VIRTUAL AND ACTUAL REALITIES:
A Feminist Environmentalist Analysis of the Computer Industry

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VIRTUAL AND ACTUAL REALITIES: A Feminist Environmentalist Analysis of the Computer Industry

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The use of computer technology is strongly woven into the fabric of life in North America, Europe, and increasingly the developing world; some of us can hardly fathom doing without computers to conduct business or personal affairs. While the density of use differs by region, in many parts of the world, money flows, health care, business operations, transport, communications, and entertainment are dependent on information technologies. Within this reality, we must be reminded that information technologies are gendered products of social relations and subtly structure and shape social existence (Latour 1993, Haraway 1995). Work and every day life have come to be dependent on information technology to the parallel extent that human societies are dependent on nature.

Women are involved with computers in different ways: as workers in global assembly line factories, or in data entering or other office work, as well as users and consumers. Higher up in the power hierarchies, such as design and management, the presence of women rapidly declines. Though some women have managed to break the glass ceiling such as the female CEO of Hewlett Packard, the actions of the few high-ranking female CEOs suggest the persistence of male bias in the control and design of new technologies (Rothschild 1983, Haraway 1995). On the other hand, there is also a positive side to computer technology, new spaces and uses are opened up which provide women who have access to new empowering resources. Given the role of information technologies in economic globalization, the relationship between women, the environment, and information technologies is a strategic research site to investigate changes in gender relations.

Mapping the relationship between women, the environment and information technologies demonstrates that information technologies have changed gender relations and the position of women involved with production and consumption of computers. Based on secondary data, this paper uses a lifecycle approach to look at the production side and consumption side of personal computers from cradle to grave. The paper describes the impact of each stage in the life cycle on women and the environment. The analysis is not entirely

comprehensive, but seeks to highlight different aspects of each stage of the process and seeks to provide a broad understanding of the impact of computers on women and the environment.

Section one will discuss ecofeminism and feminist environmental theories to consider the interlinkages between nature and women. Section two will analyze the production of computers from a feminist and environmentalist perspective and finally section three will analyze women as users and consumers of computers and the impact on the environment of computer usage. The life of a computer is imbued with power relations. Revealing the ways in which these power relations are played out can help us to see points for resistance and transformation of the present reality within global high tech computer capitalism.

SECTION ONE:
Theories of women and the environment

Global economy and computer technology

Computer technology both creates and benefits from the new global economy. The global economy has many characteristics of neo-classical economic theory whereby a free, unregulated market is considered the best system for distributing resources. Neo-classical economics relies on technological innovation to improve productivity and produce economic growth in the market as measured through Gross Domestic Product (GDP).

The logic of neo-classical economics is based on the rational economic man maximizing individual utility in a competitive market. The economic actor is a masculine one, because the system of exchange makes market exchange, that is men's socially constructed primary activities, a priority and denigrates and undervalues work socially constructed as women's domains: reproducing people in domestic situations (Mellor, 1993:1). The factors or goods not valued in the market are called "externalities" in economics. This discussion will focus on the "externalities" of unpaid work done by women in the reproductive and care economy, and the environmental impact of production which are not counted or valued.

By placing work commonly done by women and environmental resources outside market relations, capitalism and the global economy have surreptitiously created common interests for both women and the environment. Neither is adequately recognized in the capitalist system. A feminist and environmentalist analysis must take place together in order to create a more just and sustainable world. Logically one cannot happen without the other. Gender relations can never be equal if unsustainable production occurs, most obviously because our survival together as humans depends on the viability of the natural systems which sustain life. What good will equality be on a dying planet? Moreover, even if the production loop is closed and we adopt ecologically sensitive lifestyles, market relations as they are currently structured depend on the unpaid work of women and undervalue women's labour. These very basic connections demonstrate how these struggles rely on each other.

The placement of women's work and the environment as "externalities" are based on interlocking assumptions governing modern western society's thinking in reference to gender

and nature. Both must be considered simultaneously to gain a comprehensive analysis of the production and consumption of computer technology in order to resist the abuse of natural resources and unequal gender relations. Indeed, the feminist and environmental critiques of market relations in the global economy are strong and formal progress has been made at the international and national policy levels. Governments have made commitments to these issues, through *The Environment and Development Agenda 21, The Rio Declaration for Sustainable Development* and *The Beijing Platform for Action*. These formal agreements have had very little real impact in terms of a substantial change in the management of the environment and gender relations, as this paper will demonstrate.

Given the lack of real progress toward altering the relations of production and consumption, it is necessary to explore the conceptual and theoretical linkages between the status of women and men and the connections with nature or the environment. This can lead us to understand how the systems of production of technology rely and profit from unequal gender relations and environmental degradation and therefore how to resist and challenge them.

Conceptions and relations of nature, gender and society

Cultural metanarratives contain clues about social values in the use and abuse of nature, meanings of gender, race, and class. Both postmodernist and ecofeminist theory trace the metaphors used in western society which write on our consciousness the possibilities and rules regarding the use of nature.

Ecofeminist discourse connects the status of women to the abuse of nature and explains that both are part of the patriarchal capitalist system. Ecofeminist theorists such as Carolyn Merchant and Vanada Shiva argue that the dominance of women by men is based on perceptions regarding women's physiology and reproductive functions, which have conceptually placed women closer to nature. The system of domination of women is seen also in men's abuse and exploitation of the earth. Further, women's lived experience with nature in reproductive and productive activities intimately related to nature, such as agriculture, makes women intrinsically interested in preserving and protecting the environment.

In *The Death of Nature*, Merchant lays the groundwork for the historical and theoretical basis of ecofeminism. Merchant explains the identity of nature as a nurturing mother connects

women's history with the history of the environment (xvi, 1980). The subjugation of nature became permissible after the Scientific Revolution because it was associated with the feminine.

In the 17th century the metaphor used in Europe to mediate between people, the earth, and technology changed from an organic to a mechanistic conception. The organism approach emphasized the interdependence of natural systems, the subordination of individual needs to communal purposes, and nature as the nurturing mother (Merchant, 1980:1). The Scientific Revolution transformed human relations with nature to a mechanistic approach: nature came to be seen as a machine comprised of atomized parts that can be repaired and replaced and are no longer inter-related (Merchant, 1980:192). The change of world-view brought on a hierarchical ordered approach within which natural resources could be extracted and used for industrial purposes. Merchant explains that the over-arching metaphor was transformed, ushering in the dawn of the Industrial Revolution. The earth, once seen as an organic whole in which each part is inter-dependent to another, began to be viewed in the Scientific Revolution as a machine each part isolated from the rest. The change allowed production to take place breaching previous taboos on the sanctity of the earth, for example, and permitted mines to be dug in order to extract minerals.

In a bid to expose the dominant theories of nature, ecofeminists have criticized western narratives governing the relationships between production, technology, and gender. They argue that the use of natural resources cannot be separated from social relations, especially in the face of western values imposed in developing countries (Shiva, 1988). Shiva posits development as the imposition of western masculinist principles and terms it "maldevelopment". She calls for a recovery of the feminine principle as the basis for development that sustains and conserves nature (Shiva, 1988:7). The feminine principle for Shiva is both the embodiment of nature and the nurturance of nature to produce life (Shiva, 1988:39). Shiva's work is important because it gives validity to traditional knowledge structures and criticizes western development for subjugating nature for exploitative purposes. Shiva draws attention to the work done by women in subsistence economies and the political struggles of the Chipko movement in India to preserve forests and their sustainable livelihoods.

Ecofeminism and Feminist Environmentalism

Other feminist theorists have criticized ecofeminist theory for two main reasons. First it essentializes women's position with nature, meaning women and nature cannot be separated. Secondly, it relies on a unitary concept of women, negating the different interests of women and men in terms of class, ethnicity, race, sexual orientation, ability etc…In the following discussion, each of these criticisms will be discussed in relation to the production and use of technology.

Jackson criticizes ecofeminism for idealizing women's relationships with nature. This approach ignores material realities that configure different women's relations with nature, and denies the social and historical construction of gender and nature (Jackson, 1995: 127-128). The placement of nature as feminine and the glorification of women imbued with special interests in nature is exemplified in both Merchant's and Shiva's work. The intimate connection of women with nature as the antidote to industrial development is problematic because it relies on women's special connection to nature as a springboard for action. This essentializes women's relationship to nature and does not serve to break down the social construction of "woman". Men also have a relationship to nature, which must be fostered to enable all people to feel a responsibility for the preservation of natural resources.

Jackson points to the weakness of the material basis to ecofeminist theory as leading to the false idea of a positive synergism of women's gender interests and environmental interests (1995:127). Material realities inform gender roles in relation to environmental management. This is conducted within what Jackson calls gender differentiation: men and women of the same household relate differently to resources and these variations are inserted into class relations (Jackson, 1995:129). Examples of the differential patterns of men and women's management of environmental resources reflect the divergent interests of women and men in the household. For example, Jackson cites beer brewing as an economic activity for women in Southern Africa to generate independent income (1995:129). This activity requires high wood fuel consumption and long cooking periods, additionally, the delegation of tasks related to this activity is not distributed equally among women - older women delegate the gathering of wood to their son's wives (Jackson, 1995: 130). This example is useful as a demonstration of the many power dimensions at play in resource use and inter-gender division of labour and interests.

In Donna Haraway's 1991 *Cyborg Manifesto* she names each of us cyborg - a creature of social reality, fiction and lived experience. We are all created by the multitude of forces at play in the nexus between production, reproduction, race, class and gender. Haraway criticizes feminists for essentializing women bound by a sisterhood; the way to find unity is through affinity, not identity (1991:167). The implication for our discussion here is that we cannot generalize about women workers in the computer industry. Within their social reality as constructed by the demands of the industries located in developing and developed countries, women workers are usually more educated and therefore of a higher class (Goodman, 1987:76). Women computer workers occupy different race and class categories thereby influencing their interests.

The solution offered by Jackson is an uptake of Aagarwal's notion of *feminist environmentalism* – this approach configures the link between women and nature by specific gender and class organization of production, reproduction, and distribution (1995:140). In each circumstance, a gender analysis must be undertaken in order to understand the relations of production and reproduction between men and women and the environment. This approach does not assume a positive relationship between women and the environment; it does not essentialize women by her "nature" to have the best interests of the environment in mind. Instead, a gender analysis approach is taken which looks at how the construction of gender roles relates to the management of natural resources.

Building on this evolution of thinking on gender and the environment, two challenges are presented. First, it is important to remain grounded in the relations between gender and the environment while still maintaining visions and standards of women's human rights. Every situation requires a gender analysis and environmental analysis sensitive to historical and social conditions. However, it is still important to balance this material analysis with international policy and human right standards. These standards allow activists, academics and governments to gauge progress toward goals of equality and sustainable development. The trees should not be lost to the forest in the search for context-specific micro solutions. General indicators of progress must continue to be developed because they are important as a mark of how far we have left to go in the struggle for gender equality.

The second challenge is to strengthen the concept of feminist environmentalism by looking at the other side of production – consumption. Recall Jackson's example of the women in

South Africa producing beer and the unequal relations between women of different ages in this process. This is only an analysis of the production of this commodity; we have no sense as to what is driving the demand and the circumstances giving way to these relations. What is missing here is the relationship between consumption and production to gender relations and natural resource use. Just as the social construction of women's roles relates to the construction of men's roles, the production of commodities is driven and shaped by the consumption of such commodities. For example, further analysis in the above example may find that the beer is primarily consumed by men. This could have implications for increased domestic violence, for example.

Additionally, women's entry into the labour force has implications for their status as workers and consumers; in turn, both production and consumption have implications on the environment. Charkiewicz explains that the entry of women in the market is changing household consumption patterns toward a higher degree of mass produced goods (2001:107). Understanding the interconnectedness of these two processes can lead to discovering spaces to resist the present structures of global capital.

Gender and the environment are placed as externalities in the global economic production and consumption of electronics. This reality offers a challenge to transform market relations. Market relations are governed by the construction of natural and female within the parameters of the machine and cyborg metaphor, this shapes how technology is used. Feminist analysis of these connections must look at the multiple identities held by women and men within different social realities while keeping in mind the global standards of men's and women's human rights throughout the product cycle. This approach will be used in this essay to demonstrate the interlinkages and spaces for resistance between gender, the environment, and global capital in the personal computer industry.

SECTION TWO:
Production in the Computer Industry

The global production of consumer electronics is multi-dimensional, comprised of relations between capital, men, women, and the environment. Electronics are produced within the market reality of the global relations of capital, located in both developing and developed countries. The production process has a deep impact on the environment and health of the workers. The process is also imbued with gender power relations as seen in the conditions within which the majority female production workers are employed. By revealing some of the environmental and gendered realities of production, an analysis can be built on how to resist and transform harmful production processes.

Global trade and transnational production

At 30 years old, the electronics industry is still young. It was born in 1972 - the first year personal computers were made available to consumers. Since then electronics has emerged to be the world's largest and most rapidly expanding industry. The industry has experienced a great deal of growth. Export revenues have increased from $1.1 billion to $10.6 billion from 1985 to 1996 – an increase of a factor of ten (von Moltke et al., 1998:70). The industry is characterized by heavy competition and an ever-evolving product.

The global production and manufacturing of electronics is divided between developed and developing countries (von Moltke et al., 1998:69). Companies located in developing countries are either wholly owned subsidiaries of leading global semiconductor firms, or contract manufacturers competing for orders (von Molke et al., 1998:69). Subsidiary firms are increasingly under control of local personnel; they play an important role in planning production because of the demands of just in time (JIT) production processes. Korea, Malaysia, the Philippines, Thailand, and Singapore all have substantial electronic industries.

Personal computers comprise several different large components, such as the monitor, central processing unit, keyboard, printer, scanner etc…However, the heart of a computer is the semiconductor. Semiconductors are materials that conduct electricity; they transform electrical signals into sound and/or pictures and are therefore vital components in such equipment as television sets, computers, telephones and other communication devices (von Molke et al., 1998:73). The production of semiconductor devices consists of four stages.

The first two, wafer design and wafer fabrication are capital intensive and generally done in industrialized countries. Assembly and product testing are labour-intensive and generally done in developing countries and then shipped abroad.

Before computers enter into the global production chain, however, they are first conceived and designed by scientists and engineers. The social relations surrounding the creation of technology influence who gets to decide what type of technology is produced.

Mythology and actors in the creation of technology

The implementation of modern western science through technology has had many beneficial and negative applications. In the west we cannot think of doing without such modern conveniences as cars and microwave ovens, telephones and televisions. However, the same science also brought the atomic bomb, DES, and acid rain. It is the separation of scientific inquiry from the application of science in the form of technology that allows those doing the thinking of science to avoid responsibility for its consequences (Harding, 1991). Additionally, science and technology are not value-free; implicit assumptions and values of the culture of science affect how science and technology take shape in modern society (Wajcman, 1991 and Harding, 1991).

The culture surrounding the usage and application of technology is historically masculine. For example, the concept of “Man and the machine” is heavily associated with the progress of modern society. The latest fusion of man and machine can be seen in the histories told of the founders of the computer industry. Steve Jobs and Steve Wozniak are the smart young engineers to invent the Apple computer. Once upon a time Bill Gates and his schoolmates had a strong attachment and fascination with computers. Gates is quoted as saying, “It was when we got free time at C-cubed (Computer Center Corporation) that we really got into computers. I mean, then I became hardcore. It was day and night" (Mirick, 1996). These stories of a group of men working together on a computer connote ideas of fraternity. Through their identification with technology, they develop bonds with one another. These are the tales of the Knights of the Computer: clever young men who heroically delivered business and homes into the 21st century via the computer.

Judy Wajcman names this the archetype of hegemonic masculinity, that is, the social status men gain by organizing relations and cultural processes. When knowledge, power, and

technology are intrinsically linked, masculine status and self-esteem are measured in part by control over technology. “In our culture, to be in command of the very latest technology signifies being involved in directing the future, and so it is a highly valued and mythologized activity” (Wajcman, 1991:144). This masculine culture serves to benefit the group of men who speak the language of technology thereby excluding everyone else. Since this is the dominant culture within which technology is created, increasing the amount of women is considered one step in changing the privileged connection between men and the machine.

The presence of women as innovators in computing is not well known. However, women did play significant roles in the development of computers. Ada Lovelace, the daughter of poet Lord Byron, was a key figure in expanding the concepts intrinsic in computer programming. When she was young, she expanded on Charles Babbage's "Analytical Engine" and her work became the premier text explaining the process now known as computer programming (Toole). Another woman, US Navy captain Grace Hopper, invented the first computer language COBOL in the 1970s (PBS). This meant that instead of programming a computer by mechanical means, English words could be used that enables the computer itself could translate into binary code.

In the past, men were seen as suited for the sciences because they were considered more “rational”. Women, possibly prone to emotion, were not considered capable of scientific thought, despite the accomplishments of women scientists. Today, at least formally, it is recognized in the west that bringing women into fields such as science and engineering is important for diversifying human resources and to eliminate discrimination. However, women remain in the minority. In Canada, for example, women received 17.2% of engineering degrees in 1995, up from 10% in 1980. However women are still clustered in different disciplines, 47% of women received degrees in environmental engineering and only 9% in computer engineering (Canadian Coalition of Women in Engineering, Science and Technology, 2001).

Women working to develop technology may or may not bring a different approach to their work. A concern for the social impact of technology cannot be definitely attributed to women. This is related to interpretations of gender roles, and the demands of work as defined by culture and the marketplace.

Mitter explains that it is the material conditions interact with market relations and how technology is used.

> "The technological innovations become commercially successful if and when the creator of the innovation could make use of political, economic, and legal networks. Thus the dominant group in a society determines the shape and direction of a society's techno-economic order – and the image of an inventor has almost always been male." (Mitter, 1995:5).

Increasing the numbers of women in technology will not necessarily change the way that technology is applied.

> "Scientific rationality is not as monolithic or determinist as anything… it has been versatile and flexible enough throughout its history to permit constant reinterpretation of what should count as legitimate objects and processes of scientific research; it is itself shaped by cultural transformations and must struggle within them; and it is inherently no better or worse than other widespread social assumptions that have appealed to groups with different and sometimes conflicting agendas." (Harding, 1991:3).

The usage of technology must be evaluated for it's social and environmental impact. By exposing the harmful effects of the production and consumption of technology, and pointing to avenues of sustainable production, we can alter the current culture of acceptance within which the current unstable and unequal practices exist.

Scientific thought has the flexibility to benefit our society responsibly. Consider the scores of scientists working on explanations and solutions to the problem of global warming. It is the importance of science and technology to critically evaluate the intentions and consequences of science that will lead to a more thoughtful and responsible technology.

This being said about the design of science and technology, the majority of people involved in building computers, women in the global assembly line, have no say in the design of computers. While women in developing countries are benefiting somewhat from the work generated by the spread of electronics and they do not want their work to cease, but want a say in how technology is affecting the quality of their lives (Mitter, 1995:17). This can be done by first identifying the areas where technology makes negative impact of workers' and computer users' lives.

Environmental considerations in design

Rethinking the uses and designs of computers can eliminate some of the unnecessary waste generated by the production of computers. The Silicon Valley Toxics Commission is advocating clean computers: rethinking computer design using renewable materials and energy and using safer non-renewable materials (SVTC, "Just say no" 2001:11). While alternative designs such as alternative materials to toxic chemicals in the production process are being developed, they have not entered into the regular production cycle. "…we need to move beyond pilot projects and ensure all products are upgradeable and non-toxic" (SVTC, "Just say no" 2001:11).

Environmental and health impacts of production

Personal computers are continually designed and produced to be faster, more efficient, and accomplish more than previous models. This preponderance for newness over utility is known in environmental terms as "in-built obsolescence": products are made obsolete by design and the existing product is obsolete before it wears out (Charkiewicz, 2001:41-42). In-built obsolescence is a basic characteristic of the electronics industry; new features and capabilities of computers mean people have to continuously be buying to keep up. The useful lifecycle of a personal computer has now shrunk from 4-5 years to 2 years (SVTC, "Just say no", 2001:2).

Moore's Law governs the industry's expectations of an 18-month product cycle. In 1965 Gordon Moore observed that the number of transistors per integrated circuit would double every eighteen months (Intel web site, 2001). The industry has kept pace with this law. In 1971 the industry started with the 4004 microprocessor with 2,250 transistors. This device is the computation engine and is fabricated on a single chip. Intel has designed ten different transistors since then, and has doubled the capacity each time. Currently Intel has designed the Pentium 4 processor using 42,000,000 transistors (Intel web site, 2001). Designers are running out of room on the chip however, and Moore's law cannot hold out forever, a slow-down may occur in this pattern (Intel web site, 2001).

The short lifecycle of computers coupled with increasing volumes of production has a heavy toll on natural resources. Computers are comprised of many small components, metals and minerals. Producing these parts generates substantial waste and uses a great deal of energy. "8-18 tons of energy and minerals are consumed by the fabrication of 1 computer

(Malley, 1996:48 in Sach, 1999:192). Obtaining metal can only be done through major mining operations and energy-intensive transformation processes (Sach, 1999:192). The mining, benefication, and smelting of metal are inherently dirty; even though toxic waste is captured during production, it still must be disposed of (Ayres and Ayres, 1996:2).

During the production process itself, many wastes are created. For example, as the capacity of the chips increases every 18 months making the chips denser and denser, processes must be cleaner requiring a higher consumption of water. The discharge of liquid waste causes ground water and soil contamination with solvents and heavy metals (von Moltke et al., 1998:79). The miracle of the rapid innovation of computers generates significant waste.

Silicon is the material at the foundation of the electronics industry. The special semiconductive properties of silicon must be extremely pure in order to be transformed into silicon wafers and then computer chips. Although silicon is the second most common element in the earth's crust, the fact that it is abundant does not offer any consolation since the purification process is extremely demanding, energy intensive and wasteful.

Worldwide production of metallurgical grade silicon in 1990 was 800,000 tonnes, of this 4% was converted to ultra-pure electronic grade and used for semiconductors, and 10% of this was devoted to photovoltaic cells (Ayres and Ayres, 1996:183). This means that 97% of the silicon metal was lost en route to the final product (Ayres and Ayres, 1996:183). It is also very worrisome that for each tonne of metallurgical grade silicon processed 4 tonnes of chlorine is used for a total of 3,200,000 tonnes (Ayres and Ayres 1996:183).

After electronic grade silicon is produced it is converted to wafers. The efficiency of this process is 10% at maximum (Ayres and Ayres, 1996:196) and each silicon wafer produced results in seven pounds of hazardous waste (van Winkle 2001:1). Wafers then undergo five to six major processing steps, including photolithography where the circuit design is pattered on the wafer, and other processes to maximize the conductivity of the chip. Throughout this process, organic solvents, ultraviolet radiation, and strong acid baths are used. Notably organic solvents are difficult to neutralize and can be carcinogenic or toxic, and there is a trend away from their use (Ayres and Ayres, 1996:196). After this, the chips are tested for electronic performance they are shipped to distributors or placed in electronic products (Intel web site).

Women workers in the electronics industry

The gendering of the labour market in the production of electronics is familiar. A combination of prejudices and historical factors are involved in the creation of women as the worker of choice in the assembly of computers, and keep women out of occupying positions in the management and design of these systems. This section will begin by discussing women workers at the level of primary production.

Assumptions are made about women's characteristics and the perceived aptitude of a certain cohort of women for this type of work. Rasiah explains that women are hired in electronics firms in Malaysia because they are regarded as amenable to dexterous tasks and easier to manage (1994:15). These women are young and generally unmarried – the average age of an electronics worker in Malaysia is 23 (Xavier, 1995:31). Women workers are well-educated, firms require at least 11 years of formal education and in Malaysia the preferred level is 13 years, they are more educated than most women workers and therefore regarded as an elite group (Xavier, 1996:32).

Women are also preferred because they do not have any experience with unions and are considered to be less militant than men (Stuart, 1994:144). Indeed unions are the exception in this industry (Rasiah, 1994: 24). It is difficult to organize women workers because their status as worker is often temporary. Women are laid off easily, move on to another factory or cease working because of health reasons (Theobald, 1999:127). Companies have an easier time controlling the relations of production because of women cannot or do not remain in one job for a long time.

Women are also paid less than male workers are. Companies wishing to keep labour costs down find that women workers fit their needs. Production work in electronics is not well paid in relation to production work in more male-dominated manufacturing industries, but pays better than traditional women's work (Stuart, 1994: 144). Women are earning more than in the informal economy, but less than men in the formal economy.

Manufacturing companies take advantage of women's need for paid work in order to decrease their bottom line by moving labour-intensive operations to developing countries.

> "…cheap labour in the form of young women workers has been described as the single most important factor in the international movements of labour-intensive

> industries, such as garments and electronics, and gender has played a fundamental role in constituting vast labour forces around the world" (Freeman, 2000:104).

Women are seen as "reserve armies of labour", an untapped labour pool ready to step in place on the production line. This conceptualization fits with the needs of capitalism – a group of workers can be incorporated or discarded as wageworkers when required by capital (Freeman, 2000:105). Carla Freeman traces the perception of women as cheap, available and therefore 'ideal' sources of labour in the data entry operations of Barbados. She finds this clashes with the local cultural portraits of strong, resilient, resourceful, and hardworking matriarchs (Freeman, 2000: 107). This compelling example challenges the docile construction of women with 'nimble fingers'. These perceptions of women workers help to justify the unequal pay differential women receive since they are seen as disposable and therefore valued and paid less.

The conditions in which women work are designed to maintain and reinforce their perceived docility. A study by Leng and Subramanian on the safety and health of women workers in factories in Malaysia reveals draconian treatment of women workers in the production line (1994). Another study by Rasiah shows how workers are restricted from talking and visiting the washrooms and how tight labour control strategies mean workers are closely monitored and punished for any mistakes (1994:15).

The gender division between women workers on the line with male supervisor also results in sexual harassment. Since women have few avenues for reconciliation and are considered easily replaced, they also have significantly less power in dealing with these situations. Irene Xavier writes of many informal reports of sexual harassment by male supervisors and management in return for promotions and other benefits in the workplace in Malaysia. Understanding the full extent of the abuse of power is not possible because there has not been any study of this issue and women workers do not feel comfortable reporting cases of sexual harassment to the authorities (Xavier, 1994: 35-36).

Given all of the difficulties facing women workers in electronics, they do find ways to resist and deal with difficulties on the job. Women endure in these jobs because the pay is important to their survival and the well-being of their families. In a study of women workers in 17 factories in Silicon Valley, Karen Hossfeld found that the primarily Latin American

women engaged in individual acts of resistance by using management's gender and racial stereotypes against them. One worker explains:

> "First of all, the bosses think everyone from Latin America is Mexican, and they think all Mexicans are dumb. So, whenever they try to speed up production, or give us something we don't want to do, we just act dumb. It's not as if you act smart and you get a promotion or a bonus anyway." (Hossfeld, 1991: 175).

While these solutions may help in the short run, they do nothing to counter racial or gender stereotypes in the long run. Women are not interested in organizing, possibly because they have negative perceptions about unions, or perceive any hardship in the US as insignificant compared to prior experience in their countries of origin, or they are scared of losing their jobs, or are simply too tired (Hossfeld, 1991:175). Despite the conditions facing women in the electronics factories, they are there because they wish to improve the material conditions for themselves and their families.

Swatsi Mitter argues that although conditions in the new global production line are difficult, this is still a better option for women than the informal sector. Mitter cites the new 500,000 women-strong workforce in the Bangladeshi garment industry as essential to a new freedom for women (1995:23). Even given the unsafe and difficult work environments, women find that working for pay gives them a certain amount of freedom from tradition and social oppression (Mitter,1995:23). This is one of the conflicts of these new factors of production: it pulls women away from constraints within the family into a new set of problems in the factory.

Women experience the benefits of earning a wage, and but there these gains are limited taking on production work. Women earning pay have increased control in their families, but not necessarily. Wichterich finds their cheques often go to their husband or father, earnings also go to subsidize family living in rural areas (Wichterich, 1994:136). Women working in the factories face the double burden. The clash of values from the rural to urban factory zones is also problematic. Women come under fire in Malaysia for perceived immorality and "sexual permissiveness" of living on their own away from family (Wichterich, 1994: 136). These incongruent values and changes in their lives surely breed stress and difficulties for women.

Women are virtually non-existent in upper level management in developing countries. In the developed countries, gender roles may preclude women from obtaining suitable education

for these positions, and the time women spend furthering their career may be restricted by family responsibilities. Women who take time off to raise children do not advance as quickly to the upper ranks of management. Presently there is one woman CEO at the top of the high tech firms in the US, Carly Fiorina at Hewlett Packard. However, it is questionable if advancing women to upper positions will substantially advance gender equality.

> "Linda Watchner, CEO of a Fortune 500 company closed the Harthaway shirt company in 1996 in spite of the fact that the 500 female employees gave up pay raises to finance consultants which would train them to work more efficiently (Mother Jones, March/April 1998 in Charkiewicz, 2001:117).

Women in management may not change the conditions for women workers. The benefits of waged work in the global production line for women are clouded by the patriarchal capitalist relations, which construct women as ideal workers.

Health and safety of women workers

Within the context of the production line, there is little incentive for companies to guard the health and safety of this workforce. Women's health is a pawn; their treatment is a reflection of women's health as an externality. Women workers in the electronics industry experience a range of health problems, from repetitive strain injury, to stress, to chemical sensitivity, to reproductive disorders. This section will discuss some of these problems.

Part of the production process of electronics involves soldering circuit boards that are so small that they can only be seen using a microscope. After peering into these microscopes for long periods of time, women inevitably have permanent eye damage and require corrective lenses (Xavier, 1994:34). Most women require glasses after one year, but it is believed that companies do not pay for glasses because it would be a direct admission of guilt (Leng and Subramian, 1994: 86). Labour laws in Malaysia, for example, do not require employers to pay for these glasses that microscope workers inevitably require (Xavier, 1994: 34).

The industry may regard women as the ideal worker, but the machines are not designed for women's body size. In Malaysia women have to cope with this:

> "In one multinational company, for example, a process which emits fumes is carried out under hoods. The hoods, however, are too high for the Malaysian women. As a result their noses are at or below the level of the hoods instead of being above it, making the hoods rather ineffective (Xavier, 1994:34).

Women also suffer from repetitive strain injury resulting in pain in the wrists, neck, and shoulders (Corpwatch 2001). The factory itself is very noisy, causing women workers' ears to ring and making hearing difficult (Corpwatch 2001). There are also problems related to the emission of fumes within the factory. This can be from the solder fumes used to create the circuitry. "The solder fumes are so bad, they come straight to my face. I have so much tears coming out and I cannot work without using eye glasses" says a woman worker in a factory in Malaysia (Leng and Subraniam, 1994:85). This woman worker was sent to see a doctor on contract with the company who refused to give the medical certificate necessary so that she can transfer out of this department. Instead the doctor tells her that her bad headaches, eye tearing and pain are due to a cold (Leng and Subraniam, 1994:85). This is just one example of the refusal of management to be concerned with the health of workers.

The attitude of the companies is that women must work carefully to avoid difficulty. Putting emphasis on individual responsibility gets companies away from taking responsibility themselves. Some firms offer workers higher pay for riskier jobs, compromising their safety and disregarding their human rights to a safe work environment (Leng and Subramaniam, 1994:100).

The gender relations between male management and female workers influence how seriously health concerns are taken. When women are coming to men with concerns over their health, it is easy for men to look at women as the "other" and consider that it is women's perceived emotional irrationality that is causing them to complain. For example, in 1977 a group of workers in the new electronic industry in the US Santa Clara Valley began experiencing nausea, headaches, blisters, and a metallic taste in their mouths. They were told by their managers not to complain of these "female problems" until a male worker also started having symptoms (Baker, 1994:110). A problem was found in the ventilation system, but not before three women workers had developed "multiple chemical sensitivity" – an intolerance of even the smallest amounts of chemicals, such as perfumes and soap detergent (Baker, 1994: 110-111). Women occupying the ranks of workers subject to male management have to deal with management's prejudice.

Reproductive health at risk

There is a link between spontaneous abortion, miscarriage risk, and work in electronics. This is a result of the chemicals used in the production of silicon chips. Persistent organic

pollutants (POPs) and Endocrine Disrupting Chemicals (EDC) are used in the fabrication process. Both of these types of chemicals are man-made, and as a result have adverse reactions to humans and the environment. POPs are characterized by a long half-life and can bio-accumulate in the body (Charkiewicz, 2001:234). EDC are synthetic chemicals that disrupt the endocrine system, the system which regulates many developmental and regular bodily functions (Charkiewicz, 2001:232). "It is also recognized that the endocrine disrupting potential can be significantly increased through the synergistic effects of several low level endocrine disruption substances acting together" (Charkiewicz, 2001:233). The interaction of women workers with the many different chemicals required to produce silicon chips results in reproductive health problems.

A BBC documentary found that companies in the US had knowledge of the reproductive health hazards in the electronics industry and chose not to inform the workers (Poling, 2001). A study funded by the industry as a result of pressure on this issue revealed that women at certain stages of the production process have significantly greater risk of spontaneous abortion (SAB); women working in wafer fabrication[1] had a 20% increased chance of SAB (Eskenazi, 1994:62). The women in wafer fabrication had two-thirds the probability of getting pregnant over the women in non-fabrication. Also women working specifically with glycol-ethers had only a 35% chance of pregnancy as compared to women who do not work with this substance (Eskenazi, 1994:62). Women working in wafer fabrication had a greater mean menstrual cycle length and variability of their cycles, which may be indicative of hormonal problems (Eskenazi, 1994:62). In a Canadian study of pregnant women exposed to solvents similar to those used in wafer fabrication, 10% had given birth to children with major congenital malformations, compared with 0.08% in jobs not involving solvents (Stranahan, 2002: 48).

The presence of these reproductive disorders is unacceptable. This is a clear example of women's bodies suffering for the sake of capital accumulation and profit. Women and their work are undervalued in current social and economic markets and the resulting impact on women's health is placed as an externality in market relations.

The adverse impacts of technology on women's health are an example of masculine preponderance to directly or indirectly control women's reproductive abilities. Feminists have

argued that the drive to create technology is a result of "womb envy"; men need to make a substitute for the babies they cannot conceive (Wajcman, 1991:138). The push for the creation of newer and newer technology is directly inhibiting women's reproductive abilities. This is also a case of eugenics and racism; in Silicon Valley the majority production workers are women of color, as are women in developing countries. The systems of domination – white male capitalist technologists – are exploiting working class Latino women and women in developing countries. Women's bodies are once more the site of struggle in production and reproduction.

Women working with chemicals and semiconductors also suffer increased rates of breast cancer. A recent British government survey found elevated rates of breast, lung, brain and stomach cancers among workers at a National Semiconductor plant in Greenock, Scotland (Stranahan, 2002:48). In the US, at least 250 workers have filed lawsuits against high-tech companies, chiefly IBM and National Semi Conductor (Stranahan, 2002: 47). "Some veteran industry watchers believe it may take widespread, and expensive, litigation to force change. 'If the employer doesn't do what he's supposed to do, and the government doesn't step in, then in come the lawyers'" (Stranahan, 2002:49). Even in countries where workers have access to litigation, it is not guaranteed that companies will be forced to protect their workers. In the meantime, the majority of workers in this industry, women, will pay with their health.

Also, the dramatic impact of these chemicals on women workers is like a canary in the gold mine. If women are suffering so severely by working closely with these substances, what are the impacts of lesser exposure through waste disposal of these substances? As we shall see, very little is presently known about the effects of chemicals on humans and the environment.

The structure of production process is such that it considers health consequences only when confronted with them after-the-fact. "Only about 10% of the most heavily used industrial chemicals have received basic analysis for possible toxic effects, and very few of them have been screened for ecotoxilogical impacts." (Charkiewicz, 2001:72). This could be changed by adopting the precautionary principle. "This principle is based on the idea that when a human activity threatens public health or the environment, preventative measures should be

[1] Wafer fabrication is the process whereby the silicon chips are created and washed using organic

taken even if some cause and effect relationships are not fully established scientifically" (Charkiewicz, 2001:72). Adopting the precautionary principle would require rethinking our approach of production and putting people and the environment first. Educating the public on this issue and reminding policy-makers and the industry of the severe health and environmental consequences could exert more pressure in order to adopt the precautionary principle.

In a description of the mobilization around the environmental and health effects of the economics industry, Baker explains that it was a partnership between environmental activists and health and safety activists which mobilized public concern and pressured the electronics factories (1994:112). This group led to the formation of the Silicon Valley Toxics Commission, one of the only groups working on the environmental and health effects of the electronics industry. Under this pressure, the industry began to develop its own health and safety programs in the US, however small.

The situation is different in developing countries; organizing is exacerbated by biased governmental inspections. In Korea, for example, parts of the national occupational health and safely act are not enforced or some systems are inspected by private inspectors under contract from the company (Gil-Seong, 1994:119-120). Injured workers have difficulty getting compliance from government inspectors when regulations are broken and then do not receive compensation (Gil-Seong, 1994:120). In the developing country context, organizing is made more difficult when the companies have influence in altering the health and safety standards.

Governmental systems are seduced by the potential gain of increased in attracting and retaining this prosperous industry. Infrastructure such as newspapers may be very biased. Also, consumers are generally located in the west. All of these factors make changes toward respecting workers' human rights difficult.

This being said, the emergence of the "pink ghetto" in the global production line simultaneously opens up new possibilities and conflicts for women workers. Women are now receiving a wage, but they are jeopardizing their safety and health in the process. Women working in the computer industry are experiencing increased freedom by leaving

solvents and other chemicals.

traditional family structures and potentially gaining with increased bargaining power within the household, but they are subject to the gender stereotypes held by management in the production process. Given the importance of the electronic industry, it is clear that it is here to stay. This may be the one reliable aspect of the situation women workers find themselves in, that they are being relied on as a work-force to produce electronics. In this way, it is their labour power that can allow them to resist and transform the conditions under which they work.

SECTION THREE:
Virtual environments and gendered consumption

Women online or on-the-line?

There is a large variation in the distribution of the use of computer technology between the North and the South, and even between countries in the North. Industrial countries, home to 15% of the human population, comprise of 88% of all Internet users (Marcelle, 2000: 8). This next section will refer to women's status when they are among those who consume computers.

The gender gap in the use of the Internet can be used as an indicator of women's increased uptake of technology and infers progress toward equality. However using the Internet is more often than not a process of information gathering; arguably users receive information more often than they create it. This takes place in an environment where information is gathered about computer users' preferences while they gather their own information[2]. Women's place as consumers will feature prominently as an emerging market.

Women carry a formidable amount of spending power in households. A study for online marketers entitled, "The Online Woman: How to Tap Into Her Buying Power" found that in the average household, women control 75% of finances and are responsible for 80% of purchasing decisions (Nua, 2001). This study then grouped women into six different profiles. For example, "Movers" are educated, ambitious, upwardly mobile and spend the most online (Nua, 2001). Companies want women to be online in order to sell to them, thereby reframing women's identity using their shopping habits.

Women do have buying power in technology and computers. A researcher for Intel cited women's buying power in technology as "the reason why women should be involved in all

[2] The most recent version of Microsoft (MS) Windows is Windows XP. This program requires users to have a central identity called Passport that tracks use patterns on the web to offer suggestions in terms of shopping and information relevant to the user's profile. At the same time, MS is using Passport to gather information about the user's online habits and selling this to companies for marketing purposes. The metaphor of a Passport is fitting here, it is a tool for tracking and measuring an individual. In this case, however, individuals are not judged by their nationality, but on consumer identity characteristics such as earnings, interests, and gender.

facets of technology product development and innovation" (Egido, 2001). This does not question women's position as consumers, negating women's historically subordinate place as unpaid workers and consumers for the home. Women's are re-evaluated now by spending power, their ability to "vote" as consumers.

There is irony in women's position as consumers. Women are a significant market force for capital to vie for, while at the same time women are in this role because of economic and social relations. Women's gendered responsibilities as caregivers mean they have the responsibility of shopping for household goods, clothing, and food. The wage gap means that women's lower average earnings also force them to use their time to comparison shop in order to find the lowest cost goods. When structural adjustment programs or global economic volatility has an impact on household income, it is the women who must make up the short-fall in revenue by spending their time shopping for the lower priced goods (Bakker, 1998:27). The decisions of women consumers reflect their interests as shaped by the global economy – to have the lowest possible prices.

The role of women as consumers is epitomized in the cultural image of the housewife. Miller explains that this mythological figure dominates the image of consumption (Miller, 1995:8). "…the housewife in many respects epitomizes the contradictions of contemporary consumer power. It is by focusing upon the housewife as the global dictator that the ironies of power may be most directly confronted. (Miller, 1995:8). The first is to look critically at the social relations. Women's position must be made visible, along with the divisions created between women with purchasing power and women marginalized by low-incomes.

Women's position as consumers within these new market dimensions may serve the needs of the women with the status, income, and buying power to capture the interests of marketers and designers, however it ignores and excludes women who are not online. Those who do not participate do not have a "vote" as consumers and the gap between users and non-users of technology will widen.

Consumerism and status

Women are located as both consumers and producers in relation to computers in the data-processing sector. This new industry is a source of jobs for women in developing countries is another interesting thread in the fabric of computer network relations. In *High Tech and*

High Heels Carla Freeman conducted research with women data-processors in the Caribbean to explore how their identities are reformulated as they enter data for airline tickets, consumer warranty cards, and text for publishing. In the creation of this new job sector, women's status as 'high tech" workers is demarcated by professional dress, something women themselves gain pride and status in the community from even though wages are no higher than other more traditional pink collar jobs such as garment factories. "Their multiple roles as formal and informal workers together enmesh them within the international division of labour, as well as within an increasingly globalization of tastes and consumer goods" (Freeman, 1999: 239). The globalization of women's computer work expands and challenges prior ideas of northern consumers, southern producers.

Women in the south are also producers and consumers of computers. Women as workers and consumers in the developing world seek to gain the rewards of consumption: material wealth and status. But this continues to reproduce patterns of production, consumption, and ownership where women do most of the work and do not have a say in the real power dimensions of the industry held by the interests of shareholders. The consumption of computers continues then on unequal gender lines as well, with women located as new markets and sources of information for marketers.

Benefits for social justice

Just as the increasing encroachment of technology in our lives is detrimental, it has also brought benefits. Feminist activists have used the Internet to campaign on a multitude of issues. "The Internet offers activists more ways to develop and extend our work, to reach more people, to increase our speed and effectiveness, to learn more about each other, to build solidarity, and to organize (Women's Space, 2001). Feminist activism even extends to improving the online community itself with groups such as Women Halting Online Abuse aimed at educating and stopping sexual harassment on the Internet (Women Halting Online Abuse, 2001).

Environmentalists are also well-known as on-line activists. One of the most vocal and active groups on the issue of the health and environmental impacts of computers is The Silicon Valley Toxics Coalition (SVTC). Formed in 1982 when substantial ground water contamination was found leaking from underground storage tanks at high-tech companies, the SVTC is engaged in research, advocacy, and organizing associated with environmental

and human health problems caused by the rapid growth of the high-tech electronics industry (SVTC Web site, 2001). Their web site is a good example of an online activists' toolbox - with reports, interactive maps of contaminated areas, a list serve, and information on how to get involved.

The Toxics Release Inventory (TRI) is another positive example of technology providing activists with information. The American Emergency Planning and Community Right to Know Act mandated that the TRI be created to provide citizens with information about 600 designated toxic chemicals and their use in their communities (EPA, 2001). The TRI is in the format of a computer database. The uptake of this electronic resource is also a clear example of how government legislation is one of the most powerful tools to force producers to be more accountable to the community[3].

Certainly the Internet and computers have aided activists in a variety of areas to organize. Anti free-trade protests in Seattle, Quebec City, and Genoa could not have been possible without listserves, web sites, and email communication. The Multilateral Agreement of Investment (MAI), an agreement between OECD countries that would have prevented national governments from creating legislation to control multinational corporations, was defeated by Internet activism.

> "This (the MAI-Not Campaign) is the first successful Internet campaign by non-governmental organizations', said one diplomat involved. 'It's been very effective.' Canadian Trade Minister Sergio Marchi remarked that "the lesson he has learned is that 'civil society'-meaning public interest groups-should be engaged much sooner in a negotiating process, instead of governments trying to negotiate around them." (Perlas, 2000).

While computers and the Internet empower activists, resources are severely constrained. Feminists, environmentalists, and anti-free trade activists are very creative in using computers to lobby, organize, and educate on a multitude of issues. Technology is a tool to be used for the goals of whoever manipulates it. We must remember that although activists have accomplished substantial successes in pressuring governments and corporations using technology, this is still the case of a small group of under-resourced "global citizens" working against power networks of corporations, governments, and the military. David won the battle with Goliath once, however, activists are continually struggling against those holding the majority of the power and control over the design and distribution of technology. For those

with access, computers are a good resource, however we must remember that the technology is for the large part shaped by the power network of high-tech companies and the stock market.

Contents and resulting health impacts of computers for users and communities

Computers contain a large amount of toxic substances and chemicals. Not all of the health effects of the chemicals used in computers are known due to the protective policies of each company.

> "Even in the US, where the data on chemicals and minerals are most complete, many important chemicals are produced by fewer than four companies, whence data are suppressed on the grounds that publication might tend to reveal the activities of a private firm. In other words, such data are treated as proprietary and 'confidential', regardless of the possible public interest" (Ayres and Ayres, 1996:30).

This secrecy is unacceptable given that computer companies have a substantial history of using toxic substances in computers. Even the substances that we can recognize in computers are hazardous, imagine the consequences of substances companies are keeping hidden from the public.

The materials located inside computers have an impact on both the computer user, in the case of brominated flame retardants, and on citizens in general, when disposed of landfills or via incineration, for example with lead. A few of these substances are described below.

Lead is used in computers to solder printed circuit boards and as the glass panels in computer monitors. Each computer or television display contains an average of 4-8 pounds of lead. The total amount of lead in the 315 million computers that will become obsolete between 1997 and 2004 is estimated to be more than 1.2 billion pounds (SVTC, 2001: 9). Lead is known to cause damage to the central and peripheral nervous systems, blood system, and kidneys in humans. Consumer electronics constitute 40% of the lead found in landfills and this could potentially leach into the water table. It is notable that companies such as Intel are making attempts to reduce the amount of lead contained in the soldering of the circuit boards (Intel), however these efforts are only at the experimental stage now.

[3] The TRI does not include all potentially hazardous chemicals however, and does not go far enough in eliminating the secrecy around chemicals used in industrial production.

Cadmium is used in computer chips, infrared detectors and semiconductors. Cadmium is classified as toxic; it is absorbed through respiration or through food because of a 30-year half-life, accumulating in the human body and the kidneys (SVTC, "Just say no", 2001:12). Two million pounds of cadmium are present in the 315 million computers to become obsolete in 1997 – 2004.

Chromium is used to protect steel from corrosion and to decorate steel housing (SVTC, "Just say no", 2001:12). "Production and use …accounts for a high proportion of environmentally harmful and toxic chromium emissions (Ayers and Ayers, 1996:74). Chromium can pass through membranes of cells and can produce toxic effects within cells. It may also cause DNA damage. Chromium can leach from landfills and incineration results in fly ash which also leaches chromium making scientists agree that it should not be incinerated (SVTC, "Just say no", 2001:13). The 315 million computers to become obsolete from 1997 to 2004 contain 1.2 million pounds of chromium.

It is estimated that there are 1 billion pounds of plastic waste from computers per year, 26% of this is polyvinyl chloride (PVC) which is considered very toxic and indeed fatal if incinerated (SVTC, "Just say no", 2001:13). For this reason, ABS plastics are beginning to be used instead. This does not change the issue of how to deal with the present quantities of PVC plastics on obsolete computers.

Brominated Flame Retardants are used in printed circuit boards in components such as connectors and in plastic covers and cables to reduce flammability (SVTC, "Just say no", 2001:13). Used in objects such as TV receivers, computer screens and other warm consumer electronics, they emit chemical compounds made of flame retardants in the air, which appears to be absorbed into the human bloodstream (Environmental Illness, 2001). Studies have found that polybrominated diphenylethers (PBDE) might act as endocrine disrupters and exposure in early life could induce neurotoxic effects, it also has been shown to reduce thyroid hormones in exposed animals and cross the blood/brain barrier in developing fetuses (SVTC, "Just say no", 2001:13). Polybrominated Biphenyls (PBBs) have been linked to an increase incidence of cancer, and people with the highest exposure were 23 times more likely to develop digestive cancers, including stomach, pancreas and liver cancer (SVTC, "Just say no", 2001:14). PBBs have also been shown to affect the hormonal

levels in humans (Birke, 2000). PBBs are insoluble in water and are primarily found in sediments of polluted lakes and rivers.

Environmental impacts of consumption

Computers demand a significant amount of electrical power. Energy is wasted when people leave their terminals on when they are not in use for long stretches of time. Energy is also used to run the Internet in locations called server farms. For example, one recently approved server farm in San Jose will require 280 megawatts of power, this would power 280,000 households (Van Winkle, 2001). Server farms also require a back-up system of generators using diesel storage tanks holding 100,000 gallons of diesel fuel each.

After one to two years of use, many computers are abandoned. Often people hope they will have some sort of market value and keep them in storage; it is estimated that over three-quarters of all computers ever bought in the US are currently stored in people's attics, basements, office closets, and pantries (SVTC, "Just say no", 2001:2). Over 50% of households in the North America own a computer and in several years there will be a waste crisis. By 2004, 315 million computers in the US will become obsolete (SVTC, "Just say no" 2001:2).

In the US, the disposal of computers is also an example of externalizing environmental problems to developing countries. Computers are considered hazardous waste because of the many toxic components including PCB's, mercury, lead and cadmium (SVTC, "Just say no" 2001). Some of this waste may be shipped to other countries, but because producers may sell scrap to recyclers without checking its final destination, it is difficult to say how much is sent away from the US abroad (SVTC, "Just say no" 2001). Exporting scrap electronics material to recycle can be up to 10 times less expensive than recycling it in the US (SVTC, "Just say no" 2001). The Basal Ban was adopted by 77 non-OECD countries to prevent shipping waste for recycling, however the US has actually lobbied governments in Asia to establish bilateral trade agreements to continue dumping their hazardous waste in developing countries (SVTC, "Just say no" 2001).

Disposal of computers poses hazards to people and the environment. A study found that 70% of heavy metals found in landfills come from electronic equipment discards (SVTC, "Poison PCs", 2001:15). These can contaminate ground water and pose other

environmental and public health risks. Incineration is also dangerous and is one of the largest sources of dioxins into the atmosphere in North America (SVTC, "Poison PCs", 2001:15). The cost of properly disposing of computers is $40 per unit or a total of $223,200,000 USD in the year 2002; recycling is cheaper: $22.50 per unit or $41,850,000 (SVTC, "Poison PCs", 2001:21).

Recycling as an option to deal with this crisis presents also challenges. Dismantling computers is difficult because of all the small parts and the people doing the work of dismantling face health risks in the process. The Silicon Toxics Commission also explains,

> "Recycling of hazardous materials has limited environmental benefit – it simply moves the hazards into secondary products that eventually require disposal. Unless the goal is to redesign the product to use non-hazardous materials, such recycling can be a false solution" (SVTC, "Poison PCs", 2001:17).

One option to work toward sustainable production is to make producers responsible for their products once consumers are done with them. This way, they will be motivated to design the computers to be easier to disassemble and use less toxic materials.

> "Extended Producer Responsibility (EPR) encourages producers to prevent pollution and reduce resource and energy use in each stage of the product life cycle through changes in product design and process technology" (SVTC, "Just say no", 2001:5).

The European Union has drafted legislation based on EPR for electronics waste. This legislation will phase out the used of mercury, cadmium, hexavalent chromium and two classes of brominated flame-retardants by 2004 and places the financial responsibility on producers to set up collection, recycling and disposal (SVTC, "Just say no", 2001). US trade associations and the Electronics Industry Allianace have expressed strong disagreement with the EU initiative to phase out these substances because they will "impede the development of new technologies, increase costs and restrict global trade in these products." (SVTC, "Just say no", 2001). Clearly the Industry is resistant to making any changes which affect their bottom line. Individual companies may be enticed to be environmental if it sets them apart from their competitors somehow. This is happening with the case of self-regulation.

Self-regulation is an option that is beginning to take hold. This is done through symbols such as Ecolables signifying to consumers that a product meets certain environmental standards. This could put pressure on producers to conform to certain standards in order to receive the approval of the label. A risk, however, is that if the standards companies must meet to use

the labels are not extensive enough, then consumers will have a false sense of security about their purchases. Some producers have voluntarily begun take back used computer programs, however, this is not enough to deal with the substantial amount of waste generated from obsolete electronics equipment. Companies will have to be coerced into EPR through legislation and consumer pressure.

Certainly, it is not in the interests of a company to consider impacts of their products on social gender relations and the environment. The high tech industry has been one of the drivers of globalization, enabling rapid communications and breaking down national boundaries with worldwide computer networks. Ted Smith, the Executive Director of Silicon Toxics Coalition on the Industry:

> "This Industry is driven by a free-for-all frontier ethic of developing markets at any cost and it really rolled over the ability of governments to have any handle at all on how to mange and regulate that growth…I haven't seen very many top executives in the high-tech sector who have even recognized or thought reflectively on the effect they've had." (van Winkle).

Whose responsibility is it then? Consumers? Governments? Activists? Activists have used technology to advocate in the past. They need to have the ear of governments and policies should be adopted to increase producer responsibility. Consumers must continue to be informed and made aware of the ways information is being gathered from online use patterns and the influence they have on the market by choosing products with less environmental and health impacts.

CONCLUSIONS

A feminist environment analysis of the computer industry enables us to trace the ways in which the global high tech industry is reconstructing natural and social relations. Since the dominant conceptualization of nature was changed in the Scientific Revolution, organic, mechanistic, and now cybernetic metaphors have been used to regulate human's interactions with nature and transform environmental resources into products such as computers. Historical processes have led us to function within an environment constructed and mediated by technology.

The analysis presented in this paper is an example of an inter-disciplinary approach, one that is necessary now that global market systems are integrating people from around the world through capitalist relations and information systems. Production and consumption are part of a complex system linking the North and the South together. This integration is also characterized by several enabling and disabling characteristics: greater dependency amongst different groups of women, benefits accrued from technology, and costs resulting from the technology.

1. Greater differentiation and dependency amongst women

Women are pulled into the global production line for several reasons. Women are characterized as the ideal workers, their "nimble fingers" and status as a "reserve army of labour" make it possible for management in the industry to both control women and pay less. Barriers prevent women from moving up into the management of production companies, all the while the industry grows as more work is sub-contracted to the South. Women workers are also stratified by race.

Other types of work are also contacted out to developing countries. Data processing is being done in the Caribbean, changing the identity of the women workers. Their new status as technology workers leads to a preponderance to look and dress the part. Integration into the global production chain influences how they think of themselves and increases their consumption.

At the same time, women occupy a small amount of the positions in the management of firms, and the glass ceiling prevents promotions. Women managers may be as cutthroat as

their male counterparts. Nevertheless, barriers to women's participation in steering the direction of the industry demonstrate how deeply permeated masculinist values are.

All these groups of women are now blended into the global computer industry, incorporated into corporations and restricted against changing their positions as designated by the system. Global high tech consumer capitalism integrates women through a system of the unequal gender relations.

2. Benefits

Technology can create benefits for whoever has access to it. Benefits are increased speed and ease of communication internationally. Activists can coordinate their activities and mobilize resistance movements internationally. Solidarity can be built across national boundaries. Benefits to those working for social justice are limited by the large discrepancy in resources at the disposal of dominant power players versus the activists trying to alter and resist these structures.

3. Costs

The costs to society and the environment resulting from the computer industry are diverse, ranging from a loss of certain ways of operating to the loss of resources for future generations. Methods of communication used before the advent of computer technology are being lost. The encroaching technological processes in everyday life is another price we pay. Costs are what are now less and less possible when technological processes are put in place.

Costs are also tangible, such as the reproductive health risks experienced by women working with the chemicals required to produce computer chips. Costs are the resulting environmental effects of production processes and the waste produced when obsolete technology is discarded.

The integration of all of these factors takes place within this hypermasculinist global computer industry. In attempts to entrench and widen their power, the designers, executives, and shareholders end up increasing the control and surveillance of computer users. Within the market system we can never expect the various actors to work in the best interest of the environment or of women.

What are our alternative pathways?

Most fundamentally, we must continue to engage in dialogues which revision gender, the environment, and markets. The work done in the care economy and the environment are not outside of, but are intrinsic to the sustenance of life itself. Until they are valued as much as economic variables, the exploitation of women's unpaid and undervalued labour and our environment will continue. A lifecycle analysis demonstrates how unequal gender relations and exploitation of the environment are used by the global high tech consumer capitalist system.

What would a feminist environmentalist market look like? A reconnection with systems which sustain life is key. This needs to be done, as Jackson explains, by evaluating social relations and the environment and revaluing them to foster a *human* connection to nature (1995). Technological advances would be driven by a utility for human needs weighed against environmental and social benefits and costs. Responsibility for reproducing and sustaining humans would be shared between men and women. Sustainable production would take place with considerations to providing a living wage for the workers, and special considerations to redressing the unequal distribution of work in the reproductive economy. Environmental and social resources would also be shared equitably. Cleaner processes and less harmful substances would be used in production processes. This can only be done through continued participatory and meaningful participation in decision-making to transform the current relations between men, women, and the environment. Dialogues are necessary so that sustainable production processes work toward gender equality as well.

A lifecycle analysis reveals the spaces available in global high tech consumer capitalism for resistance and transformation of dominant relations today. In the production side of the process, citizens in the North need to continue to lobby their governments for increased regulation of industry labour and environmental practices. Since respecting worker's rights and the environment are not currently incentives within the market system, legislation needs to be drafted to regulate the industry. Simultaneously, if companies are lobbied to encourage the adoption of sustainable production practices, then a climate of corporate responsibility could be fostered.

Women workers in the global electronics industry must be empowered to resist unfair treatment. Women workers demand to have their rights respected in the work places. This

means first recognizing the propensity for Trans National Corporations to take advantage of women. The image of the docile woman work must be transformed. This can be done through collective action and empowering women workers themselves. Women are working in the computer industry because they have little choice to support themselves and their families. This industry is here to stay, it is important that the industry be changed to respect women, for women's health, and for their livelihoods.

The placement of women as ideal consumers in the global market also opens up possibilities for resistance. Consumers need to be informed about how corporations are gathering information about us and then using this information to tailor their marketing strategies. Surveillance is less effective when people know they are being watched, because then steps can be taken to resist the surveyor. If the media uses women as a "target market", then women can come together to define their own values and priorities as consumers and as citizens.

Consumers also need to be aware of the real impacts of global high tech consumer capitalism. Eco-labeling is one solution to this end, however it is not the only one. Consumer awareness also requires changing our approach to nature, fostering international solidarity linkages and evaluating the social and environmental impacts of new technologies. The short life-cycle of computers is also supported by consumers, since we "buy in" to the need for newer technologies. Informing people about the importance of purchasing computers as infrequently as possible and recycling are key. Extended producer responsibility and take-back programmes can also encourage a reduction in resources used for computing.

These strategies would be enabled by clearing houses and activists' centres that do research and activism on the intersections between gender relations and the environment. The Silicon Valley Toxics Commission in California is a good example of an organization using computers to change the power relationships surrounding computers. Centres like this should be located in the South as well, in order to gain from the knowledge of workers in southern production processes, and create more connections between activists working for social and environmental justice around the globe.

Through strategies such as these, production can be sustainable both in terms of gender relations and environmental relations in order to build a reality in which both humans and natural systems are valued.

Bibliography

Ayres, Robert and Leslie Ayres. 1996. Industrial Ecology: Towards Closing the Materials Cycle. Cheltenahm, UK: Edward Elgar.

Armstrong, Nicola. 1995. "Eating and Earning Your Crust Under the Same Roof". New Zealand Geographer 51, (1). 4-5.

Baker, Robin. 1994. "Pioneering Health and Safety: Fighting for Protection for Electronics Workers in the Santa Clara Valley". Behind the Chip. Chee Heng Leng Ed. Safety and Health in Electronics Conference Malaysia, December 1992. 105-116.

Bakker, Isabella. (1998). Unpaid work and Macroeconomics: New Discussions, New Tools for Action. Ottawa: Status of Women Canada.

Birke, Lynda. 2000. "Sitting on the Fence: Biology, Feminism and Gender-Bending Environments" Women's Studies International Forum 23:(5). 587-599.

Braidotti, Rosi et al. 1994. Women, the Environment and Sustainable Development. London: Zed Books.

Camp, Tracy. 2001. "Women in Computer Sciences: Reversing the Trend". Syllabus web site. Downloaded October 2001. www.syllabus.com

Canadian Broadcasting Corporation. 2001. "Manitoba electronic recycling program could cost consumers". Canadian Broadcasting Corporation web site. Downloaded November 9th, 2001. www.cbc.ca/cgi-bin/template…1/11/08/Consumers/recycleTV_011108.

Canadian Coalition of Women in Engineering, Science and Technology. "Statistics Regarding Women's participation in Engineering at University level". Downloaded November 10, 2001. http://www.ccwest.org/english/numbers/stats.html.

Chhachhi, Amrita. 1999. Gender, Flexibility, Skill and Industrial Restructuring: The Electronics Industry in India Institute of Social Studies Working Paper Series No. 296. The Hague: Institute of Social Studies.

Charkiewicz, Eva. et al. 2001. Transitions to Sustainable Production and Consumption: Concepts, Policies and Actions. The Netherlands: Shaker Publishing.

Corpwatch. 2001. Corpwatch web site. Downloaded November 11, 2001. www.corpwatch.org

Egido, Carmen. 2001. "Women at the Frontiers of Technology." Intel web site. Downloaded October 28, 2001. www.developer.intel.com/technolgy/itj/q32001/foreword.htm.

Economist. 2001. "The Internet, unteathered". The Economist, October 13, 2001: 3-25.

Elliot, Jennifer. 1994. An Introduction to Sustainable Development: The developing world. London: Routledge.

Environmental Illness. 2001. “Health issues with flame retarding chemicals in computers and consumer electronics” Environmental Illness web site. Downloaded October 28, 2001. http://stores.us.ohio-state.edu/~steen/ei/flame_retardants.html.

Environmental Protection Agency. 2001. “What is the Toxics Release Inventory?” Downloaded November 11, 2001. www.epa.gov/tri/general.htm.

Eriksson, Inger, Barbara Kitchenham and Kea Tijdens Eds. 1991 Women, Work and Computerization: Understanding and Overcoming Bias in Work and Education. Amsterdam: Elsevier Science Publishers B.V.

Eskenazi, Brenda. 1994. “Chipping Away at Health: Two Research Studies on the Reproductive Health of Women Electronics Workers” Behind the Chip. Chee Heng Leng Ed. Safety and Health in Electronics Conference Malaysia, December 1992. 57-66.

Everts, Saskia. 1998. Gender and Technology: Empowering women, engendering development. London: Zed Books.

Featherstone, Mike. 1991. Consumer Culture and Postmodernism. London: Sage Publications.

Fisher, Jim. 2000. “Poison PCs”. Salon web site. Downloaded September 24th, 2001 www.salon.com/tec/feature/2000/09/18toxic_pc/print.html

Folbre, Nancy et al. 1992. Women’s Work in the Global Economy. London: The MacMillan Press Ltd.

Freeman, Carla. 2000. High Tech and High Heels in the Global Economy: Women, Work, and Pink Collar Identities in the Caribbean. London: Duke University Press.

Gates, Bill. 1995. The Road Ahead. London: Viking.

Gebeloff, Robert. 1999. “The True Story about who Invented the Internet” The North Jersey Record web site. Downloaded January 16, 2002. http://www.bergen.com/biz/geb0405199904054.htm

Gil-Seong, Yang. 1994. “Action for Health: The Struggle for Safety and Health of Electronics Workers in Korea” Behind the Chip. Chee Heng Leng Ed. Safety and Health in Electronics Conference Malaysia, December 1992. 117-124.

Goodman, Sara. 1987. “The Implications of Computerization and Microelectronics on Women’s Employment in South-east Asia”. Technology and Gender: Women’s Work in Asia Cecilia Ng. Selangor, Malaysia: Women’s Studies Unit, Universiti Pertanian Malaysia. 64-83.

Harding, Sandra. 1991. Whose Science? Whose Knowledge?: Thinking from Women’s Lives. Open University Press: Buckingham.

Haraway, Donna. 1991. Simians, Cyborgs, and Women: The Reinvention of Nature. London: Free Association Books.

Haraway, Donna. 1995 “The Virtual Spectrum in the New World Order”. The Gendered Cyborg: A Reader. Gill Kirkup Ed. New York: Routledge. 221-246.

Haug, Wolfgang. 1986. Critique of Commodity Aesthetics: Appearance, Sexuality and Advertising in Capitalist Society. Cambridge: Polity Press.

Heyzer, Noeleen Ed. 1998. Daughters of Industry: Work Skills and Consciousness of Women Workers in Asia. Kuala Lumpur: Asian and Pacific Development Centre.

Hong, Evelyne. 1995. “Women as consumers and producers in the world market”. Third World Resurgence 61/62, September/October.

Hossfeld, Karen. 1990. “’Their Logic Against Them’: Contradictions in Sex, Race, and Class in Silicon Valley”. Women Workers and Global Restructuring. Kathryn Ward: Cornell: ILR Press.

How Stuff Works. 2001. “How Microprocessors Work” How Stuff Works web site. Downloaded October 29, 2001. www.howstuffworks.com/microprocessor1.htm.

Intel. 2001. Intel web site. Downloaded November 11, 2001. www.intel.com

Jackson, Cecile. 1995. “Gender Analysis and Environmentalisms.” Social Theory and the Global Environment. Michael Redclift and Ted Brown eds. London: Routledge. 113-149.

Latour, Bruno. 1993. We Have Never Been Modern. New York: Harvester Wheatsheaf.

Leng, Chee Heng Ed. 1992. Behind the Chip. Proceedings of the Conference on Safety and Health in Electronics, Petaling Jaya, Malaysia December, 1992. Kuala Lumpur: Women’s Development Collective and Persatuan Sahabat Wanita.

Leng, Chee Heng and Mano Subramaniam. 1994. “Speaking Out: Women Workers Talk About Safety and Health in electronics”. Behind the Chip. Chee Heng Leng Ed. Safety and Health in Electronics Conference Malaysia, December 1992. 81-104.

Lyon, David. 1994. The Electronic Eye: The Rise of Surveillance Society. Cambridge: Polity Press.

Mann, Judy. 1998. “A Hard Look at the Health of Working Women” Washington Post. Friday, September 18.

Marcelle, Gillian. 2000. “Transforming Information and Communications Technologies for Gender Equality.” New York: United Nations Gender in Development Monograph Series #9.

Mellor, Mary. 1997. “Women, Nature and the Social Construction of Economic Man.” Ecological Economics. V. 20: 129-140.

Merchant, Carolyn. 1980. The Death of Nature: Women, Ecology and the Scientific Revolution. San Francisco: Harper and Row.

Miller, Daniel. 1995. “Consumption as the Vanguard of History” Acknowledging Consumption. Daniel Miller, Ed. London: Routledge. 1-57.

Mirick, John. 1996. "William H. Gates III: Before Microsoft." web site Downloaded November 11, 2001. http://ei.cs.vt.edu/~history/Gates.Mirick.html

Mitter, Swasti and Sheila Rowbotham Eds. 1995. Women Encounter Technology: Changing Patterns of Employment in the Third World. London: Routeldge.

Molktke, Konrad von et al. 1998. "Semiconductors from the Philippines." Environment and Trade. United Nations Environment Programme: Geneva.

Ng, Cecilia. 1987. Technology and Gender: Women's Work in Asia. Kuala Lumpur: Women's Studies Unit, Department of Extension Education, Universiti Pertanian Malaysia.

Ng, Cecilia and Anne Munro-Kua Eds. 1994. Keying into the Future: The Impact of Computerization on Office Workers. Kuala Lumpur: Women's Development Collective and Women's Studies Unit, Universiti Pertanian Malaysia.

Nua. 2001. "Six Types of Women Who Use the Net" Nua Internet Surveys web site. Downloaded November 13, 2001. www.nua.ie/surveys/?f=VS&art_id=905355414&rel=true.

Nua 2. 2001. "Women see glass ceiling in tech sector". Nua Internet Surveys web site. Downloaded November 13, 2001. http://www.nua.ie/surveys/index.cgi?f=VS&art_id=905356851&rel=true

Perlas, Nicanor. 2000. "Civil Society, the Third Global Power: The Collapse of the WTO Agenda in Seattle". Southern Cross Review web site. Downloaded November 11, 2001. http://www.southerncrossreview.org/4/wto.html)

PBS. 2001. "Triumph of the Nerds: The Television Program Transcripts Part 1" PBS web site. Transcript. Downloaded November 10, 2001. http://www.pbs.org/nerds/part1.html

Poling, Samantha. 2001. "Women Workers Not Told of Miscarriage Risk." Silicon Valley Toxics Comission web site. Downloaded September 24, 2001 www.svtc.org/hu_health/natsem/grenbase.htm.

Plant, Sadie. 1999. "On the Matrix: Cyberfeminist Simulations". The Gendered Cyborg: A Reader. Gill Kirkup Ed. New York: Routledge. 265-275.

Wajcman, Judy. 1991. Feminism Confronts Technology. Polity Press: Cambridge.

Sach, Wolfgang. 1999. Planet dialectics: explorations in environment and development. London: Zed Books.

Sark, MacKenzie. No date. "The Information War" Downloaded November 19, 2001. www.mcs.mq.edu.au/Staff/mwark/warchive/21*C/21c-cyberwar.html.

Wichterich, Christa. 2000. The Globalized Woman: Reports from a Future of Inequality. London: Zed Books.

Rasiah, Rajah. 1994. "Trends and Implications of the Electronics Industry in Malaysia" Behind the Chip. Chee Heng Leng Ed. Safety and Health in Electronics Conference Malaysia, December 1992. 11-30.

Rothschild, Joan Ed. 1983. Machina Ex Dea: Feminist Perspectives on Technology. New York: Pergamon Press.

Theobald, Sally. 1999. "New International Division of Labour, New Occupational Health Hazards: Community responses to the electronic industry in Thailand" Development (42) 4, p. 126-129.

Shiva, Vandana. 1999. Staying Alive: Women, Ecology and Development. London: Zed Books.

Silicon Valley Toxics Coalition. 2001. "Just Say No to E-Waste: Background Document on Hazards and Waste from Computers" Downloaded September 24, 2001. www.svtc.org/cleancc/pubs/sayno.htm

Silicon Valley Toxics Coalition. 2001. "Poison PCs and Toxic TVs: California's biggest environmental crisis that you've never heard of." Downloaded September 24, 2001. www.svtc.org.

Stranahan, Susan. 2002 "The Clean Room's Dirty Secret." Mother Jones April, 44-49.

Thomas, Neal. 2001. Personal Communication via email. November 13, 2001.

Tom's Hardware Guide. 2001. Tom's Hardware Guide web site. Downloaded November 11, 2001. http://www6.tomshardware.com/graphic/index.html

Toole, Betty Alexandra. 1996. "Ada Byron, Lady Lovelace, An Analyst and Metaphysician" Annals of the History of Computing web site. Downloaded January 16, 2001. http://www.computer.org/annals/an1996/a3004abs.htm

Wichterich, Christa. 2000. The globalized woman : reports from a future of inequality London: Zed Books.

Women Haulting Online Abuse. 2001. Women Haulting Online Abuse web site. Downloaded November 11, 2001. www.whoa.org

Women Working Worldwide Ed. 1991. Common Interests: Women Organizing in Global Electronics. London: Women Working Worldwide.

Women's Space. 2001. "Internet Activism". Women's Space web site. Downloaded November 11, 2001. http://www.womenspace.ca/Campaign/Activism/activistways.html.

Van Winkle. 2001. "War On High-Tech Waste." Smart Computing web site. Downloaded October 24, 2001 www.smartcomputing.com/email.asp?emid=45937.

Von Moltke, Konrad et al. 1998. Global Product Chains: Northern Consumers, Southern Producers, and Sustainability. Environment and Trade 15. Geneva: United Nations Environment Programme.

Xavier, Irene. 1994. "'Clean' but Not Safe: Working Conditions of Electronics Workers in Malaysia". Behind the Chip. Chee Heng Leng Ed. Safety and Health in Electronics Conference Malaysia, December 1992. 31-38.