of time-bound targets, with a deadline of 2015. These have since become known as the Millennium Development Goals (MDG). The MDGs addressed extreme poverty in its many dimensions – income poverty, hunger, disease, lack of adequate shelter, and exclusion – while promoting gender equality, education, and environmental sustainability. They also included basic human rights such as the rights of each person on the

planet to health, education, shelter, and security. More relevant to this study Goal 8 sought to:

*Develop a global partnership for development; ...in cooperation with the private sector, (to) make available the benefits of new technologies, especially information and communications* (Target 18)

These initiatives helped open the doors for various development programs to large technology corporations such as Cisco Systems offering ICT courses in developing countries in partnership with the UNDP (McLaughlin 2005) and Microsoft’s participation with the Indian Government in various electronic governance projects such as Bhoomi (which will be addressed later on in this thesis) and Bangalore One (DH News 2002), among many others. Their participation quickly changed the focus of development programs from an emphasis on health, education and working conditions to e-health, e-learning and e-governance respectively.

The ICT4D discourse then can be assumed as being influenced by those seeking to bring economic efficiencies to the global economy through technological means, corporations seeking to exhibit corporate social responsibility, and others who see technological progress as being central to human development. These are mutually contradicting positions that raise fundamental questions about how ICT’s are conceived and diffused in developing countries; which of its influencing ideologies and motivations is a higher priority? And, who makes these choices?

According to Simon and March (1958), policy making is constrained by inherent limitations of time and resources on the part of its participants. Consequently, policy making is a political process that requires decisions to be made that affect the material interests of various groups within society (Hawkesworth 1998). The next section of this chapter will therefore argue that the focus on the digital divide in recent times reflects the converging interests of a select few and their ability to collectively set the political agenda in such a way that the digital divide is seen as a far more serious and important social problem than literacy, education and health.
4.2 Part 2 - Digital Capitalism

ICT’s seek to augment globalization. However globalization is not merely the exchange of goods and trade at a global level but represents a new sophistication in the practices of capitalism. This new form of capitalism, popularly termed as “digital capitalism” (Pieterse 2005, p. 11) is its most contemporary form and follows mercantile and industrial capitalism. Like its previous forms, it is marked by the quest for cheap labour and newer markets to dump its finished goods.

Mercantile Capitalism
Mercantile capitalism was marked by the need for raw materials to feed the burgeoning manufacturing sector of the West. It was initiated in the 18th Century through global trade by private companies of the West such as the Dutch East Indies Company and the East India Company. However the need to ‘secure’ the supply of raw materials and markets to dump its finished goods resulted in the colonization of its trading partners.

Industrial Capitalism
The post World War Two period saw the emergence of two new superpowers; the United States and the Soviet Union. While the latter shunned capitalism, the United States found the closed markets of the colonies problematic for its economic agenda. According to the prominent economist Wade (2003), its strategy was three pronged whereby it first sought to pressurize colonial powers to grant independence to their colonies. Next, it quickly shaped a new global economic architecture through the Bretton Woods treaty which made the American dollar the central currency for international trade thereby providing the Federal Reserve Board with the liberty to print limitless amounts of currency without affecting its core economy. Among other things, it made foreign governments holding vast foreign currency reserves in US Dollars a stakeholder in its economic wellbeing thereby extending its influence across the globe. And finally it was the primary initiator and economic donor of new post war multilateral agencies such as the United Nations, and the International
Monetary Fund (IMF) through which it managed to manufacture consent for its agenda and oversee the smooth operation of this new economic architecture.

Industrial capitalism operated through a system of seemingly ‘impartial multi lateral agencies’ generating development theories and research reports which inevitably ended up supporting the economies of the developed world by seeking to structurally readjust the economies of the developing world. Accordingly, modernization theory prescribed that development for developing countries entailed a shift from an agricultural to an industrial economy. This was affected through structural adjustment programs dictated and funded by the World Bank and the IMF. This prescription also fitted in well with the needs of western industrial economies to outsource low value or partially finished products such as automobile components and heavy industry spares to developing countries. As a result, in the period between the 1950s and 1975 the manufacturing output of developing countries almost doubled from 4.8% to 9% while that in the western economies experienced a decline from 72% to 65% (Dicken 1986). Also, the proportion of manufactured exports from the developing countries increased from 17% in 1963 to 50% in 1977. This phenomenon was dubbed as the New International Division of Labour (NIDL) which was to subsequently give rise to the first of the Multinational Corporations and their quest for cheap labour and newer markets in developing countries. According to Dicken (1986), the NIDL was facilitated by:

- Cheap labour made available by migration of agricultural labour to urban centers due to the ‘land reforms’ advocated by multilateral agencies and the ensuing mechanization of agriculture.
- Deskilling of the manufacturing industry due to the sophistication and automation of the manufacturing process and,
- The provision of transportation and communications infrastructure.

All of the above were achieved through prescribed structural adjustment programs which were funded at attractive lending terms by global lending agencies such as the World Bank and accepted by the corrupt and/ or inefficient governments of the developing countries.

6 http://www.imf.org/external/index.htm
According to Frobel, et al (1980, p. 13), “Infrastructure projects – transportation, communications, and electric power – are the traditional areas of Bank lending. They dominated the lending patterns in the 1950s and even after the expansion of lending for agriculture and so-called social infrastructure projects in the past two decades, they remain among the largest sectors in volume of money spent.” This resulted in the financing of large-scale infrastructure projects such as the development of large dams, roads and ports, essential to the shift to Industrial Capitalism. As Payer (1982) points out, the ‘miracle economies’ of South East Asia, all followed this pattern of development reflecting the shift from agricultural to industrial economies. For example, in the case of the Philippines, a key destination for transnational capital, 64% of public sector spending in 1982, derived out of foreign borrowings went into infrastructure projects while, spending on capital projects went up from 1.2% of GNP in 1970 to 7.3% in 1978 (Payer 1982).

**Digital Capitalism**

Digital capitalism involves the creation of a global market and facilitating the interactions of this market with and amongst local markets in an attempt to maximize profits by capitalizing on the arbitrage opportunities presented by the compositional and structural variations in the underlying economy of each of the participating markets. The most prominent among these is the labour arbitrage business model. Just as mercantile capitalism sought their raw materials and industrial capitalism used them as a manufacturing platform, digital capitalism sees developing countries as a valuable resource for offshore information processing (Luyt 2004).

In dedicated offshore data and voice processing centers across the Philippines, India, South Africa and Mexico, English speaking workers use telephones, fax and email to sell products/services, conduct commercial transactions and handle pre and post-sales queries. It has been estimated, that by 2015, the USA would lose 472,632 jobs in the information technology sector (Mieszkowski 2003). Furthermore, according to an IDC report (Ravi 2005, p. 1), “worldwide spending on Business Process Outsourcing (BPO) services which totaled approximately $384.5 billion in 2005” was expected to “increase to $618 billion in 2010 for a five-year compounded annual growth rate (CAGR) of 10%.”
The offshoring of information processing to developing countries also makes it a market for the purchase of software, hardware and information technology. According to the 2007 Global Piracy Report by the Business Software Alliance (BSA)⁷, “the voice of the world's commercial software industry and its hardware partners before governments”, the combined losses due to software piracy in 2007 were to the tune of USD 8950 million, in Asia (excluding Japan, Singapore, Australia and New Zealand). Furthermore, according to the report the legitimate software market in China alone grew to nearly USD 1.2 billion, an increase of 88% over 2005, and a growth of 358% since 2003. To put these figures in perspective, the overall size of the software market in the developing countries alone is put at USD 25 billion as compared to USD 80 billion in the developed economies of the West.

However, according to a news report titled ‘Has the BPO bubble burst?’ in the prominent Indian daily, Times of India, workers at call centers were increasingly frustrated with working conditions, including having to work at odd hours, having to adopt fake American and European accents and ‘local knowledge’, and with limited prospects of career progression. Not surprisingly, a report by Datamonitor (2003) found that attrition rates among data entry and voice operators in India reached 30 to 35 percent in 2003. According to Luyt (2004, p. 6), “these are precisely the reasons that resulted in high attrition rates in the USA and a key incentive for corporations to outsource work to the developing countries in the first place.” Furthermore, rising wages and a stronger Indian currency have made Indian services more expensive and have given rise to competitors in China, Morocco and Mexico. In response, leading Indian companies are hiring workers and opening offices in other developing countries themselves, before their clients do. In May 2007, Tata Consultancy Service, the second largest software services company in India announced a new back office in Guadalajara, Mexico; Tata already had 5000 staff in Brazil, Chile and Uruguay. Wipro, another Indian technology services company, had outsourcing offices in Canada, China, Portugal, Romania and Saudi Arabia, among other locations. Furthermore, in a poetic reflection on outsourcing’s new face, Wipro's chairman, Azim Premji, told Wall Street analysts that he was considering hubs in Idaho and Virginia, in addition to Georgia, to take advantage of American "states which are less developed". (Giridharadas 2007) These are

clear indications that digital capitalism will be in a perpetual search for new markets and populations willing to engage in such labour.

However, it raises a fundamental question of whether the offshoring of call centers and software markets is all there is to the network economy and digital capitalism? Are they large enough to constitute an entire economy? In the next section we take a look at the anatomy of the digital economy and how it works.

4.2.1 Anatomy of the digital economy

As mentioned earlier, the networked economy is a product of two mutually reinforcing processes: globalization and the development of information technology. Unlike the industrial economy, corporations in the networked economy face negligible transportation, information access and communication costs due to the introduction of information technologies. This affords a horizontal organizational structure, which is far more conducive to innovation and operational flexibility compared with the compact and vertical structures evolved towards conserving costs during the industrial era. In some cases, entire departments were hived off to form new companies. For example, Agilent Technologies was hived off from Hewlett Packard and Avaya Telecommunications from AT&T among many others. This increasingly complex process is often explained by terms such as flexible accumulation, post-fordism and flexible production. Put simply they refer to the mechanisms engineered to facilitate the globalization of demand and supply, the building blocks for markets.

Mode of production refers to the synthesis of distributed manufacturing units and the unique organizational structure of firms, facilitated by digital technologies. With rapid innovations in information and communications technology, it is easier and cheaper for firms to relocate production plants to low wage areas as well as track and monitor their operations (Luyt 2004). However, ICTs also make it easy to compare critical business information such as costs, delivery times and other conditions being offered by competing production units located in developing countries. This results in fierce competition for the outsourced business amongst the manufacturing units of developing countries, resulting in aggressive downward pricing. With each new facility that opens in developing countries, the reduced costs and increasing profit margins make the rationale for ‘outsourcing’ irresistible to
corporations in the West. This vicious cycle of outsourcing, increased competition and which in turn further reduces costs represents the globalization of supply.

The infrastructure required to sustain these ICTs however are extremely capital intensive due to a mix of varying technology regimes, telecom infrastructure, proprietary software, and rapid obsolescence of hardware requiring constant upgrades. However, the ease with which data capacity can be expanded once it is installed makes the search for newer applications inevitable. The success of websites such as eBay\(^8\), entertainment portals such as Bigpond \(^9\) from Telstra that sell movies and music online, as well as a wide range of online services ranging from airline tickets to financial services are symptomatic of this logic. Consumers can now compare prices and buy or sell any product, brand or service over the internet irrespective of where the site is hosted or the warehouse supplying the goods is physically located, effectively globalizing demand.

Finally, modern ICT’s not only facilitate markets but constitute them in a virtual form by the deregulation of the financial sector and the securitization of assets. Securitization is the process by which illiquid assets, such as houses, land and even mortgages are made tradable, by their conversion to digital forms (Pieterse 2005). The need to achieve greater efficiency by reducing transaction times and costs to effect globalization initially inspired the conception of securitization. Once introduced, it also brought about the realization that non-movable assets such as real estate could overcome the limitations of local markets and be traded globally by the creation of a virtual proxy. As securitization matured it also helped financial markets expand by becoming more inclusive and allowing new participants such as household savings and retail speculators access to markets alongside traditional investors such as the big banks and Financial Institutions. The simultaneous boom in all financial assets ranging from commodities and shares to real estate in recent years is a direct consequence of the huge amounts of liquidity injected into the global economy by the process of securitization. Retail investors can now participate in the ownership, transfer and trading of global assets such as international shares and property, commodities (oil, grains, 

\(^8\) [http://www.ebay.com/](http://www.ebay.com/)
and metals) and currencies as well as financial instruments derived from a mix of multiple assets (derivatives). Websites such as eTrade\(^\text{10}\) and CommSec\(^\text{11}\) offer households the opportunity to compare and invest in a range of financial assets, all from the comfort of their homes through PCs and mobile phones. Accordingly, a study by the Australian Stock Exchange (2004) found that 46% of the Australian population owned shares directly or via a managed fund or through Superannuation contributions, while 38% of the Australian population were direct investors. Furthermore, ownership of foreign shares was up from 7% in 2002 to 19% in 2006. This is in effect, the integration of domestic capital into a global capital that facilitates the onward rollout of markets and globalization.

To summarize, ICTs feed off, sustain and thrive so long as they remain wired into a global economy. They invariably exist as a package, sharing space with policy, investments and markets. The selective diffusion of ICTs in developing countries as attempted by ICT4D consequently cannot happen without the co-location of the entire cluster. What then explains the euphoria that surrounds ICT’s in developing countries such as India? In the next section we look at the increasing sophistication of the marketing of technology, whereby technology is seen to be associated with the buzz of entrepreneurialism, the generation of huge capital and innovations that have the potential to change people’s lives. \textit{Technological utopia} combined with the \textit{information for development} discourse facilitated by influential global institutions such as the World Bank with the active participation of state governments of the developing countries, helped to create the mechanisms that facilitate the diffusion of ICT’s.

\subsection*{4.2.2 Technological Utopia}

In their book \textit{Economies of Signs and Spaces}, Lash and Urry (1994) explain globalization, among other things, as the process of progressive dematerialization of production and consumption, channeled through the wires of information technology. With increasing dematerialization comes an increased sophistication and speed to the production and consumption of commodities, till everything is a blurred \textit{sign}, perceptible only by volume and amenable to manipulation. Within this economy of signs, information technology and

\begin{itemize}
  \item \textsuperscript{10} https://invest.etrade.com.au
  \item \textsuperscript{11} https://www.comsec.com.au/
\end{itemize}
the spread of markets equate to development and its propagation to that of the provision of choice and freedom. The process is aided by the generation of unbridled enthusiasm or *technological utopia*. Here everyone has to be connected – schools, hospitals, libraries and community centers, even the homeless (Stansbury 2003; Wicks 2003). Technology has to be the talk of the town. It is not enough to develop new products alone, they have to be invested in, bought, traded, shared, sold and stories woven around them. In other words, they have to develop socio-cultural currency.

Technologies have to be remade into what the automobile industry was to industrial capitalism beginning in the 1950s. Then, an entire generation was influenced by the magic of a ‘streamlined V6’ moving across endless stretches of roads. Highways 66 and 50 in the USA ‘where it all began’ became tourist destinations and car models such as the Datsun (later renamed Mazda), Aston Martin and the Chevrolet took on an iconic status globally. Automobiles and highways were equated to freedom and a sense of adventure while Ford and Lee Iococca became household names whose companies were the largest employers especially in Northern America and the rapidly industrializing world. Numerous cigarette companies, beverages and colas weaved their identity around this romantic imagery of the rebel further immortalized through Hollywood films.

Similarly, technology is marketed through the imagery of *innovators* and their rags to riches stories through technological *innovations*. It is all about the excitement of *entrepreneurialism* generating untold riches through the *expansion of markets*. Stories such as the development of the Mac and its promoter Steve Jobs, his failed crusade and near bankruptcy against Microsoft and re-emergence from the ashes through the iconic power of the Imac and later on, the I-pod seem to reinforce the agency of technology. Similar mythical stories abound about Bill Gates and Microsoft Windows, Akio Morita and the Sony Walkman and, John Chambers at CISCO who revolutionized data markets through the introduction of numerous high performance networking devices.

In developing countries, the middle class sees information technology as a means of upward mobility. It is often the means to bypass rigid social hierarchies and the possibility of integrating with the larger global community. Here again, the myth of technological agency
is perpetuated through the heroics of technological evangelists such as Narayan Murthy at Infosys Technologies, Azim Premji at Wipro and Jerry Rao of Mphasis BFL. The Indian electronic and print media faithfully publish stories every time an Indian technology corporation lists on the NASDAQ, breaks key wealth indicators through movement of stock prices or secures a large overseas contract. Narayana Murthy, the former Chief Executive of the largest software technology corporation in India; Infosys Technologies wields considerable influence across government, political and bureaucratic circles by his association with a string of private and public bodies. In the past five years the press has quoted him on a range of issues including but not limited to, his humble beginnings in a lower middle class household and subsequent rise to success, his creative intelligence and ethical behaviour during the founding days of Infosys, the number of employee millionaires and billionaires his company helped create through liberal stock options, his frugal ‘household budget’ despite ranking as the richest in the country, being the ‘simple IT czar who has no business card’, being ‘voted the most admired CEO’, his take on ‘leadership and values’, his ‘ringing of the starting bell for the NASDAQ from Mysore’, campaigns against corruption, his take on the reasons for few world-class colleges in India and, his ‘dream for the future India’.

Similar stories on Azim Premji of Wipro, Jerry Rao of Mphasis BFL and many more help perpetuate a technological utopia. While not everyone can hope to emulate their success, it has nevertheless inspired countless engineering students to move into information technology courses. Even working for a software firm privileges the middle class with an exceptionally good living standard. According to Daniel Pink (2004), who reported on the IT boom from Bangalore for Wired magazine, “Programming jobs have delivered a nice upper-middle class lifestyle to the people in this room. They own apartments, drive new cars, surf the internet and watch American television sipping cappuccinos.” Consequently, technology is seen as being essential to opening up new business opportunities, enabling integration with the global economy and, empowering the masses.

For the government and the bureaucracy of the developing countries who understand very little of their own people and where economic development and job creation is shorthand for state legitimacy, technology utopia and the outsourcing industry serve as a potent indicator
of positive performance without actually having done anything. In India, for example, where
government cabinets are often dubbed ‘jumbo’ for their unwieldy size, meddlesome and rent
seeking behaviour, the rise of the IT industry is attributed to the lack of any governance at
all. In fact, when the government did name the first IT minister Mr. Pramod Mahajan under
the Vajpayee Government, it was strenuously opposed by the IT industry. However, the
tendency to claim credit for the success of the IT industry also leaves governments
susceptible to pressure for opening up larger sectors of the local economy to competition and
investments. In Africa, public sector monopolies have been replaced by private sector
monopolies after years of liberalization of the telecom sector allowing foreign investments.
Or, take the case of the state of Andhra Pradesh in India, where traditional washer men,
barbers and tailors were found to have contributed an equivalent amount to the Gross State
Domestic Product (GSDP) as the information technology sector (Central Statistical
Organization 2006) and yet receive no benefits from the government while local IT firms
have secured free power and water supply, tax incentives and large tracts of very expensive
real estate at a fraction of the cost.

As the networked economy begins to mature and saturate, the need for extending digital
capitalism through the expansion and deepening of markets has become a priority. The focus
on the digital divide in recent times reflects the convergence of these interests and their
ability to collectively set the political agenda in such a way that the digital divide is seen as a
serious and important social problem.

4.2.3 Digital Divide: The induction of developing countries into the new
economy
The information for development discourse proposed by the World Bank follows notions of a
digital divide. The digital divide is a product of the converging interests of the technological
and political elites in the developing countries, large technology corporations and the
‘poverty industry’ or the development community (Luyt 2004). Until the 1980s, the
development community, guided by modernization and dependency theory believed that
planned intervention programs could rectify development imbalances in society.
Development was all about planning change. However, the imposition of neo-liberalism as
an alternative ideology, by influential political administrations in the UK and USA resulted in radical structural adjustments and the rolling back of the welfare state as well as development aid in favour of markets. Neo-liberalism completely undermined the cozy relationships and the way development organizations, multilateral agencies and governments of developing countries had been used to working, threatening the very existence of some (Hancock 1989). It looked down upon traditional development approaches as being impractical, unworkable and prone to corruption and called for their replacement by market mechanisms. Toye (1993) identifies numerous publications of the time, by authors such as Peter Bauer, Deepak Lal, Ian Little and Bela Balassa, that linked development initiatives to the distortion of markets resulting in economic inefficiencies. This was, in effect, blaming underdevelopment on the very policies and programs that were considered to be central to development for so long. The entire poverty industry was in danger of losing its sole patron.

However by the mid 1990s, development policy had come full circle with the introduction of information-theoretic economics propounded by the Nobel Laureate and Chief Economist at the World Bank, Josef Stiglitz. Information-theoretic economics acknowledged the efficiency of markets in organizing the material operations of society. However, it also suggested that markets were extremely difficult mechanisms to perfect due to the lack of appropriate information on the part of market participants. Hence, information-theoretic economics called for the integration of non-market agents such as governments and non-governmental organizations (NGO) in the decision making process to create efficient markets. Information-theoretic economics proved to be the common ideology for a range of converging interests ranging from development organizations (who lost their pre-eminence to neo-liberalism), global information technology corporations and the neo-liberals. Consequently, the propagation of information technology, its infrastructure and tools became central to development policy and decision making.

The Asian Development Bank (2007) which disburses development funds to the very locations where the outsourcing industry is located is now "reordering its operational priorities...to give much greater emphasis to technological development and knowledge management. To make room for the new and expanded activities, the realignment would phase out support for some sectors." (p. 4) Furthermore, "it would add information and
communications technology related infrastructure (such as fiber-optic cable networks and data banks) to its current definition (of infrastructure). Such infrastructure will be as essential to an economy as road and rail networks and telephone and power systems have been in the past" (Asian Development Bank 2007, p. 16). Other development organizations such as the World Summit on Information Society at its Geneva Convention in 2003 sought the establishment of a “knowledge society” by helping the economic transition of industrial manufacturing and agricultural economies to a global “knowledge economy”. The United Nations Development Program (UNDP) started the Sustainable Development Network Program and the Global Network Readiness and Resources Initiative. In recent times it has teamed up with CISCO systems to provide ICT courses in developing countries (McLaughlin 2005). The G8 and the European Commission jointly instituted the Digital Opportunities Task Force, which is endorsed by the UNDP (Shade 2003). While, the World Bank and its Global Information and Communication Technologies Department launched the Development Gateway12, InfoDev13, the Global Knowledge Partnership14, the Global Development Learning Network15, World Links for Development16, and the African Virtual University among many others (Luyt 2004; Thompson 2004; Wade 2002). From the mid 1990s, an increasing number of publications started discussing the relevance of information technology to development (Fine 2001). Today, a search for the digital divide on Google shows 36,400,000 entries in 0.11 seconds.

To summarize, the networked economy is a product of two mutually reinforcing processes; globalization and digital technologies. However globalization is not merely the exchange of goods and trade at a global level but represents a new sophistication in the practices of capitalism. Globalization seeks to expand and deepen markets in an attempt to maximize profits by capitalizing on the arbitrage opportunities presented by the compositional and structural variations in the underlying economies of each of the participating markets. Digital

12 http://www.developmentgateway.org/
13 http://www.infodev.org/
14 http://www.globalknowledge.org/
15 http://www.gdln.org/
16 http://www.world-links.org/
technologies on the other hand facilitate and reinforce global imperatives through the
dematerialization of capital, labour and commodities into digital proxies. Consequently the
strategy of digital capitalism is to sustain a global economic architecture shaped during
mercantile and industrial capitalism and consisting of developed countries in the center and
the labour and resource rich developing countries supporting it and accepting its finished
goods, at the periphery. This is achieved through the introduction of structural readjustment
programs by multilateral agencies which seek to reinforce or transform the economies of
developing countries in an attempt to augment the aims of digital capitalism. Furthermore,
these programs prescribe and fund the introduction of information technologies in a bid to
realize greater efficiencies and/ or achieve operational parity and reduce transaction costs.
The emphasis on bridging the divide in recent times is therefore a Trojan horse seeking the
expansion and deepening of markets under the guise of assisting the poor. Less charitably,
Hedley (1999, p. 86) puts down “poverty (as) a choice the world has made. It is a political
choice. The information revolution will be another instrument to implement that choice. And
to link the information revolution with democratization is naïve in the extreme, parallel to
the current leap of faith linking democratization and open markets”.
5 Case Studies

This chapter will take a closer look at the conception and implementation of information communication technologies for developing countries. As mentioned in the Research Methodology, given the relative novelty of ICTs in developing countries and the ICT for Development discourse, whereby key variables and relationships are unclear both cases are exploratory and descriptive by nature presenting complete descriptions of phenomena within their contexts. The two selected cases are polar opposites in terms of scale, ownership/participation and models of operation. Furthermore, both have been in existence for at least a year, are well publicized in the local and international press and plan to extend the number of installations suggesting that they represent successful models for the conception of ICT’s in developing countries. Analyzing them will allow a broad understanding of the ICT phenomenon and help generate theory that reinforces hypotheses generated in chapters 3 and 4.

The first case study, Bhoomi, involving the computerization of land records seeks to address the issue of how notions of development influence the conception of technologies while the second case on the $100 Laptop (or the XO as it is now known) seeks to understand the linkages between digital capitalism, developmentalism and the role of markets in the conception of digital devices.

5.1 Case Study 1 - ‘Bhoomi’

5.1.1 Context

This case analyses ‘Bhoomi’, an Indian e-governance project involving the computerization of land records. It investigates how developmentalism influences the conception of
technology and its implications for end users. It is based on secondary data derived from the Bhoomi Website, newspaper reports and journal articles.

As mentioned earlier, efficient price discovery through the perpetuation of well-functioning markets is at the core of the neo-liberal doctrine. This necessitates the roll back of governments due to a perceived tendency to distort prices and seeks its replacement by transnational corporations and non governmental organizations. As a result, technology use is directed towards enhancing the efficiency of the state in its transactions with market functionaries including citizens as well as to provide the state with suitable exit opportunities through technology substitutes, as in the case of e-governance. In the West, e-governance has helped the state realize efficiencies and reduce costs by ‘joining up’ disparate pieces of information from various government centers that help to overcome a bureaucratic ‘department’ mentality and foster a more citizen-centered approach to the delivery of government services (Oakley 2002). Furthermore, joining up of information on citizen’s backgrounds and their interactions with various government organizations could reveal patterns that could be helpful in shaping policy or the provision of targeted information/services as well as the prevention of crime.

Contrary to the West, the conception of e-governance in developing countries such as India follows a top down approach whereby it is more concerned with augmenting globalization. It represents the converging interests of multilateral agencies such as the World Bank intent on monitoring the utilisation of its funds, large technology corporations seeking new markets to sell their products into and the political and economic elites of developing countries who are intent on furthering their agenda through technological means.

5.1.2 Land reforms and the rural economy

The agricultural sector employs 40% of the work force in developing countries (World Employment Report 2004-2005, 2007, p. 127). According to the last Census of India (2001), 62% of India’s vast population is rural depending directly or indirectly on agriculture. Agriculture is the largest employer, employing 67% of the overall work force and contributing 32.8% to the overall Gross Domestic Product (GDP). According to a study by economist Abheek Barua (2005), the rural economy of India has been growing at 1.9%,
while the urban economy involving a mix of industrials and services continues to grow at 7.3%. The primary reason for this continuing underperformance includes inadequate investments in agricultural infrastructure and technology due to its low productivity. Bernstein (2002) attributes this low productivity to the existence of an agrarian class structure resulting in the exploitation of agrarian labour and small contract farmers by landed property (also called the zamindari system). According to Prakash and De (2007), increasing farm productivities was important not only for developing countries of the periphery to become self-reliant in terms of their food requirements but also for developed countries of the centre to meet increased demands of their food processing and other-related industries. Consequently since independence, India’s development policies have converged with global policy to provide ‘land to the tiller’, in the hope that ownership would provide incentives for innovation and investments thereby, increasing land productivity (Carter 1984; Byres 2004). Increased efficiency of such owner-operated farms (Deininger & Binswanger 1999) was one of the primary reasons that many national governments, including India after 1947, resorted to legislations which looked at increasing the spread of land ownership to erstwhile tenants and landless labourers (Rajan 1997).

There is now widespread consensus among the Planning Commission and Indian policy makers that maintaining good land records is essential to the objectives of the land reform programs. Consequently, there has been a strong emphasis on the need for efficient and transparent land records that provide critical information such as:

- Physical information - size, land forms, soils
- Economic information - land use, irrigation and crops, tenancy and share-cropping
- Legal information - pertaining to titles

However, the land-owning classes or the Zamindars have strongly resisted this, as accurate land records present a threat to their land ownership as well as to their incomes. Inaccurate land records have become a means of manipulation for influential and powerful sections of the society and a cause of rural conflicts and unrest. In response, the Ministry of Rural Development under the Government of India has actively sought the computerization of land records. The Bhoomi project in the Southern state of Karnataka is one such project.
5.1.3 ‘Bhoomi’ – Computerisation of land titles

In 1999, the Government of Karnataka (a state within the Federation of India) decided to digitize all its land records. This included records for 177 talukas (sub-districts) of Karnataka involving 20 million records of rights, tenancy and certification (RTC). Bhoomi (meaning land in most Indian languages), the software for land records management was designed and developed by the National Informatics Centre (NIC), a Central Government organization with assistance from Microsoft Corporation, to do away with ‘opaque’ manual records.

According to the Bhoomi website, manual record keeping was responsible for poor revenues, faulty and corrupt practices as well as inaccurate records. The process involved the delegation of all authority to the Village Accountant (VA) for the upkeep and alteration of land records. The VA was usually responsible for 3 to 4 villages and would take requests for the issuing of land records. Land records usually include temporary information requiring regular updates such as information on crops, soils etc., known as a Record of Rights, Tenancy and Crops (RTC) or, permanent changes detailing changes to land ownership within the RTC, known as a ‘mutation’ of records. According to the Bhoomi website\(^\text{17}\), manual records monopolized information at the village level resulting in the illegal manipulation of land records, harassment of farmers and, impeded the quick resolution of land disputes. Poor farmers were often cheated by corrupt VAs who changed ownership names in RTCs for a price or harassed them for money by unduly delaying the process. Often rich landlords usurped lands belonging to smaller and poor farmers who had moved off the land and onto other vocations. Furthermore, manual records resulted in Government land being shown in the name of private parties. Within the city of Bangalore alone, Rs. 25 billion worth of Government land had been manipulated and shown in the name of private influential persons. More importantly from the state government’s perspective inaccurate records resulted in poor revenues. This was especially problematic given that close to 90% of the population in the rural environment are employed in land based activities such as farming and agro based industries.

\(^\text{17}\) http://bhoomi.kar.nic.in/Bhoomi/ManualSys.htm
Computerized land records that allow universal access and transparency through PPP (Public and Private Partnership) initiatives were seen as a magic bullet to overcome inefficiencies linked to the current system. Driving this was the popular theory by Klitgaard and Baser (1998) that: Corruption = Monopoly + Discretion – Transparency. In India, where the state holds an absolute monopoly over the delivery of basic services, there are often no exit options available for citizens. Furthermore, the huge discretionary powers awarded to VA’s combined with low transparency due to manual record keeping were seen to be the primary causes of corruption. The design and development of Bhoomi can be better understood from this perspective.

The digitization of land records was first initiated in 1991 and followed up by a similar attempt in 1996, both of which failed. The explanation given for these failures was the inability of the administration to comprehend the scale and scope of the project. The VA and administrative staff were expected to both digitize records as well as discharge their normal duties. Consequently, they were overloaded with work resulting in the failure of these projects. As a result, when the Bhoomi project was initiated by a young bureaucrat, all digitization work was outsourced to an external agency to save time and avoid distracting the VA and administrative staff from the ongoing process of record keeping. This was in fact, merely an excuse to exclude the VAs and local administrative staff from the development process as they were believed to be corrupt and incompetent. Kiosk operators were trained in the day to day operations, political support secured and a tight deadline set for the operationalisation of the service. Immediately after the operationalisation, the manual processes of issuing RTCs as well as the physical RTCs themselves were made illegal.

Today, farmers travel to the taluka headquarters and approach the Bhoomi kiosk for an RTC certificate. For a fee of Rs 15 (AUD 50 cents), the farmers receive a printout with a signature and hologram sticker as verification, in less than 10 minutes. The Bhoomi Solution involves both, hardware and software components with each taluka provided with an Internet ready PC, a printer and UPS for power back up. The PC has twin hard drives that automatically mirror data and at the end of each working day data is burnt on to a magnetic disk which are accumulated over a week and finally sent over to the district headquarters and Central Revenue Office in Bangalore for centralized records keeping and archiving.
The Bhoomi land record maintenance solution developed by NIC is based on a Windows NT operating system with a Visual Basic 7.0 front end and Microsoft SQL Server 7.0 database at the back end. The software design includes an online system to carry out mutations with built-in workflow automation in the local language (Kannada). The mutation updating process is fully synchronized with the fieldwork done by revenue officials. The system is integrated with biometric access that ensures foolproof authentication, for each update and approval by the revenue officials. Bhoomi provides two public interface modules: a manned center to deliver land records on demand by the farmers and a touch screen kiosk (Figure 9) to access the details of land records without intervention by revenue officials. It facilitates the scanning of the field mutation order passed by revenue authorities and also the notice served on the public, so that they could be referenced later for various purposes. The software also generates various analysis and pendency reports in textual and graphical forms. According to the Bhoomi website, the unique features of the software make it very difficult for the user to deviate from the regulations of land records. For example, revenue officials cannot update or approve the mutation by deviating from the first-in-first-out rule or put simply, alter the sequence of information fed for mutations. However, senior officers can deviate by giving valid reasons. This helps the Government to serve the public impartially and negate any transactions that take place on non-notified Government lands, thereby assisting the Government protect its lands from being encroached upon.

Within three and a half years of its inception, all land records had been digitized. Today, for a fee of Rs 15 (AUD 50 Cents), printed land records are available in 177 Bhoomi Kiosks established across the state. The Bhoomi System cost the Government a total of Rs 200 Million (1AUD = 33 Indian Rupees) of which 70 Million was recovered through fees and charges in 2002 itself. This service has now financially broken even and generates surplus cash. In 2002, Bhoomi won the Commonwealth Association of Public Administration and Management Awards (CAPAM) silver medal and was a Finalist for the prestigious Stockholm Challenge Awards. By 2003, the Federal Minister for Information Technology and Communication, Mr Pramod Mahajan was promising to replicate the Bhoomi project across the country.
5.1.3.1 Social impacts of Bhoomi

While *Bhoomi* is an excellent example of a technological solution, its efficacy as a social solution is debatable. Bhoomi treats only the logistic and operational features of land records to be of any consequence, completely overlooking its impact on the user. Claims by the official Bhoomi website that “against a time delay of 3 to 30 days, the new system gives land records in less than 2 minutes”, or that “corrupt practices have been eradicated” and that “Bhoomi provides a secure system” indicate a predisposition towards fixing existing operational inefficiencies within the land records department\(^\text{18}\). Its failure to comprehend the broader social and economic factors that land plays in the lives of rural Indians, as well as by choosing to ignore the delicate non-formal mechanisms evolved to maximize land productivity and management, Bhoomi could end up disenfranchising some of the most vulnerable sections of society.

\(^\text{18}\) [http://www.revdept-01.kar.nic.in/Bhoomi/Benefits.htm](http://www.revdept-01.kar.nic.in/Bhoomi/Benefits.htm)
Land Tenures: Formal, Informal and administrative costs

While land titles specify ownership, land tenure defines the conditions under which the land is held or occupied. Property rights are never absolute but bound by community-based priorities. Tenures represent this balancing of private and public rights. For a better understanding, let us assume the case of an independent house in Sydney. The home owner owns the land on which the house is built. He is however not free to expand or make changes to the superstructure or subdivide the property for commercial benefits without community approval. City councils (representing the community) may decide in favour of or against a proposed change based on its impact on the wider community. Issues such as commercial usage of the house, its expansion or sub-division can be refused if it impinges on the neighbours’ rights, or if the sub-division leaves a new property without vehicular access making it a public hazard in the event of a fire. Council regulations and building laws consequently represent structured and formal forms of tenure.

Similarly, traditional and non-formal agricultural tenures are tuned to maximize land yields and improve the long term sustainability of the land. Consequently, they are localized to support the local weather conditions, soil fertility and availability of water. For example, a landowner may decide to lease his/her property simultaneously to two separate farmers with a condition that restricts the choice of crop to be sowed, by each. This may be with a view to either improve soil conditions, reduce water usage and effects on the water table or reduce the use of specific pesticides. Alternatively, rural administrators may provide some farmers with the right to farm on the land but not own it. In fact, this form of non-formal land use and tenure is called a *saguvali chit* (Prakash & De 2007) in the Shimoga and Chitradurga taluka of Karnataka state.

Traditional agricultural tenure systems can best be described as being extremely dynamic and defined by the community whereby distinct communities develop their own unique tenure systems. The state of Karnataka (where the Bhoomi project is located) was formed in 1956 by merging the princely state of Mysore with areas from other states and provinces. The amalgamation document discusses five governance regimes, various aspects of land management and up to 1500 forms of tenures. According to Jonnalagadda (2005), titles and tenures can be compared to language and dialect and they reflect a socio-economic ecology.
in the rural environment, allowing the flexible and efficient management of land. As a result, they have a tendency to fragment depending on local conditions and are best managed locally. However administrations prefer simplicity in the interests of manageability. Similarly, the Bhoomi software recognizes only 256 land tenures of the 1500 forms originally identified in the amalgamation document, with serious consequences for some of the most vulnerable sections of rural society. For example, the saguvali chit discussed earlier is one of the 1250 odd non formal tenures completely ignored by Bhoomi. By choosing to simultaneously ignore tenure and make public its ‘non ownership’, Bhoomi facilitates the illegal appropriation of land.

What was described as a case of corruption and irregularity on the part of the VAs by the Bhoomi project management team and which informed its conception, may well have been a case of the VAs awareness of the discrepancy between official records and practiced records and his indulgence of local farmers in the face of official ignorance and apathy. However, by failing to consult the VA as well as the farmers in the conception and development of Bhoomi due to their ‘perceived corruption’, the developers may have completely overlooked an important component of land titles.

Furthermore, in the urgency to meet deadlines, land record documents were selectively digitized with preference given to the RTCs. In doing so, equally important documents linked to the title and going back decades, such as the khata (land title) register, cadastral maps marking boundaries, akarband (details of survey numbers) and tippani (sketch of the surveyed land) were omitted. Bhoomi therefore can be said to have computerized only one document out of the many that are used for land administration. Thus, while the RTC remains the proof of land ownership, the underlying land holding that the RTC refers to, may itself be susceptible to manipulation. According to Keya Acharya (2003), another serious error resulting from the rush to digitize all records and operationalise Bhoomi, is that the state government did not tackle fraudulent land records prior to its digitization, resulting in fraudulent entries being validated.

**Digital Capitalism**

As suggested earlier, ICT’s represent a top down system of ordering and once installed have an inherent tendency to scale in search of newer applications. Not surprisingly in 2004, Mr.
Rajeev Chawla a senior bureaucrat and chief initiator of the Bhoomi project suggested that it had ‘the potential of setting cash registers ticking if the state government decides to share the enormous data it has on farmers with Fast Moving Consumer Goods (FMCG) Companies’ (Deccan Herald News Service 2004). By 2004, Mr Chawla had already received proposals from a tractor and fertilizer company for sharing of this information for commercial purposes. According to Mr. Chawla, “data of 20 million land holdings belonging to 70,000 farmers and the entire history of cropping patterns of the last 12 seasons provide vital statistics about the farming community to the commercial entities” (Deccan Herald News Service 2004).

Finally, the roll back of governments as prescribed by neo-liberalism saw the emergence of a new market for large technology corporations. According to an article in the reputed technology magazine Dataquest (2003), “…by the year 2002 the government in India was fast emerging as the fourth largest vertical spender on information technology after the telecom, manufacturing and banking\finance industries. By then, the Indian government had already spent around 1 billion USD on information technology. In fact, the government accounted for 9 per cent of the total IT spend in India for the year 2002 and although e-governance was still in its infancy, over 20 states/union territories already had an IT policy in place with police departments, treasury, land records, irrigation and justice being seen as having the maximum potential.” However, despite the increasing expenditure on e-governance, its effectiveness remained uncertain. Government portals were full of details on meetings, technical information complete with bureaucratic jargon providing little by way of information that allowed users to be active participants and co-producers. By 2004, senior officials in the World Bank e-governance project were acknowledging that close to 85% of its e-governance projects worldwide had failed to achieve their stated objectives due to their inability to reconcile with the local context which affected its long-term sustainability (Heeks 2004; Rediff.com 2004).

5.1.4 Conclusion

As an ideology closely associated with globalization, neo-liberalism seeks “a technology to order according to a precise model and organization” (Ciborra 2005). This ordering proceeds not at the level of a nation state but a global scale and reflects the priorities of the dominant
players in the global order (Prakash & De 2007). Because “complex ICT systems imply rigid ways of working” (Wade 2002), they are looked upon as an effective ordering technology at the global level even though they are often incompatible with the way people go about performing their day to day tasks which are often inherently vague and unpredictable. Bhoomi is a classic example of how developmentalism influences the conception of technology so that it represents merely a supply side solution that completely overlooks the demand.

5.2 Case Study 2 - Technological Devices - The $100 Laptop

In a speech at the World Economic Forum in January 2005, Professor Nicholas Negroponte of the Massachusetts Institute of Technology (MIT) outlined his vision of developing a laptop cheap enough to reach the world’s poorest children. The non-profit organization he had setup to oversee the development and marketing of the laptop, called the One Laptop Per Child (OLPC) had already secured funding from large technology corporations such as AMD, Google, News Corporation and Red Hat. The idea was to develop a fully functional laptop for $100 that would be sold directly to governments in developing countries who would then use their national educational networks to pass them on to school children. This top down system of distribution was considered necessary in order to generate the volumes needed to bring down prices, develop the technology and make a quick impact on the educational scene. Consequently, the minimum order size was placed at a million units (Luyt 2008).

This was quickly followed up by the unveiling of a model prototype at the World Summit on the Information Society (WSIS) held in Tunis in November 2005. In this speech Negroponte outlined the key principles that would guide OLPC in the conception of the laptop. The project would be aimed at 6-12 year old kids who would get to keep the laptops so that they could keep experimenting even when they were at home, acting as change agents who would help to diffuse the devices in their own remote communities and thereby prove instrumental in bridging the digital divide. Furthermore, the laptops would remain connected to the internet and only use open source software so that it could be scaled up to grow with the kids.
and their changing needs. The then UN Secretary General Kofi Annan was so impressed with the device that he welcomed its inauguration as “an expression of global solidarity” with the poor. Immediately after, the UNDP agreed to aggregate and distribute the laptop to countries unable to purchase the minimum million units (Case 2005) while Quanta Computers, one of the largest contract manufacturers of laptops in the world agreed to build the $100 laptop (or XO as it is now popularly known) for OLPC.

Typically, the conception of ICT and computing devices such as laptops for developing countries is informed only by the economic particularities of the context, while completely overlooking the geographic, social and the cultural. Such devices betray a singular concern for increasing profits and/ or expanding market share. The XO and the OLPC team however, are different. A thorough analysis of the technical specifications of the XO and the historical antecedents of its developers reveals a deep commitment to the cause of building universal laptop computers and a genuine belief that it would lead to an improvement in the living conditions of its end users. Ivan Krstic, in charge of software security and Walter Bender, CEO were highly regarded professionals who had spent years working in the free and open source software development industry before joining OLPC. Both had sacrificed lucrative careers in the private sector by opting to work in an honorary capacity at OLPC. Seymour Papert, whose educational theories on constructionism influenced the Graphic User Interface (GUI) of the XO had worked for many years with Jean Piaget, the eminent Swiss philosopher and developmental theorist known for his work on how children learn. While Negroponte has a long history of attempting to introduce laptops in developing countries such as Senegal, Costa Rica, Cambodia and Pakistan. In short, this was no get-rich-quick technology idea. It was a vision built up by people with immense and impeccable credibility in industry and academics through many decades of persistent hard work.

Unlike the previous case which looked at the role of developmentalism in conceptualizing technology, this case analyses the influence of private capital in the development of technology. In particular, it is interested in investigating the outcomes of Negroponte’s attempts to overcome the limitations of the markets based model by cleverly seeking to
rewrite the rules and reframing a simple laptop project as an ‘educational project’ of gargantuan proportions. In this light, the next section documents the technical and design features of the XO, followed by an analysis of Negroponte’s unique positioning strategy and business model for this machine. Finally, the role of governments in facilitating the conception of technology is addressed.

5.2.1 Technical Features
The Laptop itself was designed for the unique conditions of the developing countries. According to the OLPC website it was designed collaboratively by experts from both academia and industry, bringing to bear both extraordinary talent and many decades of collective field experience for every aspect of the project. This is evident in the way the laptop is detailed with rubber encasings to overcome the extreme heat, humidity and dusty environments it would encounter and its use of the AC power adaptor as a carrying strap. For added robustness, its plastic walls are 2mm thick, as opposed to the standard 1.3mm. In keeping with Negroponte’s firm belief that learning happens seamlessly across the home and schools, the laptop is designed to facilitate multiple activities and extends its functional utility beyond school work to include generic uses such as, as a television set and an electronic book. It also has 4 USB (Universal Serial Bus) ports that make integration of new hardware and stand alone devices easy. The laptop or XO, as it has been renamed, comes with a 500 MHz processor and a flash memory that replaces the hard drive in an effort to minimize costly breakdowns commonly associated with its delicate moving mechanism. According to the OLPC website these features extend the estimated product life to at least five years.

The XO is also power efficient so as to accommodate the unreliable nature of its supply in rural environments. This efficiency is achieved by designing power efficient screens and a CPU that is programmed to switch off in certain conditions. The 7.5 inch, 1200×900 pixel screens are cushioned by internal bumpers for added safety and are self-refreshing with a resolution of 200 DPI (dots per inch) They are available in two display modes: a transmissive, full-color mode, and a reflective, high-resolution black and white mode that is sunlight readable. This is especially relevant for the developing world where classes are often conducted outdoors for multiple reasons. The transmissive mode consumes one watt—
about one seventh of the average LCD power consumption in a laptop while, the reflective mode consumes 0.2 watts. The laptop itself consumes less than two watts as compared to the 20 watts consumed by a standard laptop commonly available in markets. In fact it is this detail that allows some models to bypass electric power altogether in favor of a human powered wind-up supply or alternate power charging sources, such as car batteries. In the case of human powered wind-up supply, for every minute of winding the XO remains operational for 10 minutes. The XO also overcomes network shortcomings such as location fixity and wireless signal blackouts by acting as a wireless router on its own. That is, the XO creates its own mesh network that allows students, teachers and parents to remain in touch with each other and also connect to the internet.

5.2.1.1 Product Aesthetics

The XO exhibits toy like aesthetics and detailing that is designed to appeal to its intended users. Most promotional photographs (Figure 10) show the laptop screen tilted away from the keyboard with raised ‘ears’ giving it an anthropocentric image.

![Figure 10 One Laptop Per Child: $100 Laptop (OLPC 2008)](Image)

The detailing reflects ‘ergonomic aesthetics’ with a visual vocabulary predisposed towards playful dimensioning and the use of rounded edges that give it a soft and toy like form. The
XO has large swathes of the primary color green, soft and sealed rubber-membrane keyboard (Figure 11) that feels and operates like a toy and overall dimensions that are no bigger than a school lunchbox making it not only visually but also physically light. Finally, it comes with an integrated handle that makes transport to and from school, easy.

![Figure 11 Child Friendly Detailing: Durable and playful keys (left) and (right) Protection for the interface ports (OLPC 2008)](image)

The aesthetics also integrate other forms of clever detailing such as the concealing and protection of the delicate USB and audio ports (Figure 11) by the flip-out network antenna ‘ears’, a flexible hinge that makes it easy to assume multiple forms such as an e-book reader, a hand held games console and, a dual-mode, extra-wide touchpad that supports pointing, drawing and writing as well. Finally, its use of white on large portions of the laptops surface ‘invite’ children to personalize it through sketches and stickers while the use of the colour green makes it visually distinct and thereby discourages its resale into the grey market.

### 5.2.1.2 Constructionist shaping of the Aquatic Sugar Graphic User Interface

The now standard Graphic User Interface (GUI) metaphor of a Desktop for operating systems has its origins in technically skilled, expensive and therefore shared computer usage of the early 70s. By its use of intuitive real world cues such as ‘desktop’, ‘files’ and ‘folders’, computer use was universalised. Designed to support multiple business applications such as spreadsheets and word processing for users in enclosed and private workspaces, the Desktop metaphor captured PC users’ imagination to such an extent that it is still in use almost four decades later. However, OLPC considered the Desktop metaphor as
inappropriate for classroom learning. Instead it proposed an interface which aimed to support collaborative learning. A product of free and open-source software, the Aquatic Sugar interface of the XO is based on the constructivist learning philosophy and theories of Seymour Papert and Jean Piaget. It resists the inclusion of traditional software applications such as word processing and spreadsheets and instead focuses on facilitating learning based group activities. According to the official OLPC wiki\(^\text{19}\), Constructivism (or Instructionism as it is also called) is “a philosophy of education in which children learn by doing and making in a public, guided, collaborative process including feedback from peers, not just from teachers. They explore and discover instead of being force fed information, or subjected to a regime of social control”\(^\text{20}\). The laptop, it was hoped would give the children the ability to explore, experiment and express themselves in the absence of access to books, the internet and TV.

The XO is seen as a tool towards overcoming limitations of traditional classroom environments and achieving Papert’s stated aims of collaborative learning. Therefore, collaboration is the core of the Aquatic Sugar’s user experience and the exchange of ideas amongst peers, a means of stimulating critical thinking and making the learning process more engaging. Aquatic Sugar leverages its unique mesh network to facilitate shared and collaborative learning and follows “a zoom interface that graphically captures the world of fellow learners and teachers”\(^\text{21}\) so that multiple users may collaborate on a single task as opposed to traditional PC usage that allows a single user to work on multiple tasks at the same time.

### 5.2.1.2.1 Elements of the GUI

In attempting to provide an integrated operating system with activities based applications, Aquatic Sugar has had to overcome serious hardware limitations such as the lack of a dedicated video card and a low memory (RAM) as well as small screen size that allow

\(^{19}\) [http://wiki.laptop.org/go/Constructivist](http://wiki.laptop.org/go/Constructivist)

\(^{20}\) [http://wiki.laptop.org/go/Constructivism](http://wiki.laptop.org/go/Constructivism)

programs to run only in a full screen mode. It does so through the central element in the GUI; the Frame.

It appears when the mouse moves beyond the stipulated workspace of the screen or when a key is pressed on the keyboard. The four sides of the frame represent (Figure 12 - Clockwise from right):

- **Persons (or the buddy list)**
  This is a social network that is integrated in the OS and displays classmates or friends engaged in a similar activity to oneself. So for example, everyone seeking to move beyond an abstract understanding of the lesson on the Solar System appears on the frame and a quick mouse-over their icon reveals a short profile including the name, age, class and interests of that particular user.
• **Actions (or the dock)**
The bar at the bottom of the screen represents the system tray and applications launcher. Intimations of new applications linked to a particular activity group that can be downloaded are also docked here.

• **Objects (or the clipboard)**
This can be equated to a traditional clipboard. As sharing is central to the vision of the XO, multiple activities can be docked to the left column of the frame. These activities are all simultaneously visible and allow the user to switch between different groups. For example, a student can switch between two groups, one studying the planet Mars’ atmosphere and the other its surface, and keep track of the two by dragging web pages and documents related to the two to the clipboard before moving onto some other activity.

• **Places (or the menu bar)**
The horizontal bar to the top is the ‘places’ bar which consists of the Bulletin Board and the Global Search field to the right while Neighbourhood, Groups, Home and Activity are towards the left. It is through these icons that a user may choose to work in isolation, be part of a team or even be involved in an open environment which includes everyone. The XO allows users to specify the privacy and collaboration settings even before an application is launched. This way a user can start working on a particular application and implicitly invite or reject other participants for that activity. We now have a detailed look at the degrees of inclusion/exclusion each option provides for the user:

*Neighbourhood*
This is the broadest level of activity sharing. The GUI graphically represents each user and his/her activity at the time that it detects on the mesh network. This graphically represented map is information rich and includes details such as:

• The users level of connectivity. That is, as each laptop acts as a wireless router that extends the range and strength of the network signal, the more icons there are on the screen the stronger and more reliable the connection to the internet and each other is.
• The nature and popularity of the social interactions. This includes information such as who is active at a particular point in time and what are the activities they are coalescing around.

• A peer to peer distribution of applications. That is, the graphic representation of each active task represents laptops running a particular program in Aquatic Sugar. Should these programs be unavailable on your own laptop you can choose to download the same from your peers or other machines that may be present in the vicinity. This makes the installation or removal of a particular application as simple as adding or deleting a simple file in regular PC’s.

• Finally, the bitfrost security system makes viruses and spyware simply unfeasible.

Groups
The next level of zoomed interaction is ‘Groups’ which allows the user to include and subsequently spot friends and their current activities. As mentioned earlier, an inclusion in the friends/Groups section is an implicit invitation to participate in one’s current activities as well as join others in theirs. Anyone in the group can invite more members, and everyone else will be notified and introduced to him/her (as a minimized alert on the system tray bar). All collaborators to a project are visible, and all laptops on the same Group can be viewed if they are engaged in something on this zoom level.

Home
The last level of zoomed interaction and privacy is the ‘Home’ level. Here the XO operates like a stand alone PC with all applications and activities closed off to others. In fact, the user is not visible to others at all, unless it is specifically denoted as such. The graphical element of a central ring is both a task switcher and Activity Monitor at the same time. This ring shows which applications are currently running and how much memory they are using. Every application running will appear on the circle, filling an area proportional to how much memory it uses, and when the circle is full no new applications will be allowed to run before you close some. Dragging any app from the Dock to the Ring will launch it, and dragging it out of the ring will quit it. The XO memory is scarce and this allows any children to understand visually how much space is left and to easily identify the memory intensive applications slowing down the system (Figure 12).
This detailed examination of the XO interface and wireless system clearly suggests that the OLPC is committed to a community-centric and collaborative vision of computer use. It also suggests that OLPC would be a valuable tool for the reform of school education not just in developing but also the developed countries. However, despite these measures the XO as well as OLPC are rapidly moving towards oblivion. In the ensuing sections we analyze the reasons.

5.2.2 Governments, ‘Constructionism’ and fears of a Trojan horse

The technological policies of developing countries are linked to notions of national identity, progress and economic development. Some countries view technological progress as a means of forging a new and fictive national identity that encompasses and overcomes the disparate ethnic identities of its subjects. Here, the future is unambiguously linked to the modern world and technology is seen as a means of leapfrogging towards it. While others are more circumspect and see technological determinism that eliminates difference and entrenches unequal economic growth as deeply problematic. In such cases, the introduction of technology developed overseas escapes social construction and shaping by dominant groups and is therefore viewed with intense suspicion.

Not surprisingly then, the introduction of the XO as an educational tool for developing countries raised a lot of confusion, excitement and skepticism, all at the same time. This was only to be expected given the high priority governments place on education as a means of shaping the minds of future citizens. An overwhelming majority of the countries that were interested requested for pilot studies to be undertaken as a means of evaluating the XO before placing firm orders. However, OLPC was very consistent in its rejection of any form of pilot testing. In 2006 at a talk to the Inter American Development Bank, Negroponte suggested “that to do a pilot project is ridiculous” (Chanana 2007). Then again, at a Technology, Entertainment, Design (TED) lecture in February 2006, Nicholas Negroponte firmly refused pilot studies again saying:
"...this is not something you have to test, the days of pilot projects are over. When people say "Well, we'd like to do three or four thousand in our country to see how it works, screw you, go to the back of the line and someone else will do it. Then when you figure out that this works then you can join as well". (Negroponte 2006) 22

The fact that OLPC had not approached a single education department in the West to sell the XO accompanied by Negroponte’s consistent refusal to allow pilot tests made some developing countries suspect that OLPC had a hidden agenda. Some observers such as William Easterly, a Professor at New York University saw Negroponte’s continuous bullying and badmouthing of OLPC’s critics and refusal to pilot test as a form of cultural imperialism. "It's arrogant of them. You can't just stampede into a country's education system and say, here’s the way to do it" (Hamm & Smith 2008). So, what was the reason for the consistent rejection of pilot tests? While a simple explanation could be that OLPC did not want to get bogged down with long drawn out pilot tests that could interfere with its volumes driven business model, recent events indicate that a likelier reason was the constructionist learning theories espoused by the XO and the fear that the outcomes of the pilot tests would be contrary to the expectations of many governments.

5.2.2.1 Learning theories
Constructionism is a philosophy of education proposed by Seymour Papert and which draws on the work of the Swiss psychologist Jean Piaget. Piaget argued that individuals actively made sense of the world, rather than being conditioned by it (Marshall 2005). He conducted a series of experiments with children which led him to the conclusion that people pass through successive stages of cognitive development which are common across cultures. He distinguished four key phases which encompass other minor ones and where each is characterized by its own distinctive logic. These include the sensori-motor stage (from birth to 18 months), pre-operational stage (ages 2–7 years), concrete-operations (age 7-12) and

finally, the formal operations stage (ages 12 upwards). Particularly important for understanding the conception of the XO is the concrete operations stage for the ages 7 to 12, for whom the XO is designed. This stage is marked by the ability to classify objects, understand causality and work collaboratively in social situations. However, at this age kids still have difficulty in analyzing abstract concepts without referring to real events or particular images with which they are familiar (hence the term concrete operations). According to Piaget, developing abstract thinking is dependent upon a social environment which exposes the individual to formal cognitive reasoning. That is, internal processes of the mind develop only through social interaction.

Papert’s theory of constructionism is an extension of Piaget’s work. However, Papert was more interested in the various learning styles that characterized each phase as identified by Piaget. To elaborate, he accepted Piaget’s theory that 7-12 year olds had an inherent difficulty in understanding abstract concepts that they could not see, such as the inner structure of an atom. However, he believed that kids tried to overcome this difficulty based on their own innate abilities and learning styles whereby some understood it better by drawing sketches, while others relied on comparison and classification with other entities such as ‘smaller than a molecule’ and so on. However, central to all of these styles was the need for prior and ongoing social interaction to validate their thought processes. Papert saw computers as a flexible medium that could not only accommodate all these different ways in which children learn and think but also augment them through animations, mathematical equations or sharing among friends. Consequently, he saw their introduction as essential for educational reforms (Papert 1980). He contrasted it to traditional classroom environments where students had to follow specific instructions given by a teacher which was often exclusive of the idiosyncratic ways in which different children learnt and built knowledge. According to Papert, the failure of students to accomplish certain tasks therefore could not be attributed to personal intellect but the inability of the exercise to include the student’s unique ways of solving them.
According to the OLPC website \(^\text{23}\) then, constructionism is;

“a philosophy of education in which children learn by doing and making in a public, guided, collaborative process including feedback from peers, not just from teachers. They explore and discover instead of being force fed information, or subjected to a regime of social control. The laptop, it was hoped would give the children the ability to explore, experiment and express themselves in the absence of access to books, internet and TV”.

This theoretical position forms not only the basis to introducing the laptop in classrooms but also extends to the development of key features, software and components of the XO such as the mesh antenna and the Aquatic sugar interface, as documented earlier. According to Luyt (2008), the XO and constructionism represent the pedagogical techniques that are currently being developed and employed for creating future workers of the networked economy. It distinguishes itself from the teacher centered behaviourist practices of the industrial age by emphasizing the development of collaborative and communicatively oriented communities of practice within the classroom that socialize students into acting as parts of a distributed knowledge system where one student never has all the answers and depends on the rest for success.

However, this is completely at odds with the kind of work that is being outsourced by digital capitalism to developing countries. Here, worker collaboration and access to open information is discouraged lest it results in labour and social unrest. In many developing countries such as China, Malaysia and Burma among many others (which could be large markets for the XO), all sources of information such as broadcast television, radio and the internet are consistently monitored and censored, while there are severe restrictions on public and political gatherings. Similarly, schools are considered as an extension of the political establishment and geared as much towards manufacturing consent as imparting education.

\(^{23}\) http://wiki.laptop.org/go/Constructivist
Teachers often play a vital role in reinforcing certain patterns of behaviour including a respect for authority from a very early age. According to Luyt (2008), it may well have been the case that OLPC was worried that the pilot tests would reveal to these governments the XO’s possible influence in promoting an alternate and collaborative mode of thinking, working and socially organizing among its future citizens. While there may well have been other reasons for not undertaking pilot tests, the recent decision of OLPC to undertake pilot testing without reservations (Fried 2008), after the Aquatic Sugar GUI was abandoned in favor of Microsoft XP, does seem to reinforce this line of thinking.

5.2.3 Scale as a strategy

Right from the beginning, Negroponte sought to portray the XO as a massive project. A project that was different to any other hardware project. One of the principal reasons for this was to establish an alternate business model that would allow OLPC to dictate terms to the computer component, software and manufacturing industry. Negroponte reveals a discussion that he had with one of the computer screen manufacturers:

“We wanted a small display, doesn’t have to have perfect color uniformity, can even have a pixel or two missing, it doesn’t have to be that bright. This particular manufacturer said we are not interested in that. We are interested in the living room, we’re interested in perfect color uniformity, we’re interested in big displays, bright displays, and you’re not part of our strategic plan. And I said well, that’s too bad because we need a hundred million units a year. They said oh, well maybe we could become part of your strategic plan. That’s why scale counts. That’s why we will not launch this without five to ten million units in the first run.” (Negroponte 2006) 24

This then, was a clear attempt at altering the existing business model which was built around Moore’s Law and which stated that microprocessors would keep doubling their processing

capacity every 18 months. To utilize its increased capabilities, laptop manufacturers sought to add more features to newer products while keeping the prices fixed. This fed an enormous growth in the peripherals and software applications markets which transformed the computing business into a numbers game. The hardware components/software company with the largest market share ended up dictating the industry standards and technical protocols, which in turn, reinforced its dominance. Negroponte’s plans for a $100 laptop would clearly not fit within this model and would have made OLPC and the XO amenable to all sorts of pressures. Consequently, he sought to change this model by scaling operations to such unprecedented numbers that it constituted a completely new market segment with very different characteristics; reduced features ensuring lowest prices.

This strategy seemed to have succeeded as in July 2007, Intel the world leader in the design and development of semi-conductors and technological devices declared that it had joined OLPC “to bring the benefits of technology to the developing world through the synergy of their respective programs”. OLPC now had the unique distinction of having arch rivals Intel and AMD on its board. Soon after, Quanta Computers, one of the largest contract manufacturers of laptops in the world agreed to build the XO for OLPC.

While the creation of a completely new market segment may have been instrumental in Negroponte’s ability to drive the agenda, its success inevitably drew fierce competition from multiple sources. Dell, the world's number two computer company, launched a computer in China that sold for $336, 60 per cent below the price tag of its previously cheapest machines and Quanta Computers, OLPC's own contract manufacturer decided to sell its own brand of laptops for only $200 (Hille 2007). But by far the most problematic and with the potential to completely jeopardize OLPC’s mission was the launch of Intel’s “Classmate” laptop for $230. According to the Stecklow and Bandler (2007), Intel which normally does not sell computers, introduced the laptop for developing countries and marketed it aggressively although it stood to make little money on the devices. By doing so, it hoped to “prevent rival AMD whose chips are in Mr. Negroponte’s competing computer from becoming a standard in the developing world”.

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In an attempt to ensure its success, Intel sought to ‘look into’ the design and implementation plans of the XO while on the OLPC board and sell its Classmate range of laptops to governments in the developing countries by crafting a marketing plan centred on Intel’s strengths and OLPC’s weaknesses. OLPC had designed the XO such that students could train themselves, as well as more controversially, fix any glitches that may arise with help from the open source community. Intel on the other hand leveraged its enormous clout with the software and hardware industry and provided the Classmate with Windows XP, after sales service, teacher training and assurances of future upgrades. As mentioned in chapter 4, economic development and the ability to generate jobs is essential to state legitimacy in developing countries. Consequently, for governments evaluating the purchase of computers, its ability to provide concrete skills that could translate into low end data entry and data processing jobs would prove to be a significant factor in their decision-making process. Not surprisingly by late 2007, Governments of Libya and Nigeria which had already placed orders with OLPC for the XO terminated them in favor of the Classmate. In the words of Mohamed Bani, the chair of Libya’s technical advisory committee, “the Intel machine is a lot better than OLPC” and his country could not afford to be a “junkyard for these (XO) machines” (Stecklow & Bandler 2007).

The cancelled orders meant that OLPC could never honour the volumes commitments it had made to Quanta and had to renegotiate prices leading to an increase in the price of the XO from $100 to $188. In a desperate bid to retain sales numbers and market share OLPC introduced laptops with Microsoft Windows (Lohr 2008) and without the Sugar OS. According to Andres Gonzalez Diaz, governor of Cundinamarca, Colombia; "Windows support on the XO device means that our students and educators will now have access to more than computer-assisted learning experiences. They will also develop marketable technology skills, which can lead to jobs and opportunities for our youth of today and the work force of tomorrow.” (Fildes 2008)

The move however led to the demoralization of dedicated staff such as Ivan Krstic (Software security) and Walter Bender, (CEO) who had spent years working in the free and open
source software development industry and been instrumental in the design of Aquatic Sugar and the Bitfrost security system. By June 2008 both had resigned. The introduction of Windows XP meant that the constructivist learning theories of Papert which informed the conception of the Aquatic Sugar Operating System had to be junked (Lohr 2008). Bit by bit the vision that brought people together and the unique features that made the XO special were changed till it was no longer distinguishable from other similar offerings made available by large technology corporations.

5.2.4 This side up: The XO viewed from the perspective of the developing countries

Finally, the conception of ICT devices can happen from the perspective of either the developing or the developed countries. Up until this point, this case has largely concerned itself with an investigation into the motivations and strategies adopted by key players in developed nations that have informed the conception of the XO. In the final section we analyze the XO from the perspective of a developing country.

Developing countries are characterized by mixed economies and heterogeneous populations making competing demands on limited resources. Consequently, certain sectors are prioritized while others experience chronic underinvestment. A quick glance of the UNDP, Human Development Report (2001) reveals that primary education receives very little investment as compared to the defense, science and technology sectors. For example, from 1995-97 India spent a mere 3.2% of GNP or 11.6% of overall government expenditure on education as compared to 5.5% of GNP and 13.5% of overall government expenditure in the case of Australia, during the same period. This has resulted in 56% (UNDP 2001) of the overall adult population in India being classified as illiterate.

To make amends, the Federal Government of India moved the 86th amendment to the Constitution of India making free and compulsory, education for its 192 million children aged between 6-14 years of age and followed it up with a program for the universalization of elementary education called the Sarva Shiksha Abhiyan (SSA)25. According to the SSA

25 http://ssa.nic.in/
website, the program involves opening new schools, building new classrooms, toilets, drinking water facilities as well as training for teachers and the revision of school curriculum. The total outlay for this project is USD 20 billion spread over ten years from 2001-2010.

The decision to buy the XO then presents governments of developing countries with a clear choice. They can either exceed their budget by spending USD 38.4 billion on the XO (192 million pieces at approx USD 200 per laptop) without ever getting to test them, or receive after-sales support, software upgrades etc. or, invest a similar amount on building a physical infrastructure including schools, classrooms and training teachers. The OLPC team however constructs an argument to suggest that the latter approach is not qualitatively adequate. In 2006, Negroponte suggested that:

“…when you go to these rural schools, the teacher can be very well meaning, but the teacher might only have a sixth grade education. In some countries ... as many of as one–third of the teachers never show up at school. And some percent show up drunk. So really, if you are going to affect education, you cannot just train teachers and build schools.” (Negroponte 2006)²⁶

Here, Negroponte seems to be alluding to the theory of guided constructionism as proposed by Seymour Papert and which lays a strong emphasis on the concept of “hands on experience” whereby the role of the teacher is more as a ‘midwife in the birth of understanding’ as opposed to being the agent for ‘knowledge transfer’ (Papert 1980). However, while constructionism may be appropriate for subjects like mathematics and science which require the use of ‘manipulatives’ such as the XO, constructionism is pretty much useless for building literacy and language skills which can be vital in securing low end data entry and call center jobs that are outsourced to such locations by digital capitalism.

Not surprisingly, the Human Resources Development Ministry of India rejected the OLPC laptops as being “pedagogically suspect”. Alluding to the disproportionately high costs of

²⁶ http://www.olpctalks.com/nicholas_negroponte/negroponte_netevents.html
including computers in the curriculum as compared to the provision of a regular educational infrastructure, the Ministry statement indicated that it was difficult to visualize a situation whereby the laptops would be immediately ready for use and would probably require decades for pilot testing if made available. According to the Ministry, “we need classrooms and teachers more urgently than fancy tools” (Economic Times 2006)

5.2.5 Conclusion
The inability of remote communities in developing countries to constitute either a market or a political constituency results in the level of customization and contextualization of digital devices introduced here being influenced by powerful mediators that include governments of developing countries and global capital. The development of the XO represents attempts to renegotiate these relationships. However despite OLPC’s best efforts and the devices commendable technical and design features the end results can only be termed as undesirable. For, its introduction in developing countries may result in an under-investment in the very infrastructure whose inadequacy was used as an excuse by OLPC for introducing ICTs in school curricula in the first place. It is also entirely possible that in developing countries where they are finally introduced, constituencies that enjoy political patronage selectively benefit at the expense of the wider school going fraternity.
6 Appropriate Technologies for Developing countries

Based on the theoretical constructs and the two case studies we can now outline a broad theory about the conception of technologies for developing countries that are informed by the development discourse. The development discourse is as much an instrument for furthering the economic interests of the developed countries as it is about enabling human development in developing countries. Consequently, its strategy is to sustain a global economic architecture consisting of developed countries in the center and the labour and resource rich developing countries supporting it and accepting its finished goods, at the periphery. This is achieved through the introduction of structural readjustment programs by multilateral agencies which seek to reinforce or transform the economies of developing countries in an attempt to augment the aims of digital capitalism. Furthermore, these programs prescribe and fund the introduction of technologies in a bid to realize greater efficiencies and/ or achieve operational parity and reduce transaction costs, as in the case of ICTs. As a result, the conception of technologies for developing countries is informed by the ideologies, ethics and priorities of dominant players in the global order and not from the perspective of its end users. This is the ethnocentric notion that the poor in developing countries have no knowledge and that modernism is desirable and superior to local cultures and therefore constitutes an erasure of the past. That is, modern technologies do not have to consider local cultures, modes of production and indigenous ways of being in the design of new technologies.

In response, this thesis argues that the conception of technologies for developing countries needs to be disembedded from development aid, global capital and the development discourse and instead be repurposed for sustaining and reinforcing the unique local worlds of its end users. That is, it argues for customized technological solutions whose conception is
informed by and for the local context including its culture, modes of production and indigenous ways of being. However, this raises questions about how do we define local worlds and what forms could technologies seeking to augment them, take? In an attempt to limit the possibility of engaging with another form of epistemological obstacle as a possible solution (due to limitations within the authors own knowledge), we must identify ‘ideal forms of technology and local worlds’ and investigate ways of building technology as close to it as we possibly can. This section will therefore engage with the philosophy of technology, namely the work of Martin Heidegger and his concepts of ‘worlding’ and ‘thinging’ and Albert Borgmann’s ‘device paradigm’ and ‘focal practices’.

6.1 Technologies for local worlds

This section documents Heidegger’s systematic investigation into the nature of human existence in an attempt to specify the nature of human beings, how their worlds are constituted and the role of technology. To progress our inquiry, we must first move beyond a generic understanding of technologies and their instrumental relationship with mankind. Instead, we must first undertake a philosophical approach of understanding what are human beings and technology in themselves? This question is best addressed by the ontology of ‘being’. A rough translation of Heidegger’s definition of Being would be intelligibility or that which makes everything intelligible.

The traditional understanding of being before Heidegger was to define the being of something as a ‘substance’ or self sufficient entity with ‘properties’. In this way of being, the being of a piece of equipment such as a hammer (substance) was captured through a description of its function and observable properties such as, having a wooden handle and a metallic head with a certain mass, form and weight (properties). This form of substance ontology was also extended to humans as a way of understanding the being of humans. In that, they were seen as ‘thinking substances’ with properties such as a mind (which inspires the cognitive sciences till date) and a soul (which was immortal and not involved with time), etc.
However, Heidegger thought that this understanding of being was incomplete. According to him, the being of equipment such as a hammer could not be explained purely by the subject-predicate perspective because it does not provide a satisfactory account of why it is that we ‘hammer’. The being of a hammer is different to that of a blunt, heavy stone because the hammer gathers its own world of nails, glue and wood towards a purposeful activity. That is, 'hammering' is a culturally defined activity that defines a hammer as this piece of equipment that is required for hammering a nail so that we may attach pieces of wood, for building houses. That is, it has a place in the practices of a culture, in which it is related to a lot of other equipment and to the goals and skills of people. In short the being of a hammer ‘gathers its own ‘world’ making the hammer ‘thing’ (Heidegger 2008).

Similarly, for Heidegger, the way of being for humans is not as substances or consciousness, but rather as a kind of activity: we are what we do. Human beings give themselves an identity by taking up particular practices. In the above case, we take up a hammer for attaching wood, for building houses, for the sake of understanding ourselves as carpenters. All that the various activities related to hammering amounts to is taking a stand on my being. Heidegger has a word for this form of being for humans – Dasein – who by its use of equipment and acting in the world gives itself an interpretation of what it is to be, a human being in general and a human in that particular culture – a carpenter. To summarize, our nature as human beings is to be world disclosers. That is, by means of our equipment and coordinated practices we human beings open up coherent, distinct local worlds in which we perceive, act and think. Each such world makes possible a distinct and pervasive way in which things, people, and selves can appear and in which certain ways of acting make sense. (Dreyfus & Spinoza 1997)

Let us assume the case of the classic glass coke bottle, as a means of contextualizing the concepts of local worlds, dasein and the thinging of things in everyday life. Here, my intent is to reveal the embedded cultural values and meanings of the being of devices and equipment within a particular context and how the attempt to universalize these particularities can be problematic. So, the being of the coke bottle can be described as a transparent glass container that is used to fill with a brown liquid that is not essential for human existence but finds a place in the consumptive practices of some. In this form of
being, the coke bottle ‘worlds’ or gathers its own local world and things through a network of other equipment such as bottle openers, glasses, storage crates, transport vehicles and dispensing machines.

In Jamie Uys hit comedy film ‘The Gods must be crazy’, the accidental introduction of an empty coke bottle to a tribe of African Bushmen leaves them completely bewildered as to what the object is. As they attempt to fit the coke bottle to their own local world, they perceive it to be everything else - from a cloth stamp and a hammering tool to a musical instrument - except a coke bottle. By the same logical extension, the conception of technologies cannot be independent of the local worlds within which they will operate.

### 6.1.1 Subject and Object Mode of operation

Having defined the being of humans and technology, we must now analyze the nature of their interactions. For early Heidegger, the perception of technology as being merely instrumental for performing certain tasks distracts us from realizing our true form of being, in that it radically alters our thinking and the way we perceive the world. To bring forth his concepts, Heidegger distinguishes between the being (with a small b) of the hammer, trees and ants as discontinuous and ephemeral and, that of the larger Being (with a big B), which according to him was continuous through time. The little beings were at best momentary expressions of the larger Being, through time. The great cultural and philosophical task for Heidegger was to avoid getting distracted from this fundamental nature of our existence, that is our 'being-before-death', and the specificity of our 'being-there' only at particular moments in time and in particular places (Murphie & Potts 2003). Consequently, the domination and exploitation of Being by humans for the sake of efficiency and personal satisfaction is problematic. Modern technology facilitates this exploitation by altering our way of thinking, in that, it reflects our over-reliance on merely the technical understanding of beings. In this mode, humans operate as a subject in control with the objectification of everything around him. This is a bit like encashing the natural resources all at once, and instead of running with the environment, we run against it, get as much out of it as we can and trust in a new technology to fix the problems afterwards. Our current consumption patterns as well as our limited ability to engage with the concept of reduced and localized consumption in favor of solutions that involve more technology such as clean coal, nuclear power and hybrid cars.
such as the Prius, as a means of reducing global warming; are all symptomatic of this faulty instrumental thinking (Murphie & Potts 2003).

In his book ‘Technology and the Character of Contemporary life’, Borgmann (1987) illustrates this form of thinking to great effect by bringing forth the concept of focal practices and the device paradigm. According to Borgmann, the most important characteristic of modern technological devices is its disburdening character. That is, people use technologies and devices so as to decrease the effort that is needed to accomplish things. Devices do so by creating availability facilitated through the rendering of Being into standing reserves. That is, technology facilitates the instrumental thinking that efficiency in modern life can only be achieved by making, say electricity, ubiquitously available through the damming of a river far away to generate and then distribute power into the domestic environment; not for an ongoing and specific task but only as a normative form of standing reserve that facilitates human choices, such as choosing to switch on my PC to work from home or should I choose to turn on the television when I am feeling bored or the heater, when I am cold.

By its intermediation between humans and the natural environment, devices radically alter our cultural behavior and attitudes. For example, the introduction of air-conditioning to a house originally using a fireplace radically alters seating patterns and family activities in the evening (pre-programmed by the weak heating capacity of the fireplace). Also, its comparative operational simplicity vis a vis the fireplace disburdens the users and their cultural connectedness to the forests. Vital skills such as when and which wood to cut, how many trees are remaining in the forest are lost. We simply adjust the thermostat, and heat is at our disposal. The effort that was needed in a pre-technological situation is now delegated to the machinery of a device, namely, a central heating system, which is only present at the background of our experience. In this way, heat becomes a commodity, which can be consumed without any involvement with the way in which it came about (Murphie & Potts 2003). The inseparable connectedness that people felt with their cultural and geographical context is now delegated to their machineries. In doing so, technology and devices intermediate the human environment and reality thereby allowing people to commodify the environment and consume them as unconcernedly as possible.
Based on the above, we can now integrate the validated hypotheses and the philosophical understanding of technologies into a coherent theory to suggest that appropriate forms of technology for developing countries are those that:

- Gather a local world rather than seek its disaggregation into ‘standing reserves’ /resources that then await further appropriation by the process of globalization, as in the case of ICTs
- Assist end users to resist environmental, economic and social devastation and
- Allows technological devices to ‘thing’ thereby opening up coherent, distinct local worlds in which human beings perceive, act, think and reinforce their nature as world disclosers

6.2 Local Worlds of end users in developing countries

Based on the above framework, appropriate technologies for developing countries can be described as those that are conceived by the end users themselves and are a product of their own knowledge, both traditional and contemporary. These are technologies that draw on the physical, material and cultural contexts of their own local worlds, towards delivering on clearly defined goals and which bypass an overarching infrastructure for consumption. According to this definition, even a hammer is a form of technology and the process for its conception very similar to that of product design. Consequently, from chapter 8 and onwards, this thesis will use the terms user led innovation, product design and, technology interchangeably. In an attempt to provide greater clarity to these definitions through tangible examples, this section will describe a local world and document some examples of appropriate technologies from rural India.

Typically, in remote rural villages of India where the population density is low, both market forces and public systems are unable to provide appropriate services. This is because the number of people as well as their incomes is too low to constitute a market or a political constituency. Such villages are often characterized by the absence of basic amenities such as schools and public transport (or when available are at a great distance from the village). There is also no electricity, very low telecommunication densities, or suitable employment opportunities. Consequently, the whole village is involved in agriculture and agri-processing
activities with most farmers relying on manual labour or bullock-driven implements for their labor requirements. Everyone builds their own houses out of locally available materials, and share private transport to get to the markets to sell produce or hitch a ride to the nearest public transport stop. Some of the ways of coping with these limitations is to rely on ethnic linkages, informal money lending institutions and to develop innovative solutions. Here are some examples:

6.2.1 Jugaad - Automobile design by illiterate farmers

The ‘jugaad’, is an ‘assembled’ vehicle used for taxi services. Its structure is made out of second-hand components of other vehicles like tractors and goods carriers or even accident wrecks that often litter the rural landscape. According to Sainath (2006), the jugaad in (Figure 13) runs on a 5 horse power diesel engine and costs under Rs. 10,000 (US $225). But it adequately serves the purpose for which it was built. It takes produce from the farm to the market. It drops children to school, transports old people around the village and charges about Rs. 2 (5 cents) as minimum fare that can vary depending on the region and the distance involved.

However, the ‘jugaad’ has been banned in the state of Haryana because automobile companies protested to the government. The ban on the jugaad represents the divide between the technologies of the elites and poor as identified earlier on in chapter 3 and the use of state and capital by the former in seeking to quash the technologies of the poor. According to Sainath (2006, p. 40),

“...the lobbying for the bans was spearheaded by auto makers on the pretext of safety. That is a difficult argument to understand because the ‘jugaad’ travels at 5 miles per hour!”

In one sense, the ‘jugaad’ has something that no automobile can claim – EVERY ‘jugaad’ is custom made because there is no individual inventor. Figure 14 shows another version of the jugaad. This one was made in Southern India. According to Sood (2006), this jugaad is also made out of second-hand components of other vehicles. However, it has a tin sheet roof and is driven by a gen-set (power generator) engine. Gensets are fairly common among
comparatively well off rural Indians due to the lack of electricity. However, the genset powering this *jugaad* is put to various other tasks like pumping water for irrigation, producing electricity for household consumption and for grinding food grains and so on.

Figure 13: Jugaad: Public transport vehicle (PiTech 2006, p. 36)
That is, the genset acts as a kit of parts which combines with other equipment to serve many other purposes. In philosophical terms, the genset has a place in the practices of a culture and *worlds* (or gathers its own local world) in which it is related to the goals and skills of people and a network of other equipment such as the *jugaad* and the irrigation pump etc.

Figure 14 Jugaad: Public transport vehicle (CKS 2006, p. 53)

### 6.2.2 Alternative power

The absence of electricity has resulted in a reliance on car batteries as a form of power supply. Single batteries (or in a series for higher powered devices) have been used to run everything from mobile phones (Figure 15) domestic devices such as food processors to even stereo players.
All the above examples show how technologies can be appropriated by end users through the application of their own knowledge and drawing upon the physical, material and cultural contexts of their own local worlds. Similarly, indigenous societies are rich in traditional knowledge such as the medicinal value of plants, conservation of natural resources and adapting to weather phenomena. In Kutch district of the state of Gujarat, for example, there is a large grass land called as *Banni* comprising saline flat soils. The ground water here is extremely saline and therefore not fit for human or cattle consumption. According to Gupta (1996),

"the indigenous people here have developed an ingenious way of conserving fresh water in the sub-soil. After the monsoons have leached down the salts, farmers use branches of the prosopis tree to create a framework that sandwiches grasses between them and support 20-25 feet well dug in to the ground. The wooden framework prevents soil from caving in and the grass
lining along with the porous prosopis branches filters the water which moves into the well from the surrounding soil.

Over a period of time the wells get filled up with the soil but when water is required, the soil is removed and the water oozes in from side ways. Since the specific gravity of fresh water is less than that of saline water, it floats on the saline ground water. For at least two-three months after opening the well, water remains drinkable before it becomes saline again. This is a technique which has provided solutions to the problem of drinking water for humans and livestock use for centuries in this region. Incidentally, no technology has been developed by modern science with comparable efficiency and low cost”

To summarize, end users in developing countries have a rich history of traditional knowledge as well as the ability to innovate and contextualize technologies to their own local worlds. Instead of seeking to apply newer forms of global technologies to developing countries, we must find ways to promote, facilitate, and transfer these innovations from one location in developing countries to another. Perhaps, the technique used in Kutch could be of use in other arid environments or, the jugaad could be applied to some other developing country contexts.

While this ‘transfer of technology’ may sound counter intuitive and self contradictory given that all contexts are unique, it is important to point out that the jugaad for example is an adaptation of an automobile. The automobile was never invented by indigenous communities but merely appropriated by the poor using their own ingenuity because the technology facilitated it. Similarly, our aim should be to conceive a kit of parts for appropriate technologies so that remote rural communities in developing countries can interpret and appropriate them for their own unique forms of contextual technologies.

However, there are many barriers to the evolution and diffusion of these innovations. This is primarily due to the way, in which science, its knowledge validation processes and its interface with industry are structured globally and especially in developing countries such as India as evidenced by the ban on the jugaad. There is a huge emphasis on large scale industry led Research and Development which completely overlooks small scale innovators.
and their innovations. For example, small scale and community based innovations and innovators often suffer from a lack of access to formal scientific institutions resulting in a lack of peer review process that prevent innovators from optimizing their solutions and which in many cases is instrumental to securing venture funding. Innovators in the formal sector also benefit from social networking through conferences, symposiums and industry events which fosters collaborative learning. This is unavailable to small scale innovators. Furthermore, the rewards for innovators and the diffusion of innovations are severely restricted by the lack of appropriate intellectual property mechanisms for small scale innovations. Intellectual Property Rights (IPR) tend to focus only on “breakthrough” R&D innovations resulting in important micro-innovations being rejected due to their inability to satisfy the clauses of **novelty** (which requires substantial advance with respect to preceding inventions) and **non-obviousness** (which requires that the advance should not be trivial) in IPR. Furthermore, the application and recurring costs associated with maintaining an international patent can go up to as much as USD 20,000 per year (Gupta 2006). This is clearly unaffordable for the poor.

The challenge then is how do we facilitate this user led innovation? How can we create a knowledge network that assists in taking innovations from concept to market and which protects intellectual property rights while allowing others in developing countries to benefit from what has been designed.

The emergence of networked computing accompanied by new paradigms of production such as peer to peer and open source along with a rethinking of the ‘commons’ present us with an opportunity to satisfy these conditions. There is however considerable confusion and ignorance within the Industrial Design discipline about what constitutes an Open Source project, how it differs from the Free Software Foundation (FSF), its unique operational mechanisms as well as its structuring of intellectual property rights, thereby limiting the potential for its appropriation for facilitating the design and development of physical artifacts. The next chapter therefore explores the core concepts and methodologies of the Open Source movement.
7 Free/ Open Source Software (FOSS)

The term *open source* is used to describe particular software development methodologies. It is a development process that relies on the contributions of a geographically dispersed community of developers who communicate and collaborate through the internet. Typically, programmers develop software by writing source code using computer languages such as Basic, Java, C and C++. When complete, this source code is converted into an executable binary code that speeds up software performance by converting it into a series of zeros and ones that the machine can quickly read and translate into functionality. However, once converted it is impossible to decipher the source code and therefore modify or customize software. Consequently, it is the preferred format for distributing proprietary software by large technology corporations intent on protecting trade secrets. They are further secured legally by bundling them with complex licensing mechanisms underpinned by IPR legislation. Unlike the closed and executable format of proprietary software, activity in open source projects is centered on the availability of an open source code\(^\text{27}\) that everyone can modify and redistribute. Implicit within this method then, is a rejection of monopolistic forms of intellectual property inherent in proprietary software systems as they are perceived to limit individual freedom as well as software customization and innovation.

Although, the Open Source movement has been around for at least two decades, it has witnessed a surge of public interest only in recent times. This is due to the rapid acceptance and popularity of Open Source Software (OSS) and its domination of critical software product categories such as web servers and operating systems (OS). According to Lerner and Tirole (2000), Linux, an open source OS has between seven to twenty-one million users

\(^{27}\) http://www.opensource.org/docs/definition.html
worldwide with an annual growth rate of 200% making it the only serious challenger to Microsoft Windows’ domination of the OS market. This success has helped OSS companies attract significant capital investments from venture capital firms and financial markets. By the early 2000s a number of companies who had successfully commercialized open source software such as Red Hat and VA Linux decided to list on global stock markets through very successful Initial Public Offerings (IPOs). Start up OSS ventures such as Cobalt Networks, Scriptics and Sendmail also successfully attracted venture capital investments, while large technology corporations such as Hewlett Packard, IBM and Sun acknowledge investing significant amounts in Open Source projects for their own software requirements (Lerner & Tirole 2000). Open Source methodologies are now considered sufficiently mainstream within the software, business and research community to be included in contemporary innovation and organizational discourse. There is however considerable confusion and ignorance within the industrial design discipline about what constitutes an Open Source project, how it differs from the Free Software Foundation (FSF)28, its unique operational mechanisms as well as its structuring of intellectual property rights, thereby limiting the potential for its appropriation for the design and development of physical and digital artifacts. In response, this chapter is structured into two components; first, we take a close look at the history of the Free Software and OS movement for insights into what motivated their conception and subsequently guided their diverging character and growth trajectories. Next, we place the various software licenses within the context of global IP as a means of investigating the motives and objectives that shape them followed by a close look at the specifics of each license and its implications for software innovation, competition and the structuring of the software market.

7.1 History of the Open Source Software movement

According to Lerner and Tirole (2000), while the phenomenon of Open Source software has received media attention only recently, its basic behaviours are much older in their origins. There has long been a tradition of sharing and cooperation in software development. But in recent years, both the scale and formalization of the activity have expanded dramatically,

28 http://www.fsf.org/
aided by the widespread diffusion of the Internet. In an effort to explicate the motivations and directions of the Open Source phenomenon we trace its evolution across three distinct periods.

**Early 1960s to the Early 1980s**

As is typical to new research initiatives, the inability to predict the commercial success of information technology meant that research remained restricted to a few early innovators who were distributed across corporate research facilities at AT&T’s Bell Labs, Xerox’s Palo Alto Research Center and academic campuses such as Berkeley and MIT. To facilitate this process, it was common practice for software to be installed across multiple locations and the source code to be shared among various researchers and developers. Programmers freely shared, appropriated and contributed code to customize software for their own task specific requirements. This was further accelerated when Usenet, a computer networking system was introduced in the mid sixties. Some of the most popular outputs of this period include the programming language C and the UNIX operating system. The UNIX kernel attracted the most attention as multiple users hooked to Usenet started participating in the development and customization of the Unix OS. As mentioned earlier, the inability to predict the research and commercial success of information technology meant that there were no efforts made to restrict usage and distribution through the enforcement of property rights.

**Early 1980s to the Early 1990s**

However by the early 80s, AT&T began enforcing its intellectual property rights over UNIX. In response to threats of litigation, Richard Stallman at MIT started work on the development of the GNU (GNU’s Not Unix) operating system at MIT in 1984. However, at this stage he was merely concerned with the emotional and practical aspects of software development. The GNU Project was conceived as a way of bringing back the cooperative spirit and the consequent acceleration in innovation that prevailed in the computing community prior to the advent of proprietary software. Since all computers require an operating system the GNU project was prioritized over the development of other application specific software. However, Stallman quickly realized that his aim of promoting cooperatively developed software would never attain critical mass so long as it failed to address the issue of its ownership.
By the mid eighties, in response to the increasing commercialization of the software industry and the critical role it played in the process of globalization, Stallman pioneered the Free Software Foundation (FSF) as a means of raising funds from individuals rather than corporations or grant-making foundations for the development of free software. Central to this initiative was his belief that proprietary software was a form of digital colonization that not only restricted innovation and software quality but also represented a subversion of individual liberties and freedom (Singh 2008).

Drawing on the ongoing debate between the democratic and economic interpretation of the ‘marketplace of ideas’ metaphor (which we shall closely examine later on in the thesis), Stallman saw the extension of property rights or rights linked to physical commodities such as shoes, land and houses to non tangible commodities such as ideas and concepts by the Intellectual Property regime as representing the privatization of free thought. Accordingly, the FSF website suggests “the word free in free software pertains to freedom, not price”.

FSF introduced a formal licensing procedure in 1985 that aimed to preclude the assertion of patent rights on cooperatively developed software. In exchange for being able to modify and redistribute the GNU software, users and developers had to agree to make the source code freely available. As part of the General Public License (GPL) - also known as ‘copylefting’ - developed by FSF, a user could access, use, modify and redistribute FSF software so long as he/she agreed not to impose licensing restrictions. That is, unlike the Open Source movement the FSF values contributions of all developers equally and prevents the last link in the development process from disadvantaging early contributors by claiming ownership for the product. This restriction has resulted in large software corporations being practically eliminated from the development of FSF products (Lerner & Tirole 2000).

According to the FSF website, once you have the software you have four specific freedoms in using it:

- Freedom to run the program for any purpose

29 http://www.fsf.org
30 http://www.fsf.org/licensing/essays/free-sw.html
• Freedom to study and adapt the code for personal use. Therefore, the provision of a Source Code is a precondition.
• Freedom to redistribute copies of the program
• Freedom to distribute improved or modified versions of the program to the public

The correlation of software to individual freedom and a democratic interpretation of the ‘marketplace of ideas’ metaphor, by the FSF necessitated an organizational model for software development whereby contributions from many developers were accepted and acknowledged but the official version remained in control of a smaller subset of individuals. This, combined with strict licensing terms negating the possibility of cooperatively developed software ever being commercialized, resulted in the FSF being perceived within the hacker community as a top down and ideologically driven organization which impedes software variety and innovation.

**Early 1990s onwards till date**

By the early 90s, the emergence of markets as a central mechanism for social and economic structuring combined with the widespread diffusion of the internet resulted in hybrid business and software development models. Not only did this result in the dramatic acceleration of the volume and diversity of contributions within Open Source, but also resulted in greater interaction between commercial software companies and the Open Source community.

In 1997, the process of forming the Open Source Initiative (OSI) began with the publication of Eric Raymond’s influential paper ‘The Cathedral and the Bazaar’. In this paper, Raymond sought to distinguish between the ‘cathedral’ or hierarchically structured mode of software development as envisaged by Stallman and the FSF from a more flat and open ‘bazaar’ mode. While the paper sought to influence hackers into adopting the latter model, it nevertheless had the unintended consequence of popularizing and turning hacker practices into mainstream software development methodologies. When Raymond presented his paper at the O'Reilly Perl Conference at San Jose in 1997, representatives of the internet browser company Netscape were present among the audience. They were so impressed by his ideas that they sought to employ hacker techniques for developing their newer version of web...
browsers. They invited Raymond to help them plan their browser source-code release. This new team consisting of Netscape developers, Raymond and other hackers:

"...decided it was time to dump the moralizing and confrontational attitude that had been associated with the FSF in the past and sell the idea strictly on the same pragmatic, business-case grounds that had motivated Netscape. They brainstormed about tactics and a new label "Open source", contributed by Chris Peterson, was accepted" 31

Immediately afterwards, the Open Source Initiative (OSI) was setup to manage and promote the Open Source Definition (OSD). The OSD was composed as a guideline to determine whether a particular software can be called open source or not and to formulate broad licensing guidelines for its distribution (Gacek et al 2004). The OSD guidelines allowed licensees greater flexibility in using, distributing and commercializing software programs by accommodating the restrictive General Public License alongside the right to bundle cooperatively developed software with proprietary code. Furthermore, it allowed developers the option of adding more restrictions to the modified versions so that some copies of software may not be free at all. OSI allowed users the option of compiling the program and redistributing the binary as proprietary software. These provisions were adopted in early 1997 and termed as the 'Open Source Definition' 32 and include:

- The right to redistribute the software freely. The license shall not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources.
- The availability of the Source Code. The program must include source code, and must allow the distribution of the software in source code as well as compiled form.
- The right to create derived works through modification.
- Preservation of the integrity of the author's Source Code.

31 http://www.opensource.org/history
32 http://www.opensource.org/docs/osd
• No discrimination against persons or groups for providing contributions and for using the software.
• No discrimination against anyone making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research.
• The rights attached to the software apply to all recipients its distribution.
• License must not be specific to a product but apply to all sub-parts within the licensed product.
• Any such license must not restrict other software. For example, the license must not insist that all other programs distributed on the same medium must be open-source software.
• License must be technologically neutral. No provision of the license may be predicated on any individual technology or style of interface.

These elaborate definitions and especially the insistence for the provision of a source code raise the question of how OSS can ever be commercialized. The answer is, since OSS is exclusively developed for and by the hacker community who have excellent programming skills, most OSS is difficult to install. Furthermore, in the event of a breakdown it is almost impossible to fix if the user does not have good programming skills. Therefore, the most prominent way of commercializing OSS is by providing distribution and service packages. Another way of making money out of open source is by using the relevant open source as a platform, upon which proprietary software applications can be built (Gacek & Arief 2004).

However, commercialization also requires a clear ownership title over the product. This is often achieved by elaborate licensing conditions that allow or restrict the user’s ability to use, distribute and change or customize software code. Implicit within each form of licensing then is not only the conditions for its use but also how it perceives, rewards and sustains the development process. Licenses provide insights into the choices made by each methodology such as a universal rewards or last link beneficiary mechanism, the duration of the rewards and its implications for the structure and character of software innovations. We examine all of these in the next section through a thorough examination of IP and the various licenses.
7.2 Intellectual Property and Licensing for F/OSS

The term intellectual property rights denotes a cluster of legal doctrines - mainly patents, copyright, trademark and trade secret - that differ in their structure, scope and spheres of application, but nevertheless have in common the feature of granting the owner, rights over the economic exploitation of an idea. Such rights are generally exclusive, meaning that the owner is given a legal monopoly over the protected idea (Ramello 2005).

By regulating incentives for the creation and/or disclosure of new ideas, the Intellectual Property (IP) system provides an essential framework for the promotion and protection of innovation. An ideal IP system creates incentives for innovation, without unduly limiting access for consumers and follow-on innovators. Influenced by the theories of John Locke (1632-1704) and the ‘marketplace of ideas’ metaphor the existing IP regulatory framework was shaped by industrial economies during the second half of the last century. Consequently it remains predisposed to a production and consumption paradigm seeking to promote and protect innovation by rewarding producers with short-term monopolies. However, the emergence of a knowledge economy with information as its central commodity exposes limitations within the existing IP framework and presents regulators seeking to reshape it with new challenges. What should the policy objectives and regulatory philosophy for a commodity which is integral to and guaranteed by democracy, be? How can it adequately protect innovation for ‘knowledge assets’ such as ideas and information - which while expensive to make are easier and cheaper to copy - without disadvantaging follow-on innovation for new social behaviours and production paradigms such as peer to peer production and the Open Source, which rely on the availability and sharing of information?

The licensing variations between the FSF, Proprietary and OS software can be characterized as an attempt to counter, align to, or reinterpret existing regulatory shortcomings. However, a simplistic documentation of what the FSF, Proprietary and OS software licenses allow or prohibit its users from doing would provide little by way of detail into the motives and objectives that shape the licenses thereby limiting their instrumental value in informing the development of appropriate IP mechanisms. In response, the rest of this chapter will
investigate the history and evolution of IP, especially the theories that inform the regulatory philosophy and then proceed to document the corresponding policy architecture to gain a coherent insight into objectives, motives, and mechanisms of IP, followed by a detailing of the specifics of each software license. In an attempt to avoid an economic and ideological bias we will avoid referring to a particular national IP policy as much of it is framed by global treaties and bi-lateral agreements through which individual nations seek to selectively protect and promote national innovation ecologies.

**Distinguishing Physical Property from Intellectual Property**

A popular understanding of the term ‘property’ relates to physical objects such as land, houses or bricks. Duplicating physical property requires the same amount of time, effort and money. Furthermore, when someone uses physical property such as a shoe or a parcel of land for a particular function it cannot be used by others. Therefore physical property rights invariably involve granting exclusive use and control of assets and excluding others from accessing them. Intellectual property such as a poem, formula or ideas, on the other hand, can be easily duplicated and used with little effort. However this usage does not diminish the author’s ownership nor own use of the poem. Intellectual property and especially digital property are therefore ‘non-rival’. That is, its use and ownership are not exclusive. This is the fundamental difference between physical and intellectual property. And while technology now makes it cheaper and easier to duplicate ideas there is a strong push to extend and expand intellectual property rights.

The entire debate on modern IP is centered on the ethical, democratic and economic implications of extending monopolistic property rights to thought, information and ideas. Those with a legal and economic perspective seek to restrict the circulation of knowledge to an economic context and its exploitation by the marketplace, arguing that it stimulates the production of those ideas that the market most readily rewards and that it provides an incentive for the creation and/or dissemination of new ideas (Ramello 2005). However, the democratic perspective counter argues that modern IPR represents the privatization of information and ideas which can only diminish individual liberties. Furthermore, they argue that existing IP mechanisms restrict innovation as they fail to consider newer forms of social behaviour and work which are increasingly centered on the creation, sharing/ appropriation
and manipulation of information. Finally, the ethical perspective raises questions over the private ownership of sensitive information (the human genome is an obvious example) and highlights the inability of IP to include community-based ownership of information and innovation which severely disadvantage indigenous communities.

### 7.2.1 Theoretical Origins of Intellectual Property

According to Martin (1998), the idea of intellectual property has a number of connections with the ‘marketplace of ideas’ metaphor. It is one of the most basic and foundation concepts in not only Intellectual Property Rights but also communications regulations. It has been subject to intensive analysis and scrutiny in legal, academic and policy circles (Jensen 1998; Powell 1995; Sullivan 1995). A key point that emerges from these analyses is that the metaphor contains elements of both democratic and economic theory. This duality has allowed widely divergent interpretations of the metaphor which have shaped the different policy objectives and regulations.

#### 7.2.1.1 Marketplace of Ideas and Democratic theory

The origin of the marketplace of ideas metaphor has been traced to the work of John Milton in the 17th century (Schwarzlose 1989; Smith 1981). In this early stage of the concept’s development, the central principles were those of truth being achieved via the free exchange of ideas and the importance of individual rights of self-expression and freedom of thought (Milton 1644/1961; Smith 1981). Milton described the process of truth emerging from the free clash of opposing ideas. From these beginnings as an expression of individual rights, the marketplace of ideas concept evolved into an expression of citizens’ rights and of effective democracy (Schwarzlose 1989). John Stuart Mill (1859/1978) is frequently identified as the key instigator of this transition because of the conceptualization of free speech as serving an extended social good beyond the rights of the individual (Gordon, 1997; Kendall 1960; Schwarzlose 1989). This perspective was further refined and more directly applied to the democratic process in Meiklejohn’s discussion of First Amendment Theory, in which he argued that the unhindered flow of information from a variety of sources facilitates effective political decision-making and was therefore essential to a self-governing society (Napoli 1999). Consequently, the policy objectives of a democratic theory-based interpretation of the
marketplace of ideas metaphor emphasize free speech between both the markets and the consumer and among the consumers themselves that support informed decision making and a limited and inclusive reward/ incentives mechanism that ensures a balanced trade-off between private appropriation and the public sphere.

7.2.1.2 Marketplace of Ideas and Economic theory

The economic perspective on the marketplace of ideas metaphor interprets the term ‘market’ more literally and structures it along the earliest theory of property rights – John Locke’s theory of labor mixing. According to Ramello (2005), the economic interpretation of intellectual property rights and the marketplace of ideas draw directly on the theory of labour mixing and property formulated by John Locke (1623-1704), which established a causal link between creators and ideas, thereby legitimizing the individual appropriation of the latter through the ad hoc institution of property rights. In his second book of the Two Treatises on Government (1690), Locke suggested that every man has a ‘natural right’ to appropriate the fruits of the labour of his own body. In other words, the English philosopher believed that individuals acquire property rights over assets originally contained in the state of nature, by virtue of the fact that in order to extract them they contribute their own labour, and hence a part of themselves (Hughes 1988; Drahos 1996).

However, he also defined specific limits for appropriation by establishing a trade-off between private appropriation and the public sphere. In section 27 he suggests that an individual can extract from the state of nature only that which leaves:

“enough and as good left for others”, and in any case that “the same law of nature, that does by this means give us property, does also bound that property too….Nothing was made by God for man to spoil or destroy” (Locke, 1690, sect. 27).

This concern for the preservation and enrichment of public sphere was taken up by all the subsequent literature on intellectual property, including the contemporary discourses based on the democratic perspective such as the ‘commons’ and later the ‘creative commons’ (Hardin 1968; Lessig 2001). Locke’s theory nevertheless provides us with the primary
criteria for establishing markets and the requisite regulatory mechanisms that guarantee a sufficient private incentive and establish a trade-off between private appropriation and the public sphere.

However, it was Jeremy Bentham (1748-1832) who developed a more robust paradigm for the integration of an economic perspective on markets and intellectual property. He famously wrote that "he who has no hope that he shall reap, will not take trouble to sow" (Bentham 1839, p.31) and provided a practicable solution to the problem of providing protection and the ‘incentive to create’ in his 'utilitarian theory' which remains at the core of the modern regulatory framework in developed countries. In particular, Bentham notes (1839, p. 71)

“...that which one man has invented, all the world can imitate. Without the assistance of the laws, the inventor would almost always be driven out of the market by his rival, who finding himself, without any expense, in possession of a discovery which has cost the inventor much time and expense, would be able to deprive him of all his deserved advantages, by selling at a lower price”.

Bentham's proposal helped Locke's abstract conceptualization of intellectual property evolve into a more concrete framework involving an independent regulator and specific regulations that helped promote and protect innovation. However, Bentham's concern for the economic risks faced by creators meant that most proposals were strongly inclined towards 'protection as a means of promoting innovation'. According to Ramello (2005), Bentham’s theory played a ‘totemic’ role in the law and economics literature on intellectual property, providing a universal reference framework for nearly all subsequent contributions. These have incrementally fine-tuned, systematized, updated, and occasionally leveled some criticisms at Bentham's model, but always held the central paradigm intact.

By the mid-1960’s, the marketplace metaphor had fully crystallized into a concise expression of a key dimension of the United States Constitutions First Amendment, in which the concept of economic exchange held a prominent position. In his seminal paper titled The Economics of the First Amendment: The Market for Goods and the Market for Ideas, Ronald Coase (1974), introduced a strong economic interpretation of the marketplace of ideas
metaphor focusing exclusively on the efficient production and exchange of goods and services with no acknowledgement of a broader democratic function (Napoli 1999). In 1975, media economist Bruce Owen (1975, p. 5) suggested that:

“The marketplace of ideas is a metaphor with more than one interpretation. The one that will occur to most non-economists is suggested by the epigraph from Milton’s Areopagiticia at the beginning of the book. That is, “ideas” compete for intellectual domination over men’s minds, and presumably truth wins just often enough to keep the game interesting. The sense in which I wish to use the term is, however, rather different from this. In particular, I want to take the “marketplace” notion quite literally. There is a market in which information and entertainment, intellectual “goods” are bought and sold.

Around the same time, the eminent economist, investment banker and academic, Joseph Schumpeter (1962) ascribed economic growth to entrepreneurs and gifted individuals who he suggested could be identified and promoted through markets. Schumpeter's Theory of Economic Development linked innovations and development to economic cycles and proposed that in the absence of entrepreneurs and innovation, business cycles and the consequent circular flow of money through an economy stagnates or experiences a 'Walrasian equilibrium'. The entrepreneur disturbs this equilibrium and is the prime cause of economic development, which proceeds in cyclic fashion along several time scales.

This increasing convergence on markets as a central instrument for economic growth and the testing of multiple and competing ideas and innovations for the provision of public goods, necessitated the development of appropriate regulatory mechanisms including intellectual property rights to oversee the market’s regulated and structured evolution. The policy objectives of the economic perspective of the metaphor therefore emphasize efficiency, transparency, competition and exclusive rewards/incentive mechanisms. In the next section we analyze how these policy objectives have been translated into the various types of IP such as Patents, Copyrights and Trademarks that are currently in use.
7.2.2 Classification of Intellectual Property Rights

According to Ramello (2005) there are four main types of Intellectual Property Rights; Patents, Copyrights, Trademarks and Trade Secrets repetition - this has already been identified – perhaps cut earlier. They are classified as such based on the type of information being protected, the attribution criteria, the type of exclusive right granted to the owner and the incentive conferred.

**Patents**

Patents protect ideas linked to technological and scientific innovation and invention by granting the inventor an exclusive but short term monopoly. The patent mechanism has a two fold character; disclosure and rewards. Because a patent application requires revealing the invention, patents create an incentive to disclose new information which facilitates follow-on innovation. Furthermore, the monopoly acts as a protective and rewarding mechanism that provides the primary innovator with a sufficient lead time to recover costs and make a profit. This mechanism has wide implications not only for innovators but the structure and character of markets themselves. For example, Australian experts such as the University of Queensland's Kimberlee Weatherall blame the poor innovation environment in Australia on a liberal patent framework that awards patents to the flimsiest of inventions for very long periods thereby locking up immense amounts of fundamental information with detrimental impacts for follow-on innovation (Berkovic 2008).

Patents are granted based on the fulfillment of three criteria: the criterion of *novelty* which requires substantial advance with respect to preceding inventions; the criterion of *non-obviousness*, which requires that the advance should not be trivial and finally, the criterion of *utility* whereby the invention has some practical application and should not be an end in itself. Complying with these criteria should ensure that strong exclusive rights are granted only to those ideas that effectively constitute a real technical or scientific advance.

**Copyrights**

Copyrights protect expression of ideas in any tangible medium. This includes books, film, photographs and software. Copyrights are generally granted on the basis of *minimal originality* with no prescribed or standardized procedure for verification. Consequently, new
works have to be only marginally different from an existing work to be granted a copyright and it is often up to the plagiarized author to raise objections and prove that the new works are not sufficiently original. Furthermore, copyright laws tend to distinguish between the ideas being protected and their commercialized representation in the form of books, CDs etc, and therefore include the regulation of its reproduction and dissemination.

In recent times, the duration of the copyrights monopoly have been extended through legislations in the USA (US Copyrights Term Extension Act 1998) and the European Union (European Duration Directive 93/98/EEC) to more than 70 years after the publication of a copyrighted material. This has skewed the disclosure and rewards mechanism overwhelmingly in favour of the latter and slowed the enrichment of public knowledge.

**Trademarks**

Trademarks link product quality to the manufacturer’s reputation and therefore fulfill the vital role of informing consumers about the goods that they purchase and helping them to distinguish between one product and another.

### 7.2.3 Implications of the two perspectives on Software Licensing

In recent years the economic perspective of the marketplace of ideas metaphor has taken center stage by transforming the marketplace into one of owned ideas. Those with a democratic perspective find this transformation problematic due to its reductive definition of work and labour as well as the logic seeking its causal linkage to ‘intellectual products’. Hettinger (1989) argues that not all the value of intellectual property is due to the work of a single labourer. He elaborates by expanding the concept of intellectual products not as an individual but as a social endeavour. For example, this thesis examines ways of operationalising the open source methodology for the design of physical and digital artifacts in developing countries. However, it does not exist in a social vacuum as it refers to, critically analyses and integrates the intellectual and non-intellectual works of many others.

While some are acknowledged in this document and its bibliography, there are many others whose names may not appear but who nevertheless shaped the authors views both theoretically and practically through a discussion of ideas, thoughts and techniques such as the Industrial Design group at UWS.
Then there are inputs to the author’s being as a social entity and the influence of his immediate social environments, media and personal experiences as a migrant, which made him question the embedded assumptions in the predominant discourse on design and present it as a problem that must be investigated. Thus, this study or for that matter all knowledge is socially constructed and invariably builds on existing work. Granting of an IP according to Hettinger is therefore the unlawful appropriation of commonly shared knowledge by the last link in the contributory process. Hettinger therefore questions the ability of IP to distinguish and by extension measure and reward the author’s individual contributions. In fact, markets only work once property are established, so it is circular to argue that markets can be used to measure intellectual contributions (Hettinger 1989). Martin (1998, p. 41) elaborates by suggesting that:

“Intellectual Property is built around a fundamental tension; ideas are public but creators want private returns. To overcome this tension, a distinction developed between ideas and their expression. Ideas could not be copyrighted but their expression (in the form of books, CDs etc) could. This peculiar distinction was tied to the romantic notion of the autonomous creator who somehow contributes to the common pool of ideas without drawing from it”

The democratic perspective therefore concludes that markets and IP are not the most efficient measure of a person’s contribution and reject their professed utility in measuring, rewarding and securing intellectual contributions.

Furthermore, the transformation to a marketplace of owned ideas is considered to be inequitable as it fails to consider newer modes of social and economic production and instead retains an architecture that benefits some elites. The original 17th century conception of the marketplace of ideas metaphor was based on the notion of ‘competing ideas’ necessitating fair and equal access to all contributors as well as those who evaluate those contributions. However, the mediation of this access and evaluation mechanism by large media corporations in recent times has restricted access for some groups and entirely excluded others. Consequently, certain ideas are never tested or examined and successful ideas may not be the best.
Let us take the phenomenon of globalization to get a deeper insight of this limitation of the marketplace of owned ideas. There is already a huge amount of literature that articulates how globalization tends to disproportionately reward a select few while disadvantaging a huge majority. Manual labourers, ethnic minorities as well as radical critics of the status quo rarely manage to get their viewpoints across at important global meets such as the World Trade Organisation (WTO) or the World Economic Forum (WEF). However, when these groups do manage to organize themselves and protest their non-inclusion, the media often focuses only on the violence with little effort to investigate the underlying reasons or their ideas and proposals. According to Entman (1989), this is because mass media such as the television and radio try to gain audience by pleasing them and not by confronting them with challenging ideas. However, according to Martin (1998), whatever the inherent characteristics and dynamics of mass media it nevertheless retains the capacity to singularly influence and shape ideas by circumventing communications between the audiences evaluating those ideas.

For, “there is some prospect of a measured assessment of different ideas if there is a group sitting in a room discussing an issue. But if these same people were isolated in front of their television sets, and one of them owns the television station, it is obvious that there is little basis for the testing of ideas. The reality is that powerful and rich groups such as governments and corporations can promote their ideas with little chance of rebuttal from those with different perspectives” Martin (1998, p. 42 - 43).

The marketplace of owned ideas is therefore a biased and artificial market that serves to fine tune relations between elites and provide them with legitimacy. It is therefore not surprising that the internet - the only push and pull medium - has grown exponentially and become the preferred medium for organizing ‘other perspectives’ such as the open source, the creative commons and political and economic opposition. Finally, the emergence of a knowledge economy with information as its central commodity exposes further limitations within the existing IP framework. In failing to adequately acknowledge new social behaviours and production paradigms such as peer to peer production and the Open Source, which rely on
the availability and sharing of information, the IP mechanism in fact retards follow-on innovation and infringes on individual liberties such as the freedom of speech.

To summarize, the democratic perspective questions the legitimacy and effectiveness of IP, arguing that its conception and current architecture represents the converging interests of powerful elites seeking to sustain the status-quo. In response, it calls for comprehensive reforms to the existing IP regulatory framework and the conception of a new market architecture wherein intellectual products are not owned but are available for everyone to use. And where, these open ideas can be examined, challenged, modified and improved. While there are many challenges in the articulation of such a market, in keeping with the immediate concerns of this study, a detailing of the same has been avoided. Instead, this study will seek to progress a deeper understanding of the instrumentality of this context in shaping the various software licenses.

The Free Software Foundation tends to align with the key principles of the democratic perspective and therefore prioritizes the shared construction and democratic ownership of knowledge over the conferring of rewards. Proprietary software owners on the other hand tend to benefit the most from the existing IP regulations and therefore seek to circumvent the disclosure mechanism even as they push for the extension and expansion of rewards through the conception of stringent licenses. Finally, the OSS is a pragmatic and hybrid approach that cherry picks the best practices of Free and Proprietary software. However, before we proceed with the detailing of each license we must first elaborate what a software license is.

A software license is a legal instrument governing the usage or redistribution of copyright protected software. A typical proprietary software license allows the publisher to retain exclusive ownership of the product while granting the purchaser (or the end-user) merely the permission to use one or more copies of software in ways where such a use would otherwise constitute an infringement of the software publisher’s exclusive rights. In effect, the software license acts as a promise from the software publisher to not sue the end-user for engaging in activities that would normally be considered exclusive rights belonging to the software publisher.
In its early years, the absence of sophisticated and versatile categories of software resulted in the simplistic notion that computer programs were merely a set of instructions for the computer to act on and therefore did not require copyright protection. As a way of protecting their works from unauthorized copying and redistribution, software companies evolved software license agreements or End User License Agreements (EULA) which functioned as a legal contract between a corporation and the end user. The licensing mechanism also helped software companies to overcome technical limitations specific to the computer media such as installation and activation duplication (that is, the duplication of the software on the computer memory when a program is installed or activated). However, even when the Federal Courts in the USA modified the Copyright Act of 1976 vide clause 17 USC, No. 109, to include software and provide its publisher with the same protection as it did to others such as books, CDs and films, software companies continued to use EULA as a means of avoiding the transfer of copyrights to the end user via the doctrine of first sale, and retain its search and seizure powers to uncover unauthorized copying, not provided for under the Copyright Act. The ‘doctrine of first sale’ limits copyrights by allowing the purchaser to transfer a lawfully made copy of the copyrighted work without permission once it has been obtained, so long as additional copies are not made. Software licenses are able to overcome this by claiming that the software was never sold but only licensed to the end user under specific and stringent conditions which the end user has already agreed to when installing the software. This then raises issues about why end users ever agree to such unfair conditions.

The answer is, a vast majority of users are simply unaware of the restrictive licensing conditions and fail to realize that purchasing a software does not entitle them to its exclusive use as would a book or music CD. Licenses are an additional form of legal protection layered over existing copyrights legislation. Even those who are aware, choose to overlook it as a necessary evil for using proprietary software. Typically, when software is installed, the first screen prompts the user to agree or disagree with the licensing conditions. Failure to agree may abort the installation process and most users reflexively agree to it without bothering to read the conditions (which in any case would make little sense given the extensive and exclusive use of legalistic and technical jargon).
Free and Open Source Software licenses on the other hand transfer ownership of the software to the end user. The end user is afforded all rights granted by copyright law to the copy owner. However, here it must be clarified that copy owner is not the same as copyright owner. The former refers to the transfer of ownership in a particular copy to the purchaser even while the ownership of the copyright remains with the software publisher. The acceptance of the license in the case of Open Source therefore is optional and the user may continue using the product unless he/she wishes to redistribute the software whereby the user must accept and is indeed bound by the software licensing conditions. FSF licenses are a particularly good example of how an ideological alignment with the democratic perspective of the marketplace of ideas metaphor, is translated into reality. It does so by introducing the concept of copylefting (implying an opposite direction to proprietary software’s insistence on copy ‘right’), an innovation to the IP and licensing mechanism. According to the GNU software website\(^\text{33}\) (a FSF product):

“The simplest way to make a program free is to put it in the public domain, uncopyrighted…. But it also allows uncooperative people to convert the program into proprietary software. They can make changes, many or few, and distribute the result as a proprietary product. People who receive the program in that modified form do not have the freedom that the original author gave them; the middleman has stripped it away. In the GNU project, our aim is to give all users the freedom to redistribute and change GNU software. If middlemen could strip off the freedom, we might have many users, but those users would not have freedom. So instead of putting GNU software in the public domain, we “copyleft” it. Copyleft says that anyone who redistributes the software, with or without changes, must pass along the freedom to further copy and change it. Copyleft guarantees that every user has freedom.

To copyleft a program, it is first copyrighted. Then the terms for its distribution are added, which are a legal instrument that gives everyone the rights to use, modify, and redistribute the program’s code or any program derived from it but only if the distribution terms are

\(^{33}\) http://www.gnu.org/licenses/licenses.html
unchanged. Thus, the code and the freedoms become legally inseparable. Proprietary software developers use copyright to take away the users’ freedom; while the FSF use copyright to guarantee their freedom.

However, as stated earlier on in this chapter, the Copylefting mechanisms’ prioritization of ideology over all else has implications for its quality and variety. Consequently, many hackers term the FSF strategy utopian and impractical. The OSI responds to the two extremes of Proprietary and FSF software licenses by evolving a hybrid model that allows maximum flexibility and choice to developers/contributors. OSS licenses, termed as Non-copylefted free software, permits modification and redistribution of software with the liberty to add substantial changes and restrictions so that the end product may not be free at all. Anyone can compile the program and redistribute the binary as proprietary software. The primary advantage of OSS licenses is that it provides contributors with the flexibility of choosing the destiny of their contributions. That is, it may result in a copylefted, non-copylefted free software or proprietary software. The OSI uses market mechanisms to promote competing software products thereby increasing variety and by extension product quality induced by the vigorous internal competition. It also assists in the development of secondary/complementary software and spurs competition to existing proprietary software by reducing development costs for competing commercial software corporations. Finally, it allows developers to reduce development costs, access markets for investments and accelerate innovation. In general it facilitates the development of a cheaper, healthier, efficient and innovative software market.
8 Case Studies of non Hacker Open Source Collaborative Communities

A growing acceptance of F/OSS software such as Linux and Apache as well as the commercial success of companies engaged in its development has triggered widespread interest in the F/OSS phenomenon with many suggesting that it could revolutionize not just software development but even society. According to Yochai Benkler (cited in Goetz 2003), a law professor at Yale University who studied the economic impacts of open source, the “Open source can build around the blockages of the industrial producers of the 20th century and provide a potential source of knowledge materials from which we can build the culture and economy of the 21st century”. Mirroring this optimism, the popular magazine ‘Wired’ in a cover story seeking to expand the influence of the Open Source declared that Open Source could do for "mass innovation what the assembly line (had done) for mass production" (Goetz 2003). Not surprisingly then, attempts are being made to replicate its success in disciplines other than software development that include publishing, proofreading, curriculum development, film making and many more.

While the electronic and print media faithfully publish stories every time a F/OSS project is initiated, it is not followed up with a sustained reporting of its progress. By highlighting only successful projects and failing to report on aborted attempts, the press creates an impression that the open source is a magic bullet that can solve almost any problem. There is therefore a need for a closer examination of the conditions under which the Open Source can be a truly effective form of production. That is, we must investigate the literature for insights into the specific features that ensure its success as well as instances of failure that help in identifying challenges for distributed collaboration. The outcomes of this investigation can help in generating hypotheses about distributed collaboration and collaborative communities
engaged in software development. This is then used as a framework to analyze two Open Source communities engaged in the development of physical artifacts. It is hoped that undertaking such an exercise would help in identifying the limitations that must be addressed before seeking to contextualize Open Source methodologies primarily evolved for software development to the development of tangible artifacts.

Accordingly, this chapter will investigate what motivates hackers to contribute so much of their valuable time and effort for the development of free software? What is the organizational structure of successful F/OSS communities? And, how are open source projects managed?

8.1 Understanding Contributory Mechanisms of Open Source

What motivates hackers to contribute so much of their valuable time and effort for the development of free software? This is often the most fundamental and yet, the most intriguing question posed by experts trying to understand the relative success of the F/OSS methodology. Simplistic explanations of altruistic hacker behaviour are inadequate for they raise further questions about why it is that they have never been attempted and successfully replicated in any other discipline/industry. In response, this section will analyze the motives for making contributions to F/OSS development.

According to Lakhani and Wolf (2005), the literature exploring the motivations for contributing to F/OSS projects can be categorized into two distinct components:

- **Intrinsic motivation** – that is, those providing a social and psychological account of the contributing individual; and
- **Extrinsic motivation** - based on an economic model of human behaviour

8.1.1 Intrinsic Motivations

The concept of intrinsic motivation identifies the individual as a social entity who derives a sense of self based on his/her ability to achieve competency at a particular task. According
to Ryan and Deci (2000, p.56), “Intrinsic motivation is defined as the doing of an activity for its inherent satisfactions rather than for some separable consequence. When intrinsically motivated, a person is moved to act for fun or the challenge entailed (instead) of external prods, pressures or rewards”. This definition however, is by no means complete as it fails to explain why F/OSS developers remain engaged with specific projects over the typically long periods of its development. For elaboration, let us consider the example of video games. Here, playing is inherently satisfying whereby the player is moved to act for fun or the challenge entailed independent of external rewards. However, having achieved sufficient competency at a particular game, players tend to ‘move off’ to other challenges/games that match their newly acquired skills and insights of the gaming consoles. Similarly, we may ask what ‘sustains enjoyment’ in F/OSS projects? Eric Raymond (1999), the father of the OSI provides valuable insights to this gap in the literature by stating that “…the utility function that hackers maximize is not classically economic, but is the intangible of their own ego satisfaction and reputation among other hackers”. Implicit within this statement is an acknowledgement of the critical role that both the contributing individual and the community play in persuading sustained contributions. Consequently, Lindenberg (2001) accommodates both perspectives to classify intrinsic motivations into; Enjoyment based intrinsic motivation and Obligation or Community based intrinsic motivation

8.1.1.1 Enjoyment based intrinsic motivation
Although writing a thousand line code may not seem like a very interesting or creative task to an outsider, participating in and writing code for a F/OSS project towards resolving a poorly defined problem have long been considered as an enjoyable and creative activity within the hacker community (Himanen 2001; Torvalds & Diamond 2001). The concept of having fun or enjoying oneself taking part in an activity is at the core of the idea of intrinsic motivation (Deci & Ryan 1985). Psychologists such as Csikszentmihalyi who have studied this enjoyment dimension propose a state of “flow” whereby tasks are undertaken only for the sake of enjoyment and regardless of their outcomes (Nakamura & Csikszentmihalyi 2003). Flow experiences are characterized by sustained periods of intense and focused concentration and the merging of action and awareness in which enjoyment is maximized. According to Csikszentmihalyi, flow states occur when the skill of the programmer and the difficulty of the task are equally matched. However, a task that is beyond the skill of the
programmer induces boredom. Thus F/OSS contributions can be characterized as programmers seeking a state of flow by selecting projects that match their skill levels - something that may not be available in their everyday job.

8.1.1.2 Community informed intrinsic motivation

Lakhani and Wolf (2005) integrate the sociologist Lindenberg’s perspective that individuals acting on the basis of principles informed by particular social, political or economic ideologies also qualify as a form of intrinsic motivation. According to Lindenberg (2001), individuals may be socialized into acting appropriately when in a group and in a manner consistent with the norms of that group. Thus the goal to act consistently within the norms of a group can trigger a normative frame of action. This criterion is the strongest when the potential for gaining personal advantage at the expense of other group members is minimized, as is the case with the F/OS movement.

While the ideological predispositions of the pioneering F/OSS developers are well documented in earlier sections, it is important to identify how they are translated into shared values of the community which in turn influences and motivates individual hackers. The hacker identity includes solving programming problems, having fun, and sharing code all at the same time. As Eric Raymond comments in his article *How to become a hacker?*:

“There is a community, a shared culture, of expert programmers and networking wizards that traces its history back through decades to the first time-sharing minicomputers and the earliest ARPAnet experiments. The members of this culture originated the term ‘hacker’. Hackers built the Internet. Hackers made the Unix operating system what it is today. Hackers run Usenet. Hackers make the World Wide Web work. If you are part of this culture, if you have contributed to it and other people in it know who you are and call you a hacker, you're a hacker.”

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These are often reinforced through popular films such as the *Matrix*, canonical texts such as *The New Hacker’s Dictionary* (Raymond 1996), *The Cathedral and the Bazaar* (Raymond 1998) and the widespread publicity successful software products such as Linux and Apache receive in the mainstream media. Indeed, the term ‘hacker’ is worn as a badge of honour within the F/OSS community, as opposed to its pejorative use in popular media (Lakhani & Wolf 2005). The word hacker has semiotic connotations of the insurgent, the underdog fighting an unjust establishment and someone who has a wider perspective and opinion of the world which is countered through the development of software code. The term software *programmer* on the other hand, reflects an apolitical competency.

### 8.1.2 Extrinsic Motivation

Economists have contributed the most to our understanding of how extrinsic motivations drive human behaviour (Lakhani & Wolf, 2005). “The economic model of human behaviour is based on incentives applied from outside the person considered: people change their actions because they are induced to do so by an external intervention. Economic theory thus takes extrinsic motivation to be relevant for behaviour.” (Frey 1997, p. 13)

Lerner and Tirole (2000) posit a rational calculus of cost and benefit in explaining why programmers choose to participate in F/OSS projects. As long as the benefits exceed the costs, the programmer is expected to contribute. They propose that the net benefit of participation consists of immediate and delayed payoffs. Immediate payoffs for F/OSS participation can include being paid to participate. Although the popular image of the F/OSS movement portrays an entirely volunteer enterprise, the possibility of paid participation should not be ignored as an obvious first-order explanation of extrinsic motivations. Firms might hire programmers to participate in F/OSS projects because they are either heavy users of F/OSS-based information technology (IT) infrastructure or providers of F/OSS-based IT solutions. In either case, firms make a rational decision to hire programmers to contribute to F/OSS projects.

Delayed benefits to participation include the possibility that contributors are seeking to advance their career prospects. In many cases programmers may be locked into menial day jobs with no way to prove their potential which in turn reduces their future prospects.
According to Holmström (1999), participation in a F/OSS project can be a way of indicating to potential employers their superior programming skills and talents by contributing code to projects where their performance can be monitored by any interested observer. In many other cases programmers may simply want to improve their programming skills through F/OSS projects mentoring and peer review process (Raymond 2001; Wayner 2000). Peers in the project community, software users, and interested outsiders readily find faults in programming and often suggest specific changes to improve the performance of the code (von Krogh et al 2003). This interactive process improves both the quality of the code submission and the overall programming skills of the participants.

To summarize, the motivations for contributing to open source projects are varied and depend on the nature of the activity as well as the contributor’s own worldviews and priorities. The ability to build reputation however remains the primary motivation for participants to contribute. This raises further questions about how so many self managed contributors having widely varying agendas are accommodated within a single project? Who oversees this process and what methods do they adopt?

8.2 Organizational structure and mechanisms for managing the open source community

According to Bezroukov (1999), the popular notion that F/OSS software development merely involves the sharing of intent which automatically draws a large dedicated community of developers is misleading as it understates the complexities involved in managing the process. He elaborates by citing Brooks Law which states that the complexity and communication costs of a project rise with the square of the number of developers. And while the internet helps to reduce communication costs, the distributed community and the absence of capital makes the coordination and integration of the F/OSS project very challenging. What mechanisms have been evolved towards overcoming these operational complexities? How is the need for centralized authority and management that are inherent in all large and complex projects reconciled with self managed contributors who contribute anarchically according to their desires and not to a particular ordering?
According to Coffin (2006), all innovations for managing the open source projects are dictated by the unique characteristics of the internet. Most F/OSS projects, according to her, are driven by a developers ‘personal itch’ when s/he identifies the absence of, or limitations within existing software. In these initial stages when the contributing group is small, founders (or benevolent dictators as Coffin calls them) and early adopters of the project put considerable energy into creating the foundational artifact and establishing the foundational mores and culture of the community. Once created, these artifacts are placed online in an attempt to generate interest in the project among the F/OSS community. The foundational artifact helps flesh out the aim, vision, and possible outcomes of the project. The asynchronous mode of communication helps in the generation of development methods and assists in shaping the organizational structure of the community by encouraging open dialogue and peer–review of the foundational artifact and collaborative, perpetually–clarified living documents and project histories. Therefore, transparency in all its operations is a precondition to the smooth functioning of an open source project. A transparent meritocratic structure allows for smooth succession in administrative and leadership positions in its early stages and allows new developers who join the project late in the development cycle, to understand informal community protocols and culture, as well as reduce abusive practice. Once a project matures, transparency also allows participants to understand the reasoning behind decisions, contributing to trust in the development process and the ‘benevolent dictator’. A review of the literature classifies these operational cultures and meritocratic organizational structures into a ‘Cathedral’ or ‘Bazaar’ mode of operation (Raymond 1998). In the Cathedral mode, new code patches are often submitted by hackers to core developers who filter and review them before sending them onto the initiator of the project who takes the final decision on whether a particular patch should be incorporated into the software or not. This represents a centralized and hierarchical mode of operation to manage the integration of numerous distributed contributions and hence the term ‘cathedral’. The bazaar on the other hand allows hackers direct access to the source code and operates on the assumption that anomalies would be quickly detected and fixed as “given enough eyes, all bugs are shallow” (Raymond 1998). A good example of this form of development is the online Wikipedia.
However, according to Coffin (2006), attempts to classify open source projects into one or the other model are problematic because all successful projects are hybrid models incorporating both the Cathedral and the Bazaar to some degree. According to Coffin (2006), successful free software and open source communities develop hybrid political structures to support participation and project development in the absence of capital.

“For a bazaar to function, an organizational and political structure must support it. Hybrid, flexible political systems based upon meritocracy motivates participants, provide rewards in the absence of capital, and encourage a community-wide sense of project ownership. In addition to the bottom-up, peer-administered hierarchy, the presence of a ‘benevolent dictator’ and consistently active personnel keep the project alive and dialog open from above, so to speak. Linus Torvalds was in a constant feedback loop with other Linux hackers. As Raymond points out, Torvalds kept hackers stimulated by the prospect of taking part in the project, and rewarded by the project’s constant and relatively rapid evolution. The bazaar of open source communities gets most of the work done, but an open cathedral supports the community-wide social fabric by providing feedback for involvement, reasserting foundational mores, and keeping dialog active and open”.

The power of the benevolent dictator on the other hand, is kept in check by the possibility of 'forking'. That is, if the dictator were to lose credibility, a new power center may emerge and decide to break away (or fork) from the existing project to create another version of the software. Therefore, all successful F/OSS projects are invariably the result of the efforts of not just the contributors but also the benevolent dictator and his network of early adopters. According to Bezroukov, the reputation and credibility of the benevolent dictator is often based on his/ her ideological predispositions, transparency in operations, institutional affiliations, networks and promoting a sense of meritocracy within the community. This suggests that “the problems of open source are by and large the same as those that confront academic culture” and that the OS community is just as prone to "factional disputes over ideology and technology" as in the real world (Bezroukov 1999).
The conception and success of OS projects then requires more than just opening a website, presenting a compelling concept and calling for an expression of interest from hackers. The factors that determine the success of a project in the real world are just as applicable in the virtual world although the unique social and institutional settings within which both operate needs to be acknowledged.

8.3 The Open Source and the nature of software products

Finally, we must investigate the intrinsic character of computer software and its development process for insights that can help determine if the open source methodology can be extended to designers and the design discipline or if it is limited to hackers and software development alone. According to Benkler (2002), all information products are modular and their components ‘granular’ by nature thereby allowing the development process to be easily partitioned and distributed within an open source community. His paper which also studied “lightweight forms of information production” by non hackers such as providing peer reviews of books on websites such as Amazon.com, proofreading documents, repetition. This, according to Benkler allows contributors to self identify with certain tasks for which they have competencies and contribute so long as the problems of coordination and technology are resolved. That is to say, if I consider myself an expert at designing toys and I do not have the skills and/ or time to put up, manage and promote my own website, then I may choose to contribute to the ‘reader’s review’ section for books on toy making on Amazon dot com or, I may choose to blog or be active on mailing lists/ groups dedicated to toy making, anything so long as the technological and coordination challenges of making contributions are reduced. This clearly suggests that contributions in non hacker communities for disciplines other than software are better suited for activities in which human expertise is the main input and the issue of coordination and technology are resolved through specific technology features.

But how can we characterize the product design and development process? Is it also constituted of granular components that can be partitioned and distributed? Sanders and Stappers (2008, p. 7), break down the design development process into a fuzzy front end followed by prototyping and manufacturing.
“In the fuzzy front end (Figure 16), it is often not known whether the deliverable of the design process will be a product, a service, an interface, a building, etc. Considerations of many natures come together in this increasingly critical phase, e.g., understanding of users and contexts of use, exploration and selection of technological opportunities such as new materials and information technologies, etc. The goal of the explorations in the front end is to determine what is to be designed and sometimes what should not be designed and manufactured”.

Implicit within this description is an acknowledgement of the overlapping nature between the various components of the design process whereby the boundaries are not clearly demarcated.

A similar perspective of the design process is provided by Ranjan (2007). According to Ranjan, the design process (or the design journey as he calls it) originates when a designer identifies certain limitations in the designed environment. He metaphorical likens it to the ‘casting of a stone in the pond’ which helps in triggering off the ‘design vortex’ (Figure 17), a process by which the designer accumulates vital information on the various aspects of the context that must inform the design of the artifact.
It also sets off a dual process of exploration and inploration (Figure 18) that is, “an outward looking and pattern seeking behaviour as well as an inward
looking insight seeking behaviour, both working in tandem.

Each surge of exploration is accompanied by a corresponding set of explorations and these together produce a number of insights that are gathered and held in what I call the designers antennae, a collective phrase for the reservoir of sensory and imaginary information that collectively leads to produce a degree of conviction in the direction and content of the design journey. The nature of design thinking goes through a variety of phases and these thinking styles and modes would change according to the stage in the particular design journey that is being undertaken.”

Furthermore, according to Ranjan, these modes of thought include intentional, categorical, explorative, abductive and synthetic modes of thinking which can be iterative and ambiguous. Ranjan’s description suggests that the design process is not only constituted of overlapping stages that require a designer to seamlessly move across them in an attempt to identify an appropriate design solution but also requires a synthesis of knowledge across various disciplines. Both perspectives then seem to conclude that the boundaries between various segments of the design process are not clearly demarcated and therefore cannot easily be partitioned and distributed. This would suggest that Open Source methodologies for software development would require at least some form of contextualization before they could be appropriated for facilitating distributed product design.

In an attempt to adequately respond to this hypothesis, the next section of this chapter will analyze two non-hacker online collaborative communities involved in the development of physical artifacts. Furthermore, it is hoped that undertaking such an exercise would provide a broad understanding of the various approaches as well as help identify specific limitations that can arise while seeking to contextualize Open Source methodologies originally conceived for software development to the product design process.
8.4 Case Study 1 - Architecture for Humanity

Established in 1999, Architecture for Humanity (AfH) is a web-based non-profit organization that enables collaboration between architects and other experts to help communities in need. Deeply disturbed by the plight of ordinary Kosovars following the outbreak of civil war in the late 1990’s, Cameron Sinclair and Kate Stohr, the founding members of AfH floated an online design competition to generate ideas for temporary refugee shelters. An overwhelming response to the competition from architects and designers across the world convinced the two of the need for a permanent online community dedicated to providing architectural solutions for humanitarian crises. Influenced by the internet boom of the late 90s and the emergence of the Open Source movement, they decided to create a database, accessible over the Internet and which would enable "open source" problem solving among architects and other experts related to the built environment.

Today, AfH’s stated vision is “to build a global community, encourage locally-inspired designs and to float them on the internet so that they may be shared and freely adapted by all”. In 2007, Architecture for Humanity launched the Open Architecture Network (OAN), which acts as an online repository and collaborative community of practice dedicated to improving the built environment. It is facilitated by the ‘Creative Commons’ license that protects designers’ liability and copyrights at home whilst allowing their ideas to be given away in the developing world.

The AfH’s approach is event based (wars, natural disasters and calamities) and relies heavily on a design competition model. Here is how the AfH model works:

A community leader, NGO or a sponsor typically submits an architectural problem to the OAN. A feasibility study that evaluates various practical considerations associated with the request such as the nature of the problem, credibility of the proposer and his/ her ability to create partnerships with local community groups, is undertaken. Most importantly, project proposals must show need and must be able to demonstrate that the structures will benefit an

http://architectureforhumanity.org/
underserved community that would otherwise not have access to design services. Once a project is accepted, the generic information submitted by the proposer is quickly translated into specific aims for the competition. Critical information that assists the design process is identified and included in the design brief. The competition brief and detailed guidelines are then posted on the OAN website. Registered members can browse through various competitions (Figure 19) that are available and participate in the ones that interest them the most. However, unlike the open source software development process which requires the presence of a compelling concept and a foundational artefact in the form of a source code to create a community and which helps the accretive development of a single piece of software, AfH by its emphasis on competitions seeks to generate multiple solutions to the same problem. Each participant submits his/ her entry in the form of sketches and CAD drawings. All submitted entries are blind reviewed by the AfH’s panel of experts and a final winner is identified. Entries are judged on the basis of their ability to make innovative, energy efficient and sustainable use of the context. The winning entry is then commissioned to work with the local community and build the structure. All entries, winners or otherwise, are covered by the ‘Creative Commons’ license and integrated into OAN’s database whereby everyone can share and freely adapt each design.

Active communities are at the core of any Open Source project’s success. In the case of AfH, registered members are allowed to create their own profile on a homepage as they would on any social networking website. However, there is no compulsion for members to contribute. Every time a registered member participates in a discussion room or in a competition, the details get reflected on his/ her homepage and allow them to assume and build a certain profile for themselves. For example, the homepage of the user ‘Motion’ (Figure 21) suggests that he is an expert on the use of indigenous materials such as bamboo, bricks and mud and has a keen interest in cultural aspects of architectural design. Furthermore, his homepage on OAN has a link to a blog where he shares his worldviews and includes pictures of projects that he has been associated with in his day job. Some of the OAN competitions that Motion has participated in and won include the design of a

- Low cost, energy efficient mobile tea stall for street vendors
- Improved design and construction techniques for rural areas of Bangladesh and,
Low cost appropriate housing for Tsunami affected areas of Bangladesh among many others

Motion declares himself an ‘expert on vernacular architecture, building materials and techniques and is open to consulting and mentoring others less experienced in the mentioned domains’. By allowing contributors to self identify with specific tasks for which they have competencies and by reducing the coordination and technology efforts required for contributing, OAN sufficiently motivates contributors such as Motion both extrinsically and intrinsically to participate and provide solutions.

AfH seeks to contextualize Open Source methodologies to the design process by adopting design competitions as a central mechanism for generating solutions. By seeking ‘complete solutions’ in the form of competition entries AfH manages to overcome the identified problems related to the ‘partitioning’ and ‘distribution’ of the design process. However, the elimination of the ‘source code’ methodology results in solutions that are neither accretive nor peer reviewed with consequent negative implications for their quality as well as the ability to promote a sense of community and ownership in the project.

Furthermore, as competition briefs mediate designers and the design context, solutions are invariably based on how a particular problem is framed. The design brief therefore must provide a thorough and exhaustive account of the context. To put it differently, the design brief must enable the activation of what Ranjan calls the design vortex. This is especially important in the case of traditional/ vernacular architecture - which forms a bulk of AfH’s concerns - through its various competitions, as they act as an integral component of the larger ‘cultural system’ which updates itself through a process of selective appropriation. The role of architecture here is to facilitate all human activities and the relationship between these activities and their immediate environment, as defined by the cultural systems. The architectural form and spatial programming in vernacular architecture is consequently open-ended and polyvalent so as to accommodate a range of meanings and functional variations. However, a close examination of the various AfH competition briefs available online provides very little information on the unique contexts of each location. Consequently, a majority of the solutions on the OAN are visually and aesthetically global in character and appear as episodes disconnected from the historical, cultural and economic contexts of the
locations from where they finally emerge. A case in point is the proposal for a Kenaf field clinic, an on-site medical clinic for the treatment of HIV/AIDS sufferers in sub-Saharan Africa, grown from Kenaf seeds, mown to form interior spaces and finally eaten. This idea has considerable aesthetic appeal in a western context – you can provide shelter, treat AIDS sufferers and provide nutrition all at once. However one can only wonder what its impacts would be if rolled out as a massive solution (Lopes & Desai 2007).

Finally, the absence of a benevolent dictator, as well as the absence of a bazaar due to an emphasis on competitions leads to a general lack of project robustness. For example, the OAN resources section has a mere 5 entries (Figure 20) while the project databases have competition entries that are little more than sketches and doodles. Furthermore, discussion rooms are poorly populated at all times and there is a general lack of community spirit evident from the discussion threads where most participants show a lack of familiarity with other contributors. In conclusion, AfH’s reliance on competitions for delivering solutions amounts to little more than a heuristic opportunity for architects and designers to exercise their creative skill rather than a concern for the end user (Lopes & Desai 2007).
Figure 19 Concurrent Design Competitions on OAN Website (OAN 2008)

Figure 20 OAN Resources (OAN 2008)
Figure 21 Homepage of ‘Motion’ design contributor (OAN 2008)
8.5 Case Study 2 - ThinkCycle

ThinkCycle\textsuperscript{36} is an 'open source' web-based collaborative platform for sustainable design projects. It was initiated in March 2000 by Ravi Pappu, Saul Griffith, Nitin Sawhney, Yael Maguire, Wendy Plesniak, and Ben Vigoda, a group of graduate students at the MIT Media Lab. Their idea was to create an online database that would enable "open source" problem solving among university students and communities in the developing world. They envisioned the database and the Web combining into an online repository system that could document submitted problems and the evolving design solutions to those problems including iterative design concepts, technical notes and working files. This repository would then be made searchable, free, and open to the public in an attempt to foster a culture of open source design innovation.

An important consideration in the development of ThinkCycle was a need to change the way in which design was taught at engineering schools. Typically, engineering design students are given hypothetical problems in relation to issues that have already been resolved. ThinkCycle sought to shift the emphasis to real world problems and move beyond the local classroom model to include students and faculty located in both industrialized and developing countries (Ridgway 2002) towards providing students with more challenging problems and a richer design experience. Sawhney cites three trends which emerged in the 1990s and which were critical to the creation of ThinkCycle: distributed computing and online communities; global dialogue on the digital divide and sustainable development, and intellectual and public domain movements such as the open source movement (Coffin 2006).

In the Thinkcycle model, a stakeholder may submit ‘a design challenge’ or, a problem to be resolved through design within the domain of sustainable design, underserved communities and the environment to ThinkCycle. This challenge is then peer reviewed by domain experts, whereby the generic information submitted by the proposer is quickly translated into specific aims and made accessible in the ThinkCycle database. The design process is fairly transparent as anyone is welcome to register and post ideas, suggestions and drawings of

\textsuperscript{36} \url{http://www.thinkcycle.org/}
their own proposed solutions. Design faculties in a participating school are also free to select
the design challenge and present it to their students as part of their curriculum. Working in
teams, the students first investigate current technological happenings related to the challenge.
This is followed by establishing design constraints, brainstorming design concepts, followed
by design and the manufacturing of prototypes. During the design and prototyping phase,
experts in the domain of the problem review the work of the students and provide advice as
well as resources. Each design challenge has a wiki-like area with sections for discussion,
shared team spaces and an open digital publication repository and project archive (Coffin
2006). The project ends with students submitting a final report and project presentation,
which may include recommendations for future work.

ThinkCycle Collaboration tools
According to Sawhney (2003), ThinkCycle allows contributors to self identify with certain
tasks for which they have competencies and facilitates their participation by reducing the
problems of coordination and technology through the provision of specific features such as:

- **Topics**: categorization taxonomy for problem domains and evolving solutions.
  Topics provide a shared space for discussions, contributions, resources, files and
  publications.

- **Publishing Contributions**: Users can submit content to topics in the form of
categorical notes like challenges or design concepts with file attachments, images
and online links. All content posted can be cross-linked to other content on the site,
emailed or commented on by others users.

- **Dynamic Views of New Content**: The system tracks all items contributed by users
and content posted since their last visit to the site. Users can browse selective views
of new content submitted. Content can be sorted by many different attributes.

- **Access Control**: Content owners can set permissions on any contribution to allow
others edit privileges, as well as basic privacy settings to allow selected users to
view content. Topic editors can edit/delete any content posted in their topics.

- **Threaded Discussion Boards**: Users can subscribe to any topic discussion forum and
post messages online with file attachments. Discussion boards can be moderated.
• **Peer-Reviewed Digital Library**: Allows users to add papers with bibliographic information to any topic and allows other users to submit detailed peer-reviews for any papers. Finally, authors can comment on paper reviews online as well.

• **Custom Search Engine**: Allows rapid keyword searches of site-wide contributions on ThinkCycle, as well as refined searches based on topics, files and notes categories.

• **File Management and Archiving**: Every topic provides a file-space for uploading files, with versioning features and search. All files are archived daily on distributed mirror sites.

• **ThinkSpaces**: Project repositories for distributed design teams, with public and private access to content posted. This serves as a means to archive, manage and track ongoing design iterations by team members and allow selected individuals to review the content.

According to Coffin (2006), there is however no formal moderation mechanism in place for ThinkSpaces, although the ThinkCycle coordinators who create the topics serve as initial editors to set up the domain and make suggestions to contributors as needed.

The ThinkCycle model is an improvement over the competitions based model of AfH primarily because it facilitates open dialog, peer review, and iteratively–clarified artifacts which enable and support the *categorical* and *analytical* modes of design thinking which in turn influence the overlapping zones of the design process in Ranjan’s interpretation (Figure 18). ThinkCycle actively supports these zones by integrating technology features such as threaded discussion boards, peer-reviewed digital library, search engine, and ThinkSpaces. ThinkCycle therefore allows contributors to focus on their expertise by resolving issues of coordination and technology through specific features.

Although ThinkCycle exhibits a robust operational structure and tools that facilitate the design of physical artefacts across institutional boundaries, there are several limitations within this model. Firstly, ThinkCycle remains philosophically aligned to the human centred approach of the development discourse (Coffin 2006). As pointed out earlier in chapter 3, the human centred approach despite attaching significant importance to an individual’s context and freedoms results in solutions that are merely ‘system inductive’, that is, they are
inclined to apply global solutions to local problems. Accordingly, ThinkCycle also insists on, and technologically facilitates solutions that are developed by globally distributed ‘domain experts’, independent of the contexts of the local worlds. Consequently, it represents a solution that ultimately and unintentionally seeks to replace rather than augment the knowledge of the poor.

At an operational level, it suffers from the absence of a heavily invested and involved benevolent dictator. This is due to the project being conceived only as an extension of the MIT engineering education program and as the years have progressed most of the pioneering members have already left or are leaving MIT and therefore the project. This results in a lack of political structure to support and monitor the bazaar resulting in a lack of peer review to monitor the collaborative process. Most posts therefore lack focus. According to Coffin (2006), the co–location of many of its contributors at MIT also resulted in projects being developed offline and then recorded retroactively on Think Cycle purely out of obligation, although this may be of archival benefit. In these cases, participants saw ThinkCycle as a time–waster. They felt they were duplicating their efforts by using the system (Sawhney 2003).

In conclusion, the ThinkCycle model is a vast improvement on the AfH model but would benefit if it facilitated end user innovations, successor benevolent dictators who help to shape a political structure and a widely distributed community.

8.6 Conclusion

While both cases demonstrate that Open Source methodologies need not be restricted to hacker communities and software development given the distributed and networked nature of contemporary societies, they nevertheless demonstrate the need for further innovation in the way non-hacker communities seeking to collaboratively develop tangible and physical artefacts are constituted. Some of the foremost challenges are listed hereunder:

- The social, geographic and cultural context or, the physical ‘sense of place’ plays an important role in informing the design process as well as the shaping of artefacts.
The provision of this information to a geographically distributed open source community however remains problematic and is therefore a key challenge that must be addressed in seeking to appropriate Open Source methodologies for the conception of tangible and physical artefacts.

• Both case studies seem to underplay the relevance of a benevolent dictator to the distributed design process. However, benevolent dictators who are credible and trusted can be instrumental in creating an essential political structure and social fabric by providing useful feedback and establishing and asserting project ethics, protocols and mechanisms. His/ her absence therefore can severely affect the prospect of a stable and sustainable community.

• While both cases reduce the costs of development by foregoing personal rights over the artifact in favor of collective rights, the issue of appropriate forms of intellectual property rights for rewarding and protecting the original small scale or community based innovations and innovators remains unaddressed. Existing Intellectual Property Rights tend to focus only on “breakthrough” R&D innovations resulting in important micro-innovations being rejected due to their inability to satisfy the clauses of novelty (which requires substantial advance with respect to preceding inventions) and non-obviousness (which requires that the advance should not be trivial) in IPR. Furthermore, the application and recurring costs associated with maintaining an international patent are clearly unaffordable. How can we structure IPR so that it overcomes these limitations?
9 Guidelines for the conception of an Open source Community facilitating User led Innovation

Having examined the conditions under which the Open Source can be an effective form of production as well as the limitations that can arise when attempting to contextualize it to the design process, this chapter will seek to address the identified limitations and develop guidelines based on both the solutions and the features that lend themselves to the design process so that it may assist in the conception of open source projects that seek to facilitate and promote user led innovation in developing countries.

A quick recap of the limitations identified in the previous chapter:

- How do we reconcile the duplication of roles between the user innovator and the benevolent dictator that arises primarily due to the former’s inability to participate based on his/her limited internet abilities?
- How can we provide a thorough account of the social, historical and cultural contexts for a particular project to the entire open source community and ensure that solutions are contextually relevant?
- And finally, how can we adequately reward small scale innovators in developing countries and protect their innovations without restricting follow-on innovations?

9.1 Proposed Architecture for an Open Source Community facilitating User led Innovation

The proposed model segregates the development process into an offline component consisting of the user innovator and nonprofit participants and a traditional online open
source community consisting of contributors across the academic, industrial and government sectors and who provide valuable inputs such as peer review and identifying sources for securing funding thereby ensuring the production, distribution and deployment of innovations from concept to market.

As outlined in Figure 22, the offline component includes the innovator and the NGO’s who operate in the field and can physically scout for and identify user-led innovations comprising both contemporary as well as traditional knowledge. In case of contemporary innovations such as the *jugaad*, the NGO documents the exact product architecture as well as locates the product within the material, cultural and economic contexts of a community by undertaking an ethnographic study. This study can then be made available online to an expert such as an academic or practitioner who has similar interests and is willing to act as a credible and benevolent dictator. The benevolent dictator can then decompose the innovation into sub assemblies and introduce the problem to the open source community. For example, in the case of the *Jugaad*, the benevolent dictator may be someone who is an experienced automobile engineer and can identify limitations within the existing model that inhibits commercialization. These identified limitations could include features such as poor seating, fuel consumption and safety which are then presented to the community as problems that must be resolved. Here, the existing product/design are presented as a foundational artifact that all participants must improve upon. It is hoped that the ethnographic study combined with the foundational artifact can provide developers with a common and adequate context in generating contextually appropriate solutions and help overcome some of the problems associated with the ThinkCycle and AfH model. The benevolent dictator creates the necessary political framework that supports the community-wide social fabric by providing feedback for involvement, reasserting foundational mores, and keeping dialogue active and open.

As the project matures, the online component along with a database could combine into an online repository system that could document submitted problems and the evolving design solutions to those problems including iterative design concepts, technical notes and working files. This repository could then be made searchable, free, and open to members in an attempt to foster a culture of open source design innovation.
9.2 Intellectual Property Rights for small scale Innovations

Finally, how can we adequately reward small scale innovators and protect their innovations without restricting follow-on innovations? This is problematic at many levels due to the nature of innovations as well as the existing structure of IPR.

During the past two decades there has been a growing emphasis on protecting property rights for large breakthrough innovations which provide very high returns while a similar approach for small-scale innovations is yet to appear. Small scale innovators often have to pay very high transaction costs for seeking IPR’s that far outweigh its benefits. Consequently, many innovators fail to register their innovations for patents. How can this problem be mitigated? What should the mechanisms of property rights for small-scale innovations be, so that it
adequately protects and compensates innovators, distributes development risks and yet stimulates follow-on innovation?

According to Reichman (2001), the solution is to encourage liability rules as opposed to property rules. Property rules are a strong form of protection with long term compensation rights that as evidenced earlier confer the owner with an almost monopolistic control over the innovation, while liability rules are a much looser form of rights with a limited duration of compensatory rights that allow follow on innovations while also benefiting the primary innovator. Reichman demonstrates this by using a hypothetical scenario called the “green tulip” problem. In the hypothetical problem proposed by Reichman there are three firms that breed tulips:

Breeder ‘A’ develops a green tulip for the first time; however it is unable to have commercial success. Breeder ‘B’ combines this variety and breeds a red, white and green tulip; this product is commercially successful with ready consumers. Finally other breeders, designated as Breeder ‘C’ use both A and B’s varieties to develop an array of different tulips. Assuming that A’s innovation is a micro-innovation and therefore sub-patentable due to its inability to satisfy the criterion of non-obviousness, how would A be affected in different property rule based IP regimes in terms of recouping research costs and making a profit if it allowed follow on innovation to compete with it?

- **No Rights** - There is no protection for ‘A’ and the other two are free to enter the market and compete with A’s product. As a result A loses his/ her research investments.

- **Copyrights** - Copyrights are a weak form of IP, which confer ownership but cannot stop B and C from further innovation, provided due credit is given. Here again, ‘A’ fails to realize the benefits of his innovation and recoup research investments.

- **Patents** - Patents are a stronger form of IP where ‘A’ has the right to deny follow on innovation to ‘B’ and ‘C’ and hence maintain the competitive lead advantage. Or ‘A’ can decide to benefit from the situation by licensing the follow-on products in such a way so as to extend his lead advantage by seeking to disadvantage his/ her biggest competitor. By doing so, he/ she may also secure revenue streams that can be ploughed back into research. However, this can also result in follow-on innovations being restricted as B and C may feel would be encouraged to develop their own
variants to take advantage of the strong patent-like protection and avoid having to pay A royalties in perpetuity.

The disadvantage of this form of IP is the high transaction and social costs. By granting exclusive property rights to individuals, common public knowledge is progressively divided into smaller parcels and finally, privatized. This privatization creates barriers to knowledge sharing and follow-on innovations. From a commercial perspective the higher transaction costs remove the basic incentives required for small-scale innovations, restricts competition and confines risk to a single developer and product.

The liability rules on the other hand proposed by Reichman, deny property rights to ‘A’ while granting him short-term compensation rights. Under this mechanism, ‘A’ cannot inhibit B and C from using his/her innovation and benefits monetarily from the other two without disrupting ‘B’ and ‘C’s opportunity of follow-on innovations. In the above example, ‘B’ would also be entitled to short term compensation rights from C. The value of this compensation is generally adjudged as the value added to the primary product by the follow-on innovation. At the end of the compensatory period the product becomes shared public knowledge that can be used by anyone. The liability form of protection thus provides adequate lead time advantage and compensation to the primary producer, encourages competition, supports follow-on innovation, distributes risks and most importantly shifts the focus of property rights from individuals to a community of producers. From the perspective of the small scale innovator this approach reduces filing costs by placing the burden of verification at the time of patent infringement or conflict.

Based on Reichman’s proposal, this study seeks to reward and protect small scale innovators and their innovations by integrating a *compensatory liability mechanism* as opposed to property rights for small scale innovations.

However, implementing a liability mechanism presents its own unique problems.

- Indigenous knowledge and innovations are never documented in written form but passed on orally from one generation to another. Furthermore, in many indigenous
communities knowledge is viewed as a form of shared responsibility whereby profiting from it is considered as unethical (Ostrom 2000).

- The boundaries between individual and community knowledge is often blurred within such communities making it difficult to distinguish between community and personal contributions to new knowledge. Typically, community laws are unprotected under existing IPR laws as it is argued that if the knowledge is already publicly known then no new information is being disclosed and therefore does not qualify for rewards.

- There are currently no national and international institutions to monitor and support such mechanisms. For example, should an indigenous community or a small scale innovator argue that his knowledge/innovation has been copied, there are currently no records to substantiate his/her claims.

These are only some of the problems involved in introducing a parallel system to the existing IPR. While identifying and addressing them could constitute a doctoral study in itself and is therefore beyond the scope of this study, this study will nevertheless propose measures which point to a possible way forward:

- Document micro-innovations and traditional knowledge that is often oral in nature. This provides an adequate reference in case of infringements.

- Setup a national and global registry system for tracking claims for small scale innovations which could assist in preventing multinational corporations from taking out patents on traditional and contemporary knowledge as well as innovations. There have already been some tentative steps in this direction with groups such as the Third World Network (Nijar 1996) arguing for Community Intellectual Rights (CIR) and mechanisms such as the “registry of invention” which are very similar to Reichman’s proposal.

- Setup a subject domain specific classification system that adopts flexible standards of novelty. For example, the effort required to incrementally innovate the banni technique of filtering drinking water from saline environments by switching plant species maybe different as compared to innovating a jugaad with twice the fuel
efficiency. Therefore, there should be separate classification systems for automobile and resource conservation techniques with their own unique rules.

9.3 Guidelines for the conception of an Open source Community facilitating User led Innovation

In conclusion, the conception of an open source initiative that seeks to facilitate and promote user led innovation in developing countries must:

- Visualize the role of the user innovator as distinct to the benevolent dictator.
- The user innovator innovates by drawing upon the material, cultural and socio-economic context while the NGO partners in scouting for innovations and documents the rich context which informs its conception through an ethnographic study that is readily available to all contributors. The foundational innovation can then be decomposed into components by the benevolent dictator and presented to the open source community as a foundational artifact to be worked and improved upon and be taken from concept to the market.
- Since such a community may have poor or no programming skills it must allow contributors to focus on their expertise by resolving issues of technology through specific features. These features must be functional, easy to use and seek to maximize the internal motivations of the contributors.
- It must have collaborative, iteratively clarified, living documents and project artifacts.
- It must build a hybrid political system based upon meritocracy
- It must have a mechanism for institutional history. This could also facilitate the creation of the envisaged national and global registry system.
- The open source project must work transparently and record dialogue and peer review of project materials, discussion and decisions. This can assist new members in getting acquainted with the project and the community mores and culture.
- It must use consensus as a decision–making tool
- Membership must be widespread but based on participation and/ or contributions.
• And finally, it must emphasize a liability mechanism for rewards and protection of innovations as opposed to property rights.
10 Conclusion

This thesis began with the research question of what are appropriate technologies for developing countries and how do we facilitate their design? Addressing this question required a thorough investigation of existing technologies that are being introduced in developing countries. It was found that the conception of technologies introduced in developing countries is informed by the ideologies, ethics and priorities of dominant players in the global order and not from the perspective of its end users. This is the ethnocentric notion that the poor in developing countries have no knowledge and that modernism is desirable and superior to local cultures and therefore necessitates an erasure of the past. That is, modern technologies are not compelled to consider local cultures, modes of production and indigenous ways of being in their development. Consequently, they represent top down supply side solutions that merely seek the expansion and deepening of markets.

In response, this thesis argued that the conception of technologies for developing countries be disembedded from development aid, global capital and the development discourse and instead be repurposed for sustaining and reinforcing the unique local worlds of its end users. That is, it argued for customized technological solutions whose conception was informed by and for the local context including its culture, modes of production and indigenous ways of being. However, there are currently many barriers to the evolution and diffusion of these technologies. This is primarily due to the way in which science, its knowledge validation processes and its interface with industry is structured whereby there is a huge emphasis on large scale industry led Research and Development which completely overlooks small scale innovators and their innovations.

The follow-on research question then was to identify ways of facilitating this user led innovation. That is, how do we create a knowledge network that assists in taking innovations
from concept to market and which protects intellectual property rights while allowing others in developing countries to benefit from these innovations. This study identified the Open Source and new paradigms of production such as peer to peer along with a rethinking of the ‘commons’ as a possible way of satisfying all these conditions. However, the contextualization of the Open Source methodologies originally conceived for the development of software to the design process presents its own unique problems. Consequently, this thesis investigated means of achieving this contextualisation and incorporated its findings within a proposed architectural framework and detailed guidelines for an Open Source Community that facilitates User led Innovation.

While this thesis sufficiently addressed the primary and secondary research questions, I am only too aware that many of these questions have not been fully addressed due to the limited scope and timeframes of a Master’s study. Furthermore, this study constitutes a theoretical understanding of a practical problem and in the absence of time and resources to build and test such a system there are bound to be inaccuracies in the final solution. I therefore conclude this study with a documentation of the future work required to formalize the conception of an Open source Community that facilitates User led Innovation in developing countries.

**Future work**

Some of the key issues related to the appropriation of Open source methodologies for end user innovation which require further investigation include Intellectual Property Rights and Information Communication Technologies that would be most appropriate to this proposal.

Intellectual Property Rights are important mechanisms not only for protecting and rewarding innovations but also for creating and sustaining a culture of innovation. Consequently, breaking the cycle of dependence on development aid and accepting unfair conditions imposed by aid providers requires a critical rethinking of IPR. That is, how can we build on the only resources that the poor are rich in? Some of the key issues that remain unaddressed in this thesis and which designers are best placed to provide solutions to is, how do we classify various small scale innovations?, How do we distinguish between community and individual contributions to innovation? How can they be documented and commercialized?
What kind of institutional and government supports would be required to create global registries for small scale innovations and indigenous knowledge and how can they be networked with private capital so that the poor may benefit from it?

Some of the issues concerning ICTs that remain completely unexamined due to the theoretical nature of this study pertain to the mutually interdependent issues of the technical aspects of ICTs and its facilitation of the design process through the inclusion of specific features. For example, how important are bandwidth considerations for the features that can be included in an OS project? What is the nature of the interface that can maximize intrinsic motivation? How can an OS project be made customizable so that it may accommodate technologically proficient as well as non-proficient contributors?
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