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WORKING AT HOME AND SUSTAINABLE LIVING: ARCHITECTURE AND PLANNING IMPLICATIONS

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June, 1995

A thesis submitted to
the Faculty of Graduate Studies and Research
in partial fulfilment of the requirements of the degree of
Master of Architecture

ISBN 0-612-07914-7

Canada

ACKNOWLEDGMENTS

I would like to acknowledge the wisdom, patience and encouragement of Dr. Avi Friedman, which he generously afforded me through the course of this thesis.

I thank the students of Minimum Cost Housing, Domestic Environments and Affordable homes. They have enriched my time in Montreal and the experience of writing this thesis. I thank Sharif Senbel who has continuously rejuvenated my excitement towards architecture. I am grateful to the people who took the time to reply to my questionnaire, and the home workers who patiently allowed me to gain invaluable insight through their personal accounts. The authors and researchers who have laid the foundations of sustainability have provided me with a wealth of knowledge and a source of great inspiration. Without their pioneering work this thesis would not have been possible.

Last, but certainly not least, I am indebted to Wagdi Senbel and Fadila Basha who have brought me into this world and have helped me in more ways than I will ever know.

WORKING AT HOME AND SUSTAINABLE LIVING: ARCHITECTURE AND PLANNING IMPLICATIONS

ABSTRACT

The goal of this thesis is to determine the correlation between the practice of working at home and the theoretical needs of sustainable living. The author presents a brief synopsis of the present theories of sustainability which he then uses as an evaluative backdrop for the study. Urban transport, architectural design and quality of life issues are addressed. The author conducted an extensive literature review, several case studies and a survey. Conclusions drawn from these studies were used to attempt to envision sustainable home working communities.

It was found that sustainability was directly related to whether the home worker telecommutes or operates a home-based business. Home-based business owners continue to be heavily reliant on automobile transportation, while telecommuters make fewer overall trips and travel shorter distances than conventional commuters. Although neither work type demands significant changes to the infrastructure of the typical residence, home-based businesses require more space and more attention to design. Telecommuting has potential adverse side effects of personal isolation and physical strain. To ensure the sustainability of working at home, the practice must be adopted as an integral part of a larger transformation on the scale of the local community.

ENTREPRISE À DOMICILE ET CONSÉQUENCES EN MATIÈRE D'ARCHITECTURE ET DE PLANIFICATION POUR UN MODE DE VIE VIABLE

RÉSUMÉ

La thèse a pour but de déterminer le lien entre le travail à domicile et les besoins théoriques de viabilité de cette existence. L'auteur présente une brève synopsis des théories actuelles de viabilité qu'il emploie ensuite comme toile de fond évaluative pour l'étude. Dans ce travail, il étudie les questions de transport urbain, de la conception architecturale et de la qualité de vie. L'auteur a effectué une étude étendue de la documentation, plusieurs études de cas et un questionnaire. Les conclusions tirées de ces études ont servi de base à un essai de concevoir des communautés viables où le travail à domicile est la norme.

Cette étude a mis à jour le fait que la viabilité dépend de certains facteurs: la personne travaillant à domicile est-elle un télétravailleur ou a-t-elle une entreprise de son domicile. Les propriétaires travaillant à domicile continuent d'être très dépendants du transport automobile tandis que le télétravailleur effectue moins de trajets en général et parcourt des distances moins importantes que les navetteurs habituels. Bien qu'aucune de ces formes de travail ne demande de changements majeurs de l'infrastructure de la résidence typique, les entreprises à domicile requièrent plus d'espace et plus d'attention sur le plan de la conception architecturale. Le télétravail a des effets secondaires potentiels négatifs d'isolement personnel et de stress physique. Pour assurer la viabilité du travail à domicile, il faut le considérer dans le cadre d'une plus grande transformation à l'échelle de la communauté locale.

CONTENTS

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CHAPTER ONE : INTRODUCTION

There are many indications that the practice of working at home is increasing throughout North America.[1] The current separation between areas of living and those of working, within the typical North American city, suggests that a shift towards physically combining the two functions will fundamentally alter the workings of the built environment. This thesis attempts to qualify these changes. It explores the effects that working at home may have on the design of residences and residential communities.

The state of the world's natural environment as portrayed in contemporary literature demands an analysis of the sustainability of any new or current trend that affects the physical realm. A superficial look at the practice of working at home, suggests that it is more sustainable than conventional work patterns in that it reduces the need for human transport, therefore saving the resources that would otherwise go into that transport. This thesis explores the sustainability of working at home in a probing fashion that touches upon several areas of study. Issues from both the macro-scale, such as urban and transportation implications, and the micro-scale, such as architectural and personal implications will be discussed.

Although the notion of sustainability is used as a backdrop for the study of home work, it actually acts as a catalyst for the discussion. The ultimate aim of the thesis is to discover how the marriage of the notion of sustainability with the practice of working at home would affect the design of residences and residential communities. To ground the discussion in the reality of today's urban environment, some discussion of the city as a whole will follow. It is hoped that this research will provide designers and planners with some insight into a lifestyle that is becoming increasingly popular, and that it will do so from the viewpoint of a theory of sustainability that is becoming increasingly essential for the survival of life as we know it.

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[1] Chapter Three (p. 39) will demonstrate that the number of full time home workers has been steadily increasing over the last five years

Research Objective

Primary research question:

> **How do concepts of sustainable living influence the design of home offices and home office communities?**

Research sub-questions:

> What are the demands of sustainability on the architectural design and planning of residential communities?
>
> What elements of sustainability does home working achieve?

Rationale

> "Hidden inside our advance to a new production system is a potential for social change so breathtaking in scope that few among us have been willing to face its meaning. For we are about to revolutionize our homes as well."[1]

Toffler proposes that we are about to undergo a societal change of such enormous proportions that it is unprecedented throughout human history. He talks of the coming of the information age where the productivity of an economy is directly related to its access to information. Efficiency would be vastly improved through the availability of up to date relevant information about everything affecting the manufacture of a product or provision of a service. Integral to the network of information is the image of the human being united with a computer. Communications technology has freed the computer from having to be physically close to other computers and in turn has allowed humans a greatly expanded choice of where they choose to live.

When this technical capability is coupled with the societal imperative of sustainability, it follows that a logical place of employment is the home. Working at home, the bread winners of the family would be able to maintain full electronic contact and communication with their peers, while spending less time traveling back and forth to work,

[1] Alvin Toffler, The Third Wave (New York: William Morrow and Company, Inc., 1980)

and more time with their families. Toffler coined the term the *electronic cottage.* It describes an ideal for the home of the future: a center of family unity and happiness, and a center for communication with the rest of the world.

> "Watching masses of peasants scything a field three hundred years ago only a madman would have dreamed that the time would soon come when the fields would be depopulated, when people would crowd into urban factories to earn their daily bread. And only a madman would have been right. Today it takes an act of courage to suggest that our biggest factories and office towers may , within our lifetimes, stand half empty , reduced to use as ghostly warehouses or converted into living space. Yet this is precisely what the new mode of production makes possible: a return to cottage industry on a new higher electronic basis, and with it a new emphasis on the home as the center of society."[1]

This image of the home and society is rather seductive in its promise of a bright and harmonious future. It suggests that today's societal and environmental problems could be eliminated in a single massive sweep of information technology. The author embarked on the research for this thesis with the desire to inject a dose of reality into this otherwise rosy imagery. The author sought to discover whether this envisioned electronic cottage is indeed a possibility, and if so, is it sustainable? What seemed even more critical in fueling the flame of research was the extent to which working at home would render the North American lifestyle more sustainable.

These questions are broad and on the surface seem more akin to sociological research than they are to architectural research. Nevertheless, answers to these questions have profound implications that touch upon every aspect of human life. The built environment would undoubtedly be affected, if not altogether revolutionised, by a widespread adoption of home-based work.

The author hopes to synthesize the possibilities of working at home with a vision of a more sustainable way of living in North America. The relevance of this study

[1] Ibid.

lies in the reality of the forces of economics and sustainability, as well as in the ever present progression of technology. By understanding the factors that make home employment so appealing a solution to some of society's excessive transportation consumption, and by exploring the implications of such a transformation in our daily living patterns, we will be better equipped to facilitate, limit or regulate, and ultimately design, home offices and home working communities.

Method of discovery

The compilation of this thesis will take advantage of a variety of different sources of information. The final synthesis of gathered data will be in flowing prose form. Each chapter will explore a different dimension of the central theme and will freely borrow from the information gathered under that central theme, but will also generate its own research demands as its contents unfold.

The study begins with a selective literature review on sustainability and an extensive literature review on home employment, with specific concentration on the areas affecting residential and neighbourhood design. The literature review was supplemented by case studies of several functioning home offices that were chosen to represent the different scenarios of working at home. Included in the home office case studies is the range of locations, architectural typologies and occupational categories that typify North American home office scenarios. These studies were in turn supplemented by a number of interviews of home workers and individuals that are either experienced or knowledgeable in the field. These are intended to function as illustrators of particular issues and not as a source of statistical information. A short questionnaire was also sent out to *internet* users to shed some light on the possible future migration patterns of information workers.

The six home office case studies fall under the following categories of location, architectural type and occupational category. They will be referred to in the thesis by their respective location labels. For example, the home office that is located in Vancouver will be referred to as the Vancouver home office.

Vancouver	City centre	Condominium	Home-based consultant
East Vancouver	City	Duplex	P/time home-based business
Richmond	Suburb	Single-family home	Home-based business
West Vancouver	Suburb	Single-family home	Telecommuter
Tofino	Rural	Cottage	Home-based business
Montreal	City centre	Apartment	Self employed

Fig. 1. Home office case studies

The thesis will follow the following structure. Chapter two will lay the foundations on which the remainder of the thesis will be built. It will present an argument for the pertinence of environmental sensitivity and the resultant importance of sustainability. The notion of sustainability will be defined. Beginning with a global perspective and progressively narrowing the focus towards local issues, the author will present directives for sustainable development, sustainable planning and sustainable architecture. The chapter will conclude with a table of directives that will be used as a reference in subsequent chapters.

Chapter three will begin by defining home work. The various types of home work will be briefly discussed; followed by a synopsis of the latest estimates of the proliferation of home work. This section adds pertinence to the entire thesis by demonstrating the recent increase in the number of people who currently work at home. An analysis of empirical evidence on telecommuters' changing patterns of travel will then follow. The societal significance of these changing patterns will be presented in light of energy and pollution savings.

The potential for home work to become an integral part of society will ultimately depend on the economic viability of home offices relative to conventional offices. Furthermore, sustainability demands, as will be seen in chapter two, necessitate efficiency and reduced consumption and waste. Hence the potential savings that can be achieved as a

result of working at home are of great significance to this thesis. These will be presented at the end of chapter three.

In chapter four the specific requirements of bringing an office into the home will be discussed. Findings drawn from the home office case studies will be presented to illustrate issues of architectural design. The overall location of the home office within the home will be addressed. Issues of public access, circulation and the relationship to other rooms will be discussed. Having defined the boundaries of the office, analysis will then move to the internal requirements of the office. Space demands and constraints will be followed by the infrastructure needs of the home office. The chapter will conclude with a brief analysis of the sustainability implications of the evolved house.

The personal needs of the human being become the focus of attention in chapter five. Quality of life issues will be addressed. Workers' satisfaction in light of productivity changes and financial well being will be used to reflect the quality of work life. The quality of home life, on the other hand, will be seen through family dynamics and role conflicts. Last but certainly not least, the health of the home worker, both physically and mentally will be discussed. This will shed some light on certain issues of social isolation and physical strain.

Chapters three to five will uncover many issues related to working at home along several scales ranging from that of the city to that of the home and the individual. These issues will bring forth a set of recommendations on the various scales. Together these will contribute to creating an image of what a sustainable home working community may ultimately look like. This manifestation will be the subject of chapter six. In attempting to assess the sustainability of home work, it was considered important to attempt to envision what the totality of recommendations made concerning sustainable home work would entail, and whether this totality is in itself sustainable. The following figure summarises the structure of the thesis as it is described above.

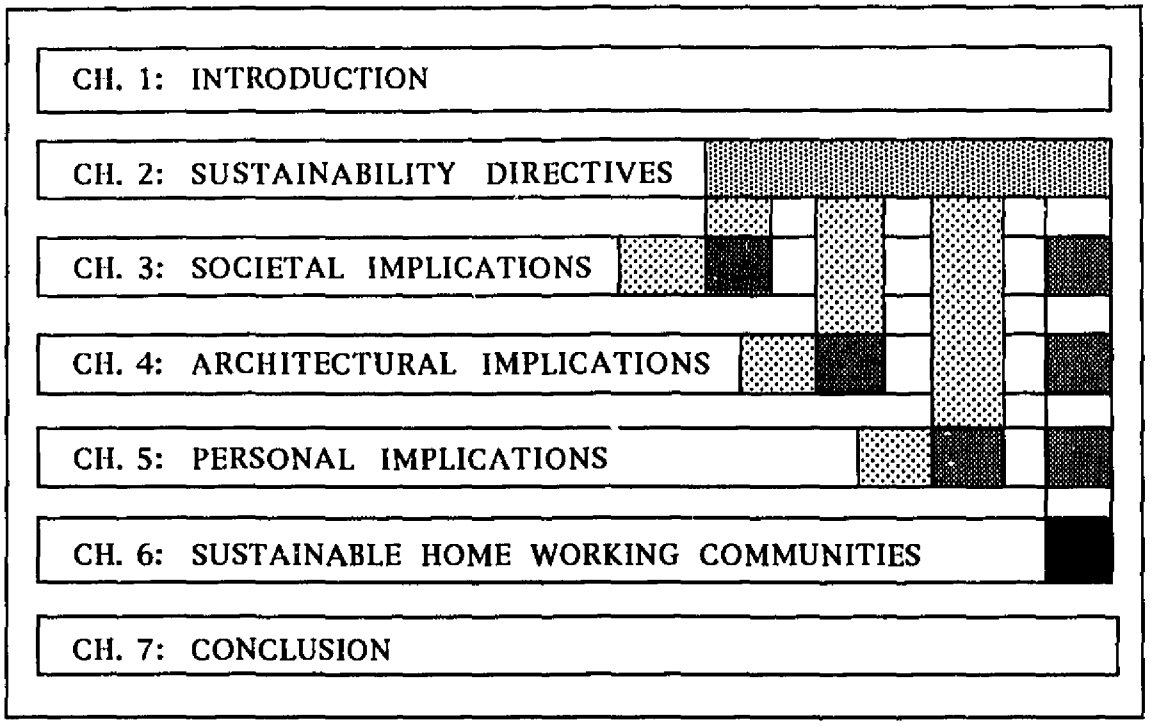

Fig. 2. The structure of the thesis. Lighter shades represent influence and darker shades represent content.

Scope

This study will be limited in scope to the North American continent. All the research conducted and all the data collected will either be derived from North American sources or will be directly applicable to North American conditions. The larger portion of existing research and experiments in home work has been undertaken in the United States. To the extent to which Canada and the United States converge on the issue at hand, findings concerning one country will be considered to concern the other. In the cases in which a particular circumstance is unique to a specific location it is treated as such.

Working at home is a pattern of living and working that is as old as society itself, but this thesis will be limited to the study of the modern re-emergence of this lifestyle as enabled by contemporary information technology. In seeking to overlay a living pattern that is currently unconventional in its spatial combination of living and working with concepts of sustainability, this study will inherently venture into future scenarios that remain largely speculative.

CHAPTER TWO : SUSTAINABLE LIVING

This chapter will present a rationale for the inclusion of sustainability as a major reference during the course of the thesis . It will also provide sustainability criteria that will help evaluate the many issues of working at home as they surface during the discussion. Beginning with a global overview of the natural systems upon which we are inherently dependent, and gradually moving to the scale of individual buildings, this chapter will attempt to demonstrate the importance of sustainability and will then define it in both theoretical and practical terms.

The Limits of the Earth

Fundamental to the appreciation of the human predicament on earth, and the position of the earth in the universe, is our understanding of the law of entropy.[1] Entropy is explained in Newton's second law of thermodynamics which touches upon every physical event that has ever occurred in the universe. Every time an action occurs, there is a transfer of energy from one object to another and a certain amount of energy is lost in the form of heat. This lost energy is termed *entropy* or *chaos*, and it can never be recovered again as usable energy. According to this theory, with every passing moment the total amount of entropy in the universe is increasing and the total amount of available energy is decreasing.[2]

Regardless of the precise limits of the universe, the finite nature of the planet, coupled with our understanding of the ever increasing nature of entropy, indicates that the amount of available energy on the earth is limited. Although it is the eventual cooling and dimming of the sun that will cause the demise of the earth as we know it, other essential life-giving resources such as food and water are likely to threaten earthly

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[1] This is Newton's third law of thermodynamics. The implications of this law are discussed at great length in Jeremy Rifkin's Entropy: Into the Greenhouse World (New York: Bantam New Age Books, 1989)

[2] Jeremy Rifkin, Entropy: Into the Greenhouse World, (New York: Bantam New Age Books, 1989) 47-59

livelihood much sooner.[1] It is our use of these resources that will ultimately determine the longevity of life on earth. Shnaiberg and Gould consider the entire foundation of today's industrial society to be based upon a socio-economic system that is in direct contradiction to the laws of thermodynamics.[2] Philosophical discussions of industrialism, and the parallel consumerism, render modern society as a machine bent on growing exponentially and indefinitely in order to maximize its output. In the end it will run out of fuel, and stall.

A number of authors have written about our proximity to the limits imposed on us by the carrying capacity of the earth.[3] This capacity is a function of four distinct yet inseparable factors; resources, population, consumption and waste production.[4] These relate in the following way. The more people there are, the larger the demand on a finite amount of resources; and the more these people consume, the less time they have before the resources will run out. The production and discarding of waste, especially when it poisons vital fluids, further restricts the ability of the earth to support human life. Once the resources are exhausted, the population will inevitably decline and so too will the average amount of resources available for each surviving individual. The case is such today that the earth's population is rising exponentially, while the resources upon which this population is inherently dependent are dwindling (Fig. 3).

Fossil fuels, our primary source of energy today, are reaching depletion.[5] Top soil, which is essential for the cultivation of food, is being eroded from all the regions of the world due to deforestation and desertification.[6] In addition rapid urban

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[1] Robert W. Kates, Sustaining life on Earth, Scientific American, October 1994, 114

[2] Allan Schnaiberg and Kenneth Gould maintain that the laws of thermodynamics are the basic principles that govern the natural environment and their opposition is the source of an enduring conflict. Environment and Society (New York: St. Martin's Press, 1994) 6

[3] These authors include Brundtland (1987), Angell (1990), Ramphall (1990), McKibben (1989), Meadows (1992), Goodland (1992) and Schnaiberg (1994)

[4] Sandra Postel defines the carrying capacity as "the largest number of any given species that a habitat can support indefinitely" State of the World 1994 (New York: W.W. Norton and Company, 1994)

[5] Meadows, Meadows and Randers (1992) analyse the state of the world's fossil fuels; oil will be the first to become depleted, natural gas is the cleanest and coal will last the longest.

[6] Ghillian T. Prance, Deforestaion: a Botanist's View, Sustaining Earth, ed. by David Angell (London: Macmillan Academic and Professional, Ltd., 1990) 57. According to the United Nations Environmental Program, every year six million hectares of previously productive land loses its

growth in cities throughout the world is causing further displacement of arable land. Meanwhile a large portion of existing farmland soil is losing its fertility due to erosion, salination and monocultivation.[1]

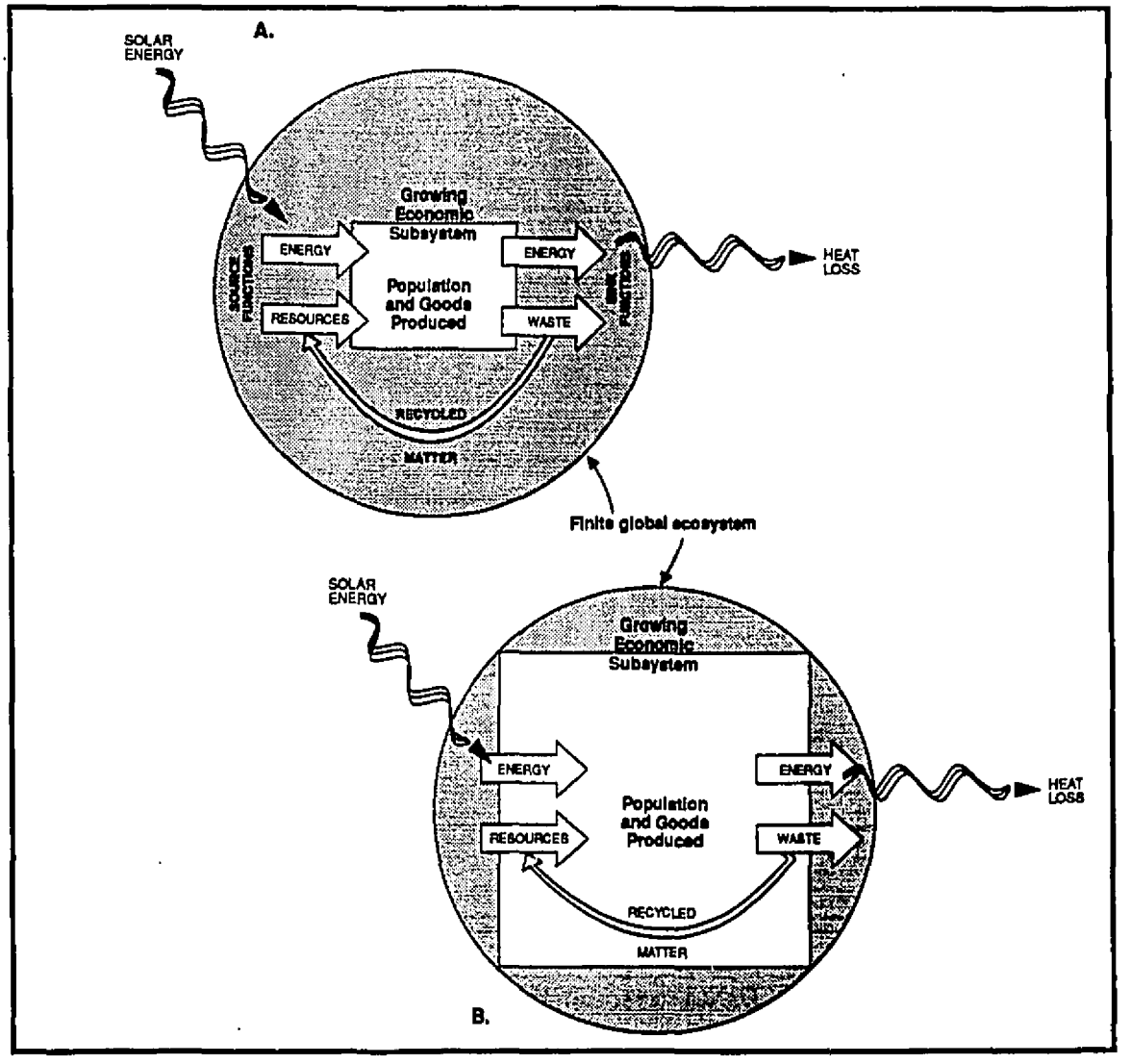

Fig. 3. The limits of the earth and their relationship to throughput of resources, from Robert Goodland, Population Technology and Lifestyle (Washington: Island Press, 1992) 6

capacity to produce food, costing 42.3 billion dollars (1992 prices) in lost productivity, Nick Middleton, Atlas of Desertification, UNEP (London: Edward Arnold, 1992)

[1] Sandra Postel, State of the World: 1994, ed. Lester R. Brown (W.W. Norton & Company, New York,1994) 3-12, and Robert Goodland, Population Technology and Lifestyle (Washington: Island Press, 1992) 13.

In 1986 Vitousek et al. estimated that we are already using about 40% of the earth's products of photosynthesis on land.[1] If, in accordance with U.N. estimates the world's population doubles by the year 2015, then we are only about thirty years away from reaching the limit of global environmental fertility.[2] Parallel to the decrease in resources is an equally ominous increase in waste production throughout the world. According to Meadows et al. each resource used by the human economy is not only limited by its sources but also by its *sinks*.[3] The sinks are those physical systems that are relied upon to absorb the wastes produced by the use of resources. The waste is both biological, such as fecal matter, and industrial, such as carbon monoxide and spent uranium. As the sinks approach their limits the toxicity of the waste that they absorb begins to poison vital ecosystems including human habitats.

Water supplies around the world are being contaminated by a myriad of pollutants. The Rio Grande-Rio Conchos water system in Mexico for example, is being devastated by "cyanide and acid from mines, silt from overgrazed rangeland, nuclear waste from New Mexico's Los Alamos National Laboratory, and human waste from the impoverished cities that line the (U.S.-Mexico) border."[4] The extent of the problem is demonstrated by the quantities of dangerous impurities that are turning up in drinking water supplies. A recent study conducted in Ontario found that 62% of 422 samples of surface water used for public drinking water supplies, contained an agricultural herbicide.[5] In 1993, 370,000 people in Milwaukee, Wisconsin, contracted diarrhea from a parasite found in municipal tap water. It was believed that the parasite originated from either human or cattle waste.[6]

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[1] Peter M. Vitousek et al., Human Appropriation of the Products of Photosynthesis, BioScience, 34(6) 1986, 368-373

[2] Lester Brown, State of the World: 1995, (W.W. Norton & Company, New York,1994) 3.

[3] Meadows, Meadows and Randers, Beyond the Limits (Post Mills, Vermont: Chelsea Green Publishing Company, 1992) 45

[4] World Resources Institute, 1994 Information Please Environmental Almanac, (Boston: Houghton Mifflin Company, 1994) 70

[5] Ibid. 72

[6] Ibid. 73

The oceans of the world which, aside from providing us with an important source of food, "have irreplaceable roles in global climate and biological diversity, " are also threatened.[1] A number of signs indicate that even the seemingly inexhaustible oceans are reaching their limits of waste absorption. Nutrients and sediments from human, agricultural and industrial waste, are providing nourishment for harmful algae that cloud coastal waters and in turn kill marine life.[2] Weber describes the oceans of the world as the ecological keel of the biosphere. They play a major role in stabilizing the earth's atmosphere. With that understanding not only are we losing the valuable fish stocks upon which countless coastal communities are dependent, but we also run the risk of tipping the delicate balance of the biosphere, and drastically altering global weather systems.

In addition to the vital purity of water bodies themselves, of paramount importance is the hydraulic cycle of evaporation, cloud formation and precipitation; for this is one of the primary building blocks of life. Human intervention has also made its way into this cycle. Gaseous industrial waste, such as sulfur dioxide, which is the primary source of acid rain, is dissolved by airborne moisture which eventually falls as rain water. Acid rain slowly alters the acidity of water bodies and much more rapidly destroys forest ecosystems.

Gaseous pollutants also have other more potent side effects that are taxing the ability of the atmosphere to absorb waste. Chlorofluoracarbon emissions (CFCs) for instance, are the subject of great concern because of their ozone destroying properties. "One CFC-spawned atom can catalyze the destruction of 100,000 ozone molecules".[3] The destruction of the ozone layer allows the admittance into the earth's atmosphere of previously shielded harmful ultra-violet radiation from the sun. The effects of which

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[1] Peter Weber, State of the World: 1994, (New York: W.W. Norton & Company, 1994) 41-45

[2] Peter Weber, State of the World: 1994, (New York: W.W. Norton & Company, 1994) 41-45, and World Resources Institute, 1994 Information Please Environmental Almanac, (Boston: Houghton Mifflin Company, 1994) 319-322

[3] World Resources Institute, 1994 Information Please Environmental Almanac (Boston: Houghton Mifflin Company, 1994) 334

include increased rates of skin cancer in humans, as well as a decrease in the ability of many plant species to photosynthesize.[1]

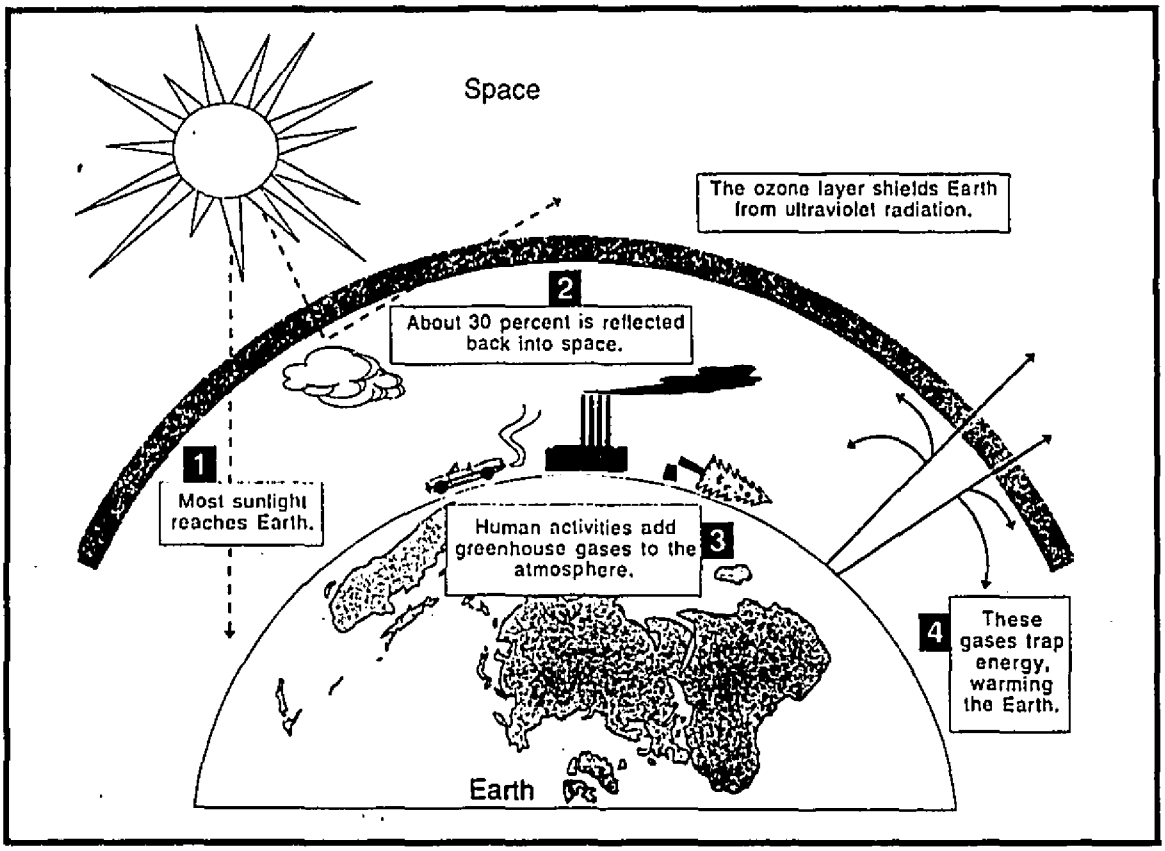

Fig. 4. The greenhouse effect, from World Resources Institute, 1994 Information Please Environmental Almanac, 343

The passage of ultra-violet light into the earth's atmosphere further exasperates a phenomenon which poses an even greater threat to global ecology. This is the greenhouse effect. Carbon dioxide emissions produced by the burning of fossil fuels in factories and automobile combustion engines rise into the atmosphere where the gas has a life span of up to five hundred years. Once in the upper atmosphere, carbon dioxide, along with other gases such as methane and nitrous oxide, traps some of the heat energy leaving the earth (Fig. 4). Over time, the accumulation of this heat will cause *global warming*. Even though the average air temperature increase is only expected to be 1.5°c to

[1] World Resources Institute, 1994 Information Please Environmental Almanac, (Boston: Houghton Mifflin Company, 1994) 344

4.5°c over the next fifty years, this increase is sufficient to melt enough Arctic ice to raise sea level by three to ten feet. Needless to say this will devastate coastal cities and communities. Global warming will also increase desertification in many regions of the world that are already short of fresh water supplies.[1]

By now it should be evident that we are approaching the limit of the earth's ability to support our current human practices. Meadows et al. clearly state that "human society is now using resources and producing wastes at rates that are not sustainable." In fact, they go on to say that if current trends in growth of population and industrialization continue unabated then we will reach the earth's limit within the next one hundred years. They do not however conclude on a negative note. Using a sophisticated global modeling program developed at MIT, they claim that such excessive rates of consumption are not necessary, and that the "quality of life" can be maintained and even improved with sufficient changes in industry, government and transportation.[2]

A similar optimism was shared by the World Commission on Environment and Development, otherwise known as the Brundtland Commission, at the close of its final meeting in Tokyo. The commission was constituted as an independent body of the United Nations in 1984 to address the global environmental predicament. The Tokyo Declaration stated that it was still "possible to build a future that is prosperous, just and secure."[3] The commission does state however that such a future can only be realized if all the nations of the world adopt *sustainable development* as a primary objective, and accordingly adapt both their internal and external governmental policies.

Since the publication of the report of the World Commission on Environment and Development, countless authors, both academic and popular, have addressed the pressing issues of *sustainability*. The theory has therefore emerged as a

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[1] Nick Middleton, Atlas of Desertification, UNEP ((London: Edward Arnold, 1992) 6

[2] The"World3" computer model was created by Jay W. Forrester, Meadows, Meadows and Randers, Beyond the Limits (Post Mills, Vermont: Chelsea Green Publishing Company, 1992)

[3] World Commission on Environment and Development, Our Common Future, (Oxford, Oxford University Press, 1987) 363

global imperative. It is gradually turning into practice as the various disciplines of human endeavor incorporate sustainability into their respective professions. The following section will begin to define the theory of sustainability. This will then be followed by a more pragmatic exploration of the applications of that theory in relation to sustainable development and the built environment.

Defining Sustainability

> Can we move nations and people in the direction of sustainability? Such a move would be a modification of society comparable in scale to only two other changes; the agricultural revolution of the late Neolithic and the Industrial Revolution of the past two centuries. Those revolutions were gradual, spontaneous, and largely unconscious. This one will have to be a fully conscious operation, guided by the best foresight that science can provide....If we actually do it, the undertaking will be absolutely unique in humanity's stay on Earth.[1]

What, the question is begged, is sustainability? The roots of its conception lie in the relationship of life to the natural processes of the earth. A sustainable life form is one that can be supported well into the future. This life would therefore be perpetuated for as long as it can be supported by the natural systems upon which it is dependent. In the purest sense of the word such support would continue indefinitely. We now know that such temporal infinity is impossible due to the finite life-span of our cherished sun. We also know that the earth itself is finite. Sooner or later the earth will cease to support life. Nevertheless, as far as the human species is concerned, we can deduce from the previous discussion of the factors affecting the carrying capacity of the world, that the depletion of the earth's carrying capacity can be postponed through a decrease in both the consumption of resources and the production of waste. Such a decrease can only be achieved through

[1] William D. Ruckelhaus, "Toward a Sustainable World," Scientific American, September 1989: 167

controlling the growth of global population and actively conserving the natural resources of the planet.

Sustainability is quintessentially about the appreciation of the limits imposed on us by the earth. Unlimited growth is therefore inherently unsustainable. Human sustainability can only be achieved through the perpetuation of the human species' life support systems. These are the natural systems of the earth, and it is through the continued maintenance of these systems that life can be sustained. Burdening them with depletion and suffocating them with waste will undoubtedly decrease the sustainability of our species.

Indeed many of the earliest proponents of sustainability called for a halt to economic growth and a global adoption of a subsistence lifestyle.[1] They argued that the modern lifestyle is excessively consumptive and that human contentment can be attained using much less. This continues to be the viewpoint of contemporary writers on sustainability.[2] What is new however, and this can be directly attributed to the Brundtland Commission, is the realization that a halt to growth cannot occur before extreme poverty is alleviated.[3] It is now widely acknowledged that extreme poverty poses a threat to the natural systems equal to that of industrialization. A direct link between third-world poverty and the depletion of the natural environment necessitates enough growth to curb this depletion. Thus the emerging practice advocated by the global academic community is that of sustainable growth and sustainable development.[4]

This global view of sustainability, inclusive of the earth's biosphere, and all the people and nations of the earth, both rich and poor, hardly brings us any closer to an understanding of what sustainable living might entail. The Brundtland commission

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[1] Earlier Environmental analysis, such as E.F. Schumacher, Small is Beautiful (London: Vintage, 1973) and the Report of the Club of Rome, called for a halt to economic groowth and the adoption of minimalistic living.

[2] Meadows et.al. (1992) Goodland (1992) Bookchin (1980) Brown (1994) Van Der Ryn (1986)

[3] Shridath S. Ramphal, Sustaining Earth , ed. Angell et al. (London: Macmillan, 1990) 3-14

[4] Igor Vojnovic, The Pathway Towards Sustainable Development and Sustainable Urban Forms, (Toronto, Center for Urban and Regional Studies, University of Toronto May 1994) 1

defined sustainable development as that which meets the needs of today's generations without compromising the ability of future generations to meet their own needs. While providing essential groundwork for the intergenerational temporal framework that sustainable development must address, this definition is so broad in scope that it is of little help to the practitioner. Meadows et al. offer a similar yet somewhat more pragmatic vision.

> A sustainable society is one that can persist over generations, one that is far-seeing enough, flexible enough, and wise enough not to undermine its physical or social systems of support.[1]

Herman Daly defines such a society further as one whose rates of use of renewable resources are slower than the rates at which these resources can be renewed. In the case of nonrenewable resources, the rates of use must be slower than the rates at which these resources can be substituted by renewable ones. A third condition essential to sustainability according to Daly is the rate of pollution. It must not exceed the ability of the environment to absorb and neutralize it.[2] A more tangible description of sustainability is offered by these definitions, but once again pragmatic necessity is left unattended. The following sections will attempt to draw us closer to an understanding of what sustainability demands of us as societies perpetuating our collective existence and as individuals living our daily lives.

Sustainable Development

The most prevailing imperative in recent writing on sustainability is that of global cooperation across all borders and all oceans. Natural processes know no boundaries, and the condition of one country will invariably affect that of its neighbours.[3] Thus the need for active international cooperation that fosters mutual aspirations and

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[1] Meadows, Meadows and Randers, Beyond the Limits, (Post Mills, Vermont: Chelsea Green Publishing Company, 1992) 209

[2] Economist Herman Daly's three conditions. Meadows, Meadows and Randers, Beyond the Limits, (Post Mills, Vermont: Chelsea Green Publishing Company, 1992) 209

[3] Power stations in England and Germany are polluting lakes in Norway and deforestation in Nepal has led to flooding in Bangladesh, Ibid 11

promotes and monitors environmental performance, rises as one of the necessary characteristics of a sustainable society.

On the more local scale, the general factors affecting the carrying capacity of the earth and therefore the ability of humans to sustain themselves can be distilled to environment, society and economics.[1] The environment, because it is our life source; society, because it is what dictates the patterns of consumption and depletion of the environment; and economy because a financially comfortable society is ultimately more free to exercise whatever changes it deems necessary. Conversely, an indebted society has to consider affordability above all else. Appreciating the degree to which these three factors are interminably intertwined is essential to the discussion and practice of sustainability.

On a more local level still, sustainable development demands a modification of personal and societal consumptive behavior. More efficient and less wasteful patterns in industrial production, urban and regional transport, and the provision of goods and services, can all contribute to a decreased impact on the natural environment. The more efficient a mode of production or distribution the more sustainable it is in the long run: the less wasteful and less consumptive it is , the more likely it is to endure.

Literature abounds on the macro-economic changes necessary for the shift from unlimited development to that which is sustainable. Recommendations range from international emissions treaties to national population control, but the issue that is most congruous with the topic of this thesis is that of environmental accounting. Daly, El Serafy, Meier, Bartelmus, Costanza and Wainger all use different acronyms to describe what is essentially a single form of accounting.[2] This is different from traditional gross

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[1] Robin Sharp, Organising for Change: People Power and the Role of Institutions, ed. by Johann Holmberg, Making Development Sustainable (Washington D.C., Internaional Institute for Environment and Development, 1992)

[2] Herman Daly and J. Cobb, For the Common Good, (1994) El Serafy, Population Technology and Lifestyle (1994) Richard Meier, Ecological Accounts, Berkeley Planning Journal (vol. 9 1994) Peter Bartelmus, Environmental Growth and Development (1994) Robert Costanza and Lisa Wainger, Mending the Earth, Paul Rothkrug and Robert Olson, eds. (1992)

accounting, such as gross national product, in that it includes the cost of the depletion of natural resources in the final pricing of any given commodity. It is argued that if all the resources on the planet, along with the annual supply of solar energy that is captured and stored by the earth, is treated as a finite stock the use of which is an erosion of wealth, then the price of a product would more accurately reflect its true cost.

Bartelmus ventures a step beyond to suggest the inclusion of the hidden costs that depleting one resource might have on other resources, such as species extinction, and what effect this might have on the remaining species. There is also the loss of the capacity to absorb waste which might ensue after a certain saturation point is reached. Even non-tangible environmental degradation costs, such as the loss of health, culture, aesthetics and spiritual values, may be included in the net accounting equation.[1] If this manner of thinking is adopted on all levels of economic activity, its impact on the built environment would be substantial. This point will surface again in the following section with reference to sustainability as conceived through residential planning and design.

Another ingredient of a sustainable society that pertains directly to the built environment is put forth by Nozick. She views the local community as the seed of any kind of larger more comprehensive global transformation: "...to restore social and ecological balance to the world we must shift our economic, cultural and political orientations away from global competition to a concern with local needs."[2] These local needs can be addressed through a series of measures that are aimed at decentralising development and replacing mass production with scaled down industries. This would not only minimise the distance that goods must travel but would also revitalise local economies. In addition waste production and resource depletion would be considerably slower and more evenly distributed, allowing natural systems the amount of time necessary for them to regenerate.

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[1] Peter Bartelmus, Environmental Growth and Development, (London: Routledge, 1994) 40-49

[2] Marcia Nozick, No Place Like Home: Building Sustainable Communities, (Ottawa: Canadian Council on Social Development, 1992)

Mimicking the limits of the global biosphere by enforcing local limits and ensuring that both the resources and sinks within these local boundaries are met, would ultimately mean that the totality of localities are within the global limits. This translates directly into a sustainable biosphere. Local residents would be assured that their own lifestyles are sustainable and that they are not contributing to the devastation of a remote location. Furthermore, observing such local limits of throughfare promote an awareness of the cyclical nature of life and our own dependence on that cycle. On the fundamental level of sustenance we depend on soil to cultivate our food and to absorb and neutralise our waste. The closer we are to this cycle, both physically and temporally, the more sensitive we would likely be to the health and well being of the natural environment. A certain proximity to local natural systems is therefore more conducive to sustainable living.

Even in the case of goods dependent on resources outside of organic life cycles sustainability would be best served if these goods were confined, as much as possible, to their original location. Since these resources are by definition non-renewable and exist in finite amounts, then they would only be sustainable if recycled. The least transport and energy intensive form of recycling is simply reusing, which will once again be most efficient if achieved locally.

Given this understanding of the word *local*, it can be inferred that the most sustainable living scenario is one in which all three parts of the cyclical process of production, consumption and waste assimilation occur in a single location. However, a balance must be met between the transportation efficiency of a single location and the manufacturing and agricultural efficiency of volume production and composting. This balance precludes the delegation of these processes to individual households. **The optimum definition of *local* therefore emerges as that area of land within which the benefits of communal cooperation can be realised with a minimum dependence on remote resources.**

This local area of land with its accompanying habitats will henceforth be referred as the *local community*. This will be regarded as a building block for sustainable living. What remains unclear however, is the physical dimensions and the population capacity of this community. These are undoubtedly dynamic quantities that fluctuate with the particular fertility and richness of resources in any given area. Chapter six will address this issue further and will attempt to estimate what the maximum size of this community might actually be.

Sustainable Planning Practices

Although the discussion of sustainability has been largely conceptual thus far, it has already alluded to certain physical requirements. The necessity for less energy consumption and less waste production is in itself a mandate that will influence decision making on every level of the built environment. Less consumptive modes of transport would be given priority over more consumptive ones, thus affecting the execution of transport planning. In addition, the importance of the local community as outlined in the previous section, demands a planning ideology that treats the local neighborhood as a multi-functional entity tending towards self-sufficiency. If sustainability is to be attained then these directives mark only beginnings of what will ultimately be a complete revision of planning ideology. In order to appreciate the degree of transformation necessary for achieving more sustainable residential communities let us briefly visit the reality of the status quo.

Suburban residential developments are a particularly consumptive planning pattern, and are especially significant because it is where the majority of North Americans live.[1] One of the main culprits is the private automobile. The design of suburban residential neighborhoods may be summarized as being any circuitous configuration of

[1] A recent Newsweek article provides a brief synopsis of the state of suburbia, Jerry Adler, "Bye-Bye, Suburban Dream," Newsweek, May 15, 1995, 40 It is claimed that in the case of Pheonix, Arizona, suburban development occurs at the rate of an acre an hour. Although statistics for population distribution are those of the U.S. alone, population figures for Canadian cities clearly indicate an overall weightednes towards municipalities situated outside of central districts.

roads that minimises through access, while simultaneously providing each individual house with street frontage and enough land for a front and a back yard. While the sizes of houses and their lots may vary, and the pattern of the roads may change, the minimum requirements for road widths and turning radii are generally constant. Almost no community amenities are within walking distance to the typical suburban home. The demands of the house and its yards rule the size of the lots and the demands of the car rules the size of the roads. The roads are designed for peak period congestion which occurs only twice a day during morning and evening rush hours. For the remainder of the time, suburban roads are far more spacious than their use demands.[1]

Interrante provides an informative description of the transformation to auto-centricity in North American society. "What began as a vehicle to freedom soon became a necessity. Car movement became the basic form of travel.....Car travel could have remained an option offering certain distinct advantages; instead it became a prerequisite to survival." Dependence on the automobile resulted from the reconstitution of transportation needs within the spatial context of metropolitan society, a reorganization of the physical and social environment which the car facilitated but did not require.[2]

One of the most environmentally devastating habits that North Americans in particular have, is their reliance on the private automobile. Aside from the deforestation and soil displacement that the construction of car centered residential suburbs have necessitated, and the inefficient use of infrastructure that such developments entail, the car itself is a massive consumer. According to Freund et al. the single-occupant automobile uses 270 kJ to transport a single passenger for one km (443 calories/mile), compared to 133 kJ for a bus and 127 kJ for light rail.

By contrast, non motorized transport methods rely on renewable resources and contribute to the physical health of their user. Walking uses 15 kJ per passenger

[1] Donald Appleyard, Liveable Cities (Berkeley: University of California Press) 1981

[2] Joseph Interrante,"The road to Autopia: The Automobile and the Spatial Transportation of American Culture," David C. Lewis et al., eds., The Automobile and the American Culture, (Ann Arbor, University of Michigan Press,1983) 100

kilometre and cycling uses only 5 kJ. In addition to the operational demands of automobiles an equally depletive toll is exacted on the environment in their production. In the United States, in 1990, the motor vehicle industry consumed 13 percent of the total national consumption of steel; 16 percent of aluminum, 69 percent of lead, 36 percent of platinum and 58 percent of rubber [1] In the case of Germany the extraction of a single car's raw materials produces twenty five metric tons of waste and 422 million cubic metres of polluted air. The transport of these raw materials produces an additional 425 million cubic meters of polluted air and twelve litres of spilled crude oil in the oceans of the world.[2] According to the Environmental Protection Agency in the United States emissions from road vehicles constituted 37% of all controllable emissions in 1990.[3] Suffice to say, the car is contributing to the mounting stock of pollution that is burdening the earth.

Cars are also land intensive. Given current planning practices the average car demands about twenty square meters of land simply to park.[4] Land is also taken up by the network of roads and highways that are devoted to automobile transportation. For every square mile of land in the United States there is a mile of road.[5] This intensity of land use cannot be sustained indefinitely: if unabated any amount of growth in population will translate into a loss of natural and arable land.[6]

Freund and Martin provide a chronological breakdown of the changes necessary to reduce auto centered transport. The first short term transition involves physically transforming road space to other uses while simultaneously upgrading facilities that cater to the pedestrian. The second phase involves the expansion of mass transit as well as the widespread proliferation of less consumptive and less polluting automobiles. In

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[1] Peter Freund and George Martin, The Ecology of the Automobile, 17

[2] John Whitelegg, The High Cost of Motormania, TheGuardian, London, 1991

[3] Peter Freund and George Martin, The Ecology of the Automobile (Montreal: Black Rose Books, 1993) 28

[4] Lester Brown, "The Future of Automobiles" Society vol. 21, 1984, 65

[5] Jeremy Rifkin, Entropy, (Into The Greenhouse World. New York: Bantam New Age Books, 1989), 162

[6] Lester Brown, State of the World, (New York: W.W. Norton and Company, 1993)

the long run, they claim, the goal must be a unilateral one in which inner city areas are revitalised, land use patterns revised, and new efficiency methods devised.[1]

Jane Jacobs has long advocated the human qualities of streets and their potential to contribute to healthy pedestrian oriented street life.[2] While her advice seems to have gone unheeded for a couple of decades a recent rekindling of interest in pedestrian centered mixed-use residential planning, has brought her ideas to fruition. A few designers have envisioned, and indeed built, communities that are more conducive to pedestrian transport. Elizabeth Plater-Zyberk and Andres Duany have specifically targeted the automobile. Plater-Zyberk goes as far as to label asphalt as a social problem. "The more of it," she claims , "the grimmer the landscape, and it even causes people to stop walking, and neighbors to stop talking."[3] This philosophy has manifested itself in a number of projects in which Plater-Zyberk has transformed suburban malls into open town centers.

Other examples of her work include widely publicised collaborative efforts with her husband Andres Duany. The project of *Seaside* in Florida, for example, has been the subject of considerable debate both within and without architecture and academic circles. One of Seaside's many characteristics is its sensitivity to the pedestrian. It uses a higher density of land occupancy than is commonly used with single family homes. Clustering people close enough to their daily amenities allows them to walk rather than to have to drive. Roads are also articulated to accommodate the pedestrian, with some sections reserved exclusively for pedestrians and cyclists.

Another less tangible attribute of Seaside that is in tune with sustainable development is the communal organization of the blocks and lots. Roads, for example run perpendicular to the beach allowing for the maximum number of residents to have a view of the ocean. Rather than have only a handful of select residents enjoy a front view, it was

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[1] Peter Freund and George Martin, The Ecology of the Automobile (Montreal: Black Rose Books, 1993) 183

[2] Jane Jacobs, The Death and Life of American Cities (Baltimore: Penguin Books, 1965)

[3] Barbara Flanagan, A Massachussets Mall is Just Disappeared, The New York Times, March 14, 1991

considered more desirable to have more people enjoy only a side view. Whether it was intended as a marketing scheme, or was a genuine gesture of equality and sharing, this kind of egalitarian thinking is an important step towards community formation. The precedent from which this design team draws its influence is rooted in nineteenth century small American towns. This has given rise to other unifying and community forming design features such as the arrangement of blocks so that they converge towards a central focal point in the centre of town.[1]

Kunstler sites two elements of suburban development as being problematic. "The extreme separation of uses and the vast distances between things."[2] As Jane Jacobs has advocated, residential sections amidst commercial ones create a vitality that is less temporally confined.[3] Examples abound throughout North America of lifeless suburbs and downtowns that become lifeless after five o'clock. Because no amenity is within walking distance, suburban residents cannot help but use their car for any errands outside the home. Calthorpe targets this particular malady using what he terms "pedestrian pockets." These are designed with the scale of the walking human being in mind.[4] In his proposals Calthorpe recommends mixed use zoning as the key to sustainability gains (Fig. 5). Through a mixture of commercial activity, high density housing and shared outdoor space, positive community interactions amongst residents can be both encouraged and facilitated.

There are some indications that projects such as the ones outlined above are increasing in numbers, but they are far from being the norm.[5] In the meantime the introduction and promotion of alternative forms of transport can begin to alleviate some of the problems of auto-centricity.[6] Bicycle paths and efficient public transport could go a

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[1] Alex Krieger et al. Andres Duany and Elizabeth Plater-Zyberk: Towns and Town Planning Principles (New York: Rizzoli, 1991)

[2] James Howard Kunstler, The Geography of Nowhere (New York: Touchstone, 1994) 117

[3] Jane Jacobs, The Death and Life of American Cities (Baltimore: Penguin Books, 1965)

[4] Peter Calthorpe, and Sim Van der Ryn. Sustainable Communities (San Francisco: Sierra Club Books, 1986) 7-11

[5] Jerry Adler, "Bye-Bye, Suburban Dream," Newsweek (May 15, 1995) 40-45

[6] Curitiba, Brazil is a model of progressive transport planning. Commercial streets were closed off to traffic and an extensive efficient bus system was intoduced in a period when the population grew by

long way in reducing our present levels of consumption. Nevertheless sustainable planning practices reach further than simply altering modes of transportation. In addition to catering to the pedestrian, the higher densities achieved by the designs of Plater-Zyberk, Duany and Calthorpe reduce land consumption and the appropriation of new land for development. This allows for relatively more land to be preserved either in its natural state, or as food producing and waste absorbing agricultural land.[1]

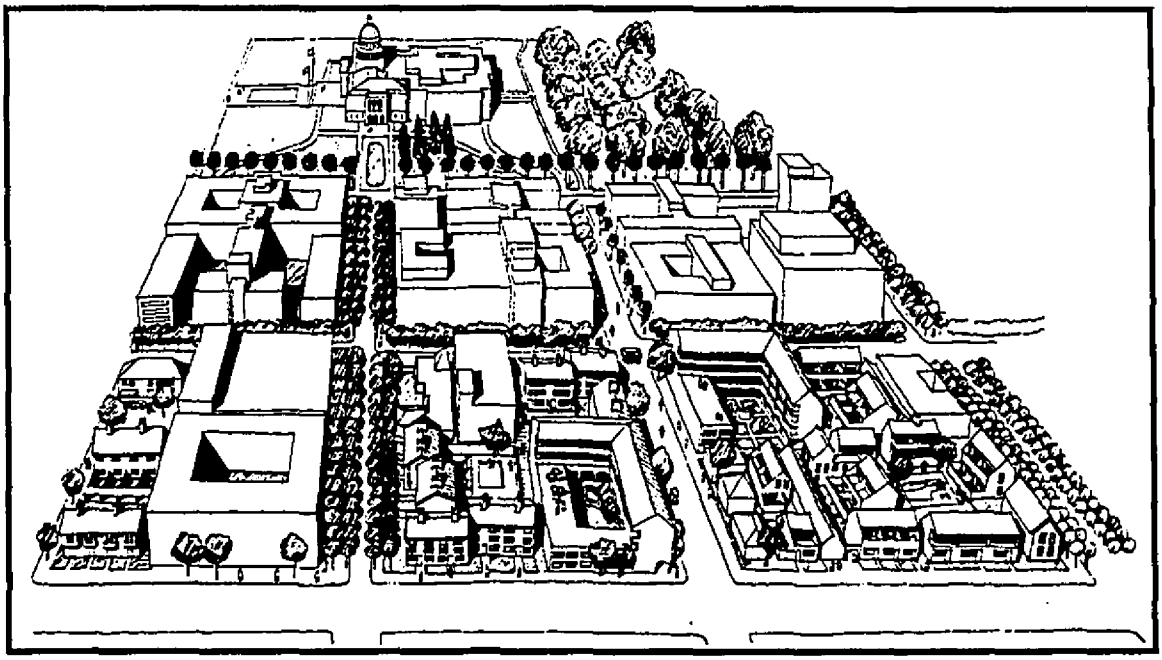

Fig. 5. Masterplan for Sacramento, showing a mixture of uses and human scaled design, from Peter Calthorpe, and Sim Van der Ryn. Sustainable Communities (San Francisco: Sierra Club Books, 1986) 7

This directive can be extended further to include an explicit intention on the part of planners to conserve natural features that are essential to the ecological functioning of areas undergoing development. It is typically easier to rally public support to preserve areas that are aesthetically pleasing, such as old growth forests and pristine mountain lakes. Nevertheless flood plains, marshlands and swamps, for example, which are often

200%. The city is clean quiet and green, consuming 25-30% less fuel than the average Brazilian city. Curtis Moore, International Wildlife (January/February 1994) 40.

[1] Igor Vojnovic, The Pathway Towards Sustainable Development and Sustainable Urban Forms, (Toronto, Center for Urban and Regional Studies, University of Toronto May 1994) 22

considered undesirable are perhaps more crucial as life supporting systems.[1] Planners have to recognise the worth of the entire spectrum of natural topography and adopt each microcosm as an essential feature that has to be preserved.

In the case of the many existing suburbs that have already disregarded the natural terrain, a reintroduction of natural processes can be implemented. This would be especially beneficial in dense urban areas where no sign of vegetation remains. Nozick recommends urban farming as a mechanism for increasing local self-sufficiency, but this can also be a form of reconnecting with the organic life cycle.[2] Ecological sewage treatment methods, for example, can reduce the physical and temporal boundaries necessary for biological decomposition to such an extent that the entire cycle of life can be confined to a single location. Using sunlight, rocks, fish ponds and marshes, raw sewage can be converted into purified water in just four days.[3]

Furthermore, less benign ecological engineering technologies, along with genetic engineering, may one day create machines that are alive and responsive. Although the introduction of such technology into our food crops to increase productivity warrants great precaution, its utilisation in the creation of organisms that are able to digest toxic waste may one day breathe life into the most polluted of environments.[4] The long term effects of incorporating artificial technology into natural systems will not be fully understood for some time. Nevertheless, ecological sewage treatment technology simply mimics the natural cycles of decomposition, rather than redefines it: much the same way that farming and agriculture have domesticated wild vegetation. A more sustainable practice of planning is one that appreciates the potential benefit of ecological waste

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[1] Robert Costanza and Lisa Wainger, Mending the Earth, eds. Paul Rothkrug and Robert Olson, (Berkeley: North Atlantic Books, 1992) 56

[2] Marcia Nozick, No Place Like Home: Building Sustainable Communities, (Ottawa: Canadian Council on Social Development, 1992) 84-91

[3] Richard Meier, Ecological Accounts, Berkeley Planning Journal (vol. 9 1994) 30,and Marcia Nozick, No Place Like Home: Building Sustainable Communities, (Ottawa: Canadian Council on Social Development, 1992) 90

[4] Robert Olson, Mending the Earth, eds. Paul Rothkrug and Robert Olson (Berkeley: North Atlantic Books, 1992) 72

treatment systems and incorporates them into community design rather than always be dependent on remote sinks that will one day reach the point of saturation.

Perhaps the quintessential problem facing planners in relation to sustainability, lies in those suburban residential developments that have been built to date with little regard for environmental concerns. They have already dedicated themselves to automobile transport. Even public transport routes would be difficult to introduce owing to the dispersed distribution of individual homes. Hence the crucial planning concern is not just a matter of regulating new developments, but is rather a matter of introducing new mechanisms for revising old communities to allow natural processes to infiltrate them and touch the lives of community residents.

Sustainable Architectural Design and Construction

The general sustainability directives of reducing consumption and waste production, and the more specific ones of environmental accounting and community formation all begin to define a practice of architecture that is more sustainable. A more complete understanding of environmental costs can inform decision making through the various stages of the design process. Priority would be given to choosing and specifying products that require less energy and fewer resources to manufacture and transport to the construction site.[1] Aside from the direct environmental benefits there are other implicit benefits towards sustainability. Environmental cost accounting will ultimately give priority to more local building materials and products, therefore contributing to the economic activity and self-sufficiency of the local region.

It can be safely claimed that vernacular or indigenous architecture is inherently more sustainable than that which is not indigenous. "Vernacular, because profoundly local, is more efficient than centralised industrialisation - more adaptive to local

[1] The Sourcebook for Sustainable Design: a Guide to Environmentally Responsible Building Materials and Processes, ed. Andrew St. John (Boston: Boston Society of Architects, 1992) this provides the tools for informed decision making, however it should be noted that a single guide cannot be utilised for all regions or bioregions. Environmental appropriateness varies with changing local conditions and resources.

climate, local society and local ecology."[1] This is not infer that sustainable architecture means reverting to pre-industrial construction materials and practices, but there are lessons to be learned from studying time tested traditions of adapting to local climatic needs. Perhaps the modern manifestation of vernacular architecture has more to do with ideas of humility, simplicity and conservation than with specific forms and details. To the extent to which it is possible, for example, recycling and re-using both buildings and materials should be exercised. Building products that are recycled will undoubtedly have a reduced environmental impact than newly logged or mined ones. Steel that is produced from scrap produces 85 percent less air pollution and 76 percent less water pollution than that which is mined. There are also added transportation benefits associated with recycling and re-using.[2]

With respect to the community promotion requirement of sustainability it can be a part of architectural execution in two distinct ways. What has been termed *community architecture* is a process of design that actively involves community members in the design and possibly construction of their own residences. It is believed that if residents are involved in their own homes from the initial stages of conception they will not only be more satisfied, but will, in the long-run, be more inclined to maintain and improve them.[3]

The other type of community promotion is in the conscious design of spaces that are intended to foster community interaction.[4] This is a delicate matter that requires a careful balance between the privacy of the individual home and the social activity of public spaces. A study by Leinward found that communal land sharing may actually lead to hostility over areas of shared responsibility and that most community interaction occurs in

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[1] Jean-Lous Bourgeois, Spectacular Vernacular, (Salt Lake City:Peregrine Smith Books, 1983) 89-91.

[2] Lester Brown, Christopher Flavin and Sandra Postel, "Earth Day 2030," Mending the Earth, eds. Paul Rothkrug and Robert Olson (Berkeley: North Atlantic Books, 1992)

[3] Jim Scott, What is the Point of Community Architecture (Oxford: Oxford Polytechnic, Department of Town Planning, 1986) 3

[4] This idea was briefly mentioned with reference to Calthorpe's sustainability recommendations p. 25

areas where the division between public and private spaces are clearly and uncontentiously demarcated.[1]

Relative to community promoting design guidelines, house performance theory is an exact and precise science. Here we enter into the domain of quantifiable variables. The chemistry of natural biological processes and the physics of electric and heat energies must all be considered in the making of a sustainable house. The Farallones Institute built and tested an experiment in self sufficient sustainable living in a house in the middle of the city. They termed it *The Integral Urban House.*[2] It does indeed, represent the epitome of sustainable design for a single family detached dwelling sitting on a fertile plot of land (Fig. 6). The house integrates the traditional residential functions of shelter and spatial definition with a more active function that traps, stores and distributes heat, stores and composts human and food wastes, filters and recycles used water, and provides food by way of fish ponds and urban farming (Fig. 7).

The directive of siting communities around rather that on top of natural features as detailed with regards to planning can be extended to the scale of individual buildings sitting on individual lots. Natural features can also be used to contribute to the indoor environmental control of buildings. In the case of cold climates buildings can be nestled against trees or rocky outcrops to shelter against the wind.[3] In addition, creeks could be used to cool houses through evaporative cooling while trees could be incorporated as seasonal shading devices. They should therefore be maintained as essential constituents to a balanced ecosystem. The common practice of leveling an entire building site, then building on small portions and paving or "landscaping" the rest, must be substituted with

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[1] Stanley Leinwand, Creating Community in The Neighbourhood Unit. (Montreal: McGill University, School of Urban Planning, 1994)

[2] Farallones Institute, The Integral Urban House (San Francisco: Sierra Club Books, 1979)

[3] Richard L. Crowther, Ecologic Architecture (Boston: Butterworth Architecture, 1992) 185

the attitude that the entire neighbourhood is a natural landscape and it is the buildings that are the exception to an otherwise natural setting.[1]

Fig. 6. The Integral Urban House, from Farallones Institute, The Integral Urban House (San Francisco: Sierra Club Books, 1979) front cover.

[1] Marcia Nozick, No Place Like Home: Building Sustainable Communities, (Ottawa: Canadian Council on Social Development, 1992) 84

Fig. 7. Habitat and life support system of an Integral Urban House from, Farallones Institute, The Integral Urban House (San Francisco: Sierra Club Books, 1979) 10

The energy consumption of buildings is possibly the area of architecture in which most gains can be made towards reducing resource depletion. Meier claims that urban residents living in technologically advanced cities presently use from ten to twenty times more energy than is necessary simply to ensure comfort and convenience.[1] Perhaps the workings of this technology equation can be reversed. Computer efficiency when applied to housing technology has the potential to produce architecture that will not only perform its traditional roles of form and function, but it will do so from a vantage of intelligence. *Smart Houses* respond to variables of human occupancy and outdoor air temperatures to create the most comfortable and energy efficient living environment.[2] Regardless of the luxury that smart features afford, the benefits of central, automated environmental control merit consideration in the context of sustainable architecture.

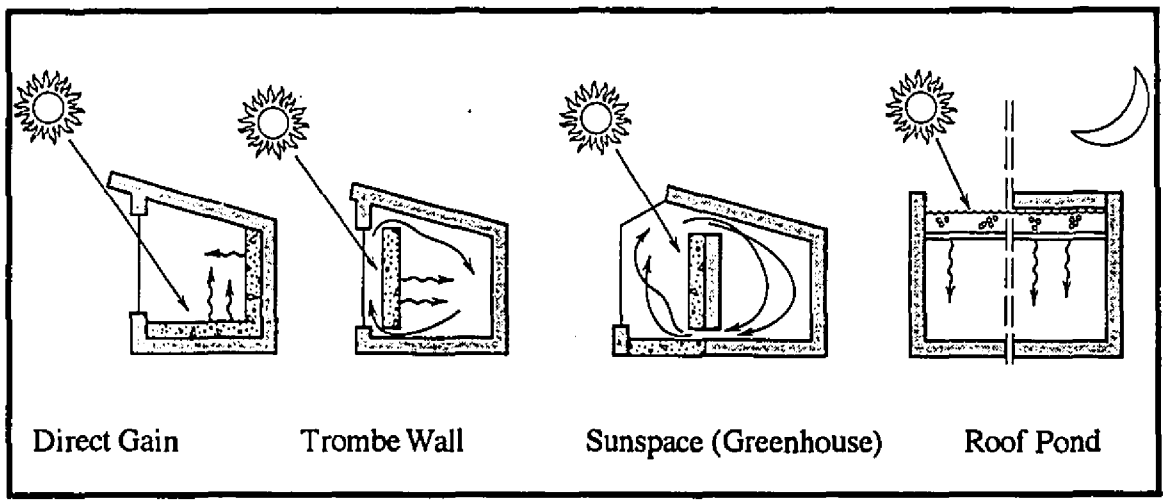

Fig. 8. Methods for solar heating, from John Reynolds, Mechanical and Electrical Equipment for Buildings. New York: John Wiley, 1989, 208.

Improving the thermal efficiency of buildings is an area of research that has made great gains in the last two decades. In the aftermath of the oil embargo of 1973, emphasis was placed on reducing the amount of energy used to heat residences. Many devices and countless systems were developed, both active and passive. A primary

[1] Richard Meier, Ecological Accounts, Berkeley Planning Journal, (vol. 9 1994) 30
[2] --, Smart House, Proffesional Builder and Remodeler (January 1992) 137-144

objective was to draw heat from solar radiation, store it during the day, and disperse it at night when the air is cooler. The methods for achieving this generally follow the basic premise of providing thermal mass in a space that is enclosed but exposed to the sun by virtue of glazing on the south side (Fig. 8).[1] This heated space can be either habitable, as in the case of greenhouses, or used purely as a heat source, as in the case of trombe walls and roof ponds.

Recent advances in energy performance have concentrated less on alternative forms of heating and more on reducing heat loss once the interior has already been heated. A continuous sealed weather envelope, leak proof windows and doors and increased levels of insulation within the walls have virtually eliminated heat loss with the exception of the air exchanges that take place when windows and doors are opened.[2] The savings achieved by this insulation are tangible and proven. Nevertheless because initial construction costs are higher than conventional homes, developers motivated by quick sales and short term profits continue to choose not to incorporate this new technology.[3] Once again full cost environmental accounting would ensure that only the most sustainable methods of construction are adopted in every case.

Professional architectural practice has also paid only tertiary attention to environmental concerns. When budgets are not the deciding factor aesthetics take on that role. However, with the inclusion of environmental costs in economic calculations it is inevitable that professional architectural associations address issues of sustainable development. Indeed the last few years have seen a number of indications of the growing concern on the part of architects. In 1993 the World Congress of Architects met to discuss

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[1] John Reynolds, Mechanical and Electrical Equipment for Buildings (New York: John Wiley, 1989) 208

[2] The R-2000 house developed in by CMHC and EMR is a good example of this technology David D'Amour, Sustainable Development and the Canadian Housing Sector (McGill, School of Urban Planning, 1990)

[3] Ibid.

the concept of sustainable development as it pertains to design. They explored the issue of a new form of design that provides shelter without environmental or human exploitation.[1]

URBAN SCALE	SUSTAINABILITY DIRECTIVES	
SUSTAINABLE DEVELOPMENT	a	• Reduced consumption and waste production
	b	• Multi-disciplinary, economy, society, environ.
	c	• Localization of consumer products life cycle
	d	• Environmental accounting
	e	• Proximity to natural environment
SUSTAINABLE PLANNING	f	• Alternative transport (non-automotive)
	g	• Pedestrian planning
	h	• High density
	i	• Mixed use
	j	• Inhibit lateral development (urban sprawl)
	k	• Preserve natural "features"
	l	• Urban farming
	m	• Ecological waste management
SUSTAINABLE ARCHITECTURE	n	• Reduce excessive const. consumption & waste.
	o	• Select local and low impact materials
	p	• Recycle buildings and materials
	q	• Provide opportunity for community
	r	• Preserve natural elements
	s	• Allow for gardens, composts, water treatment
	t	• Utilise alternative energy (solar wind etc.)
	u	• Adopt energy efficiency

Fig. 9. The Directives of Sustainable Development, Planning and Architecture, summary of Chapter Two findings, by author.

[1] Herbert Muschamp, "Design vs. Environment: Architects Debate," The New York Times, (June 23) 1993

Figure 9 summarises the findings of this chapter which identify a number of sustainability directives that are relevant to the various scales of the built environment. The benefit of working at home in light of these directives is already implicit especially with reference to transport and land use issues. The following chapter will attempt to ascertain the extent to which working at home, as it is practiced today, has already impacted the malady of energy intensive transportation. It will also seek to uncover the potential for more people to work at home, and in doing so will determine the pertinence of subsequent chapters. Thus the foundation will be laid for a further appreciation of the benefits of this lifestyle, or lack thereof.

CHAPTER THREE : WORKING AT HOME AND ITS IMPACT ON TRANSPORTATION

One of the most obvious and most discussed advantages of home work, is its potential to reduce urban automobile traffic and its associated problems. Theoretically the absence of the daily commute to central business districts on the part of suburban dwellers would undoubtedly reduce traffic congestion during peak hours. If indeed, the total amount of automobile operation is reduced as a result of home work, then considerable ground will have already been gained towards sustainability. In this chapter the author will attempt to uncover the extent to which sustainable transportation directives will be achieved as a result of home work. The discussion will draw from empirical research and surveys conducted on the travel patterns of home workers. It will also present findings that indicate the effects of changing travel patterns on the overall energy consumption and emissions. First however, home work must be defined.

Defining Home Work

People who work at home fall into a number of distinct categories. It should be noted however, that there is considerable overlap between the different categories, and that many workers may belong to more than one group. The following is a list of terms that have typically been used to describe those working at home.

Home workers; This is a general term that describes everyone who performs income generating activities at home. It has traditionally been most commonly used by researchers in reference to women workers who perform light industrial and clerical tasks in the home due to the dual responsibility of earning an income and performing domestic chores.[1]

[1] Sheila Allen and Carol Wolgovist, Home Working: Myths and Realities (London: Macmillan Education Ltd. 1987) and Marnina Gonick, Working from Home: Women Work and Family (McGill University, Dept. of Anthroplogy, unpublished Master's thesis, 1987) 1-17

Home-Based Business Owners / Home-Based Entrepreneurs / Self employed Homeworkers: These are individuals who own a small business and operate that business from their own homes. The term may also include those who work outside the home for the majority of the time but use their homes as the place of contact for their business. These home-based business owners commonly refer to themselves as working from home.[1]

Telecommuters / Teleworkers: This group is the most recent addition to the practice of home working. As the term implies, a telecommuter is one who substitutes the physical commute of traveling to and from the office, with an electronic commute of information to and from that office via telecommunications services. It refers to subcontractors or salaried employees that continue to work for an outside employer but do so from a remote location, as well as self employed individuals relying primarily on telecommunication for their work. The remote location may either be a worker's home, or any other transient or stationary location that is away from the employers offices. Workers included in this definition are only those who rely on telecommunications equipment to access their employees. This equipment may or may not include personal computers.[2]

In the chapters that follow all three terms will be used. For the purposes of this thesis, unless otherwise stated the telecommuter will only refer to those who telecommute from their homes. Chapters five and six will see the emergence of another form of telecommuting, namely that which takes place in *telecentres*. When the term home worker appears it will always refer to the general practice of working at home, including both home-based business owners and telecommuters. In all cases the work option need not necessarily be on a full-time basis. In some cases a distinction will be made between full and part-time work to facilitate a better understanding of the work option's impact.

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[1] Barbara Orser and Mary Foster, Home Enterprise, (Abbotsford, B.C.: The National Home-Based Business Project Committee, 1992) 67

[2] Joanne H. Pratt, Myths and Realities of Working at Home, (Joanne H. Pratt Associates, Dallas, 1993) 3-9

Home Office: The area within a home, or immediately adjacent to it, in which a home worker performs income generating work. Home office equipment is similar to conventional office equipment, although usually somewhat less formal in appearance. In many instances, even in the case of many telecommuters, the only equipment used for performing work related tasks is a telephone and typical office stationary with conventional filing systems.[1] A growing number of home offices however include a personal computer, which not only functions as a data entry, manipulation and retrieval tool, but also as an office management tool. Other equipment that is generally affiliated with personal computers are printers, scanners and modems. The "fax" machine, although gradually being replaced by modems and fax modems, continues to be essential for transmitting data.

Telecenter: This is a group office which caters to a number of individual telecommuters. It provides each worker with a workstation and all the necessary communication links. A telecenter may be set up by a single employer as a service to company employees, or by an unaffiliated private body catering to a variety of telecommuters working for many different employers.

The Growth of Home Work

Not only is it difficult to attribute a specific characteristic to the home worker that would include all the various types of home work, but to also have to define the extent to which this work occurs and how much of it actually occurs in the home further compounds the problem of determining how many people are working at home. The definition needs to also limit a certain number of hours below which work done at home would be considered too sporadic for documentation. Huws et. al. clearly state that the nature of home working is so multifaceted that it is virtually impossible to come up with a

[1] Gil Gordon, Keynote Address at the "Telework '94 Symposium", Toronto.

single definition that could account for all the different areas that home working touches.[1] In addition, statistics are distorted by the informal nature of a considerable amount of homework. Home workers often hide the fact that they operate a business at home for fear of tax increases or the enforcement of zoning regulations.[2]

Different researchers have defined home working differently in their various surveys of home workers. Some include all types of work done at home even if it is only part-time evening work while others include only full-time work done at home. Even the definition of *at home* varies. Some home-based business owners consider their homes as their primary work location, while spending the majority of their working hours outside of the home visiting and soliciting clients.

This definitional problem becomes apparent when comparing statistics compiled by various sources. Orser et al. reported that in 1992, 23 percent of working Canadians were involved in home-based business.[3] In the period of time since that study many indicators have suggested that telecommuting and home-based businesses are generally on the rise in Canada and the United States.[4] Nevertheless, a 1994 study by Market Facts of Canada reported that only 14.7 percent of Canadian households were involved in home-based business.[5] The use of different statistical units render it difficult to make informed comparisons.

A more informative comparison would avoid the incongruence of comparing statistics gathered by different sources using different definitions of home

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[1] Ursula Huws, Werner B. Korte and Simon Robinson. Telework: Towards the Elusive Office, (Chichester, England: John Wiley) 1990

[2] Barbara Orser and Mary Foster, Home Enterprise (Abbotsford, B.C.: The National Home-Based Business Project Committee, 1992) 91-94

[3] Barbara Orser and Mary Foster, Home Enterprise (Abbotsford, B.C.: The National Home-Based Business Project Committee, 1992) 114

[4] Ken Robertson, "Telework Around the World," Telework '94 Symposium, (Toronto: unpublished conference proceedings)

[5] David Shoalts, "Report on the Home Office," Globe and Mail, June (13, 1995) C1

work.[1] LINK Resources reported 4.6 million part time salaried telecommuters and 876,000 full time telecommuters, with a total of 5.5 million telecommuters in the United States in 1991(full and part time, salary and contract work).[2] Given that the total labour force in the United States is 121.6 million this constitutes about 4.5 percent. In 1992 the same group reported that number as being 5.3 percent.[3] A report to the United States Congress by the Department of Transportation, gave a chronological four year evolution of the number of full-time employees, "who otherwise would have commuted daily to an office or other workplace, (but are now going) to work without traveling at all." In 1990 these numbered 0.4 million; in 1991, 1.4 million; in 1992, 2.4 million and in 1993, 2.9 million.[4]

There are other indicators that home working generally, and telecommuting specifically, will continue to rise. Information workers are estimated to constitute up to 60 percent of the current work force in North America.[5] According to Nilles, 80 percent of these workers will have the option to telecommute which translates into 46 million people. This is almost 40 percent of the work force. In addition sub contracted consulting work across all sectors is expected to rise. An estimate of corporate plans to subcontract work suggests a rise in the order of 200 percent by the turn of the century.[6] This would allow an even larger portion of information workers to join the pool of telecommuters. The infrastructure for the transformation may already be in place. A study by the International Data Corporation found that 37 percent of homes in the United States have one or more

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[1] LINK Resources has been the most consistent source of statistics on telecommuting. It is quoted by all government sponsored telecommuting researchers as well as a large portion of academics including Jack M. Nilles, Patricia Mokhtarian, Penny Gurstein and Ritter et al.

[2] Maureen Quaid, and Brian Lagerberg, Puget Sound Telecommuting Demonstration, (Olympia, Washington: Washington State Energy Office,1992) 1

[3] Daniel Rathbone, "Telecommuting in the United States," ITE Journal (December 1992) 40

[4] Gary Ritter and Stan Thompson, "The Rise of Telecommuting and Virtual Transportaion," Transportation Quarterly (Vol. 48, No.3, Summer 1994) 240

[5] Herbert S. Dordick and Georgette Wang, The Information Society, A Retrospective View, (Newbury Park, California, Sage Publications, Inc., 1993) 91

[6] Jack M. Nilles, "Traffic Reduction by Telecommuting," Transportaion Research (22A, 1988) 301-317

personal computer. An average of ten hours a week are already spent on these computers doing work related tasks.[1]

While estimates of the number of people working at home are as varied as the definitions of home work, it can be construed from the aforementioned statistical evidence that home work is actually rising. Whether or not working at home becomes the work option practiced by the majority of the working population, the technology to facilitate that option for an ever increasing range of jobs is constantly progressing.[2] Adding to the complexity of issues confronting home worker researchers is the mixed scenario in which it is likely to take place. Traditional attitudes towards home work saw telecommuting in light of a polarity of extremes in which home work either occurs full-time, or it does not occur at all, the emerging realization is that telecommuting will likely fine-tune the traditional workplace rather than replace it entirely.[3]

The Changing Patterns of Travel

By definition, telecommuting reduces commuter traffic especially for those who telecommute from their homes. The steady increase of single-occupancy commuting vehicles in the 1980s, has given rise to a situation which directly translates the number of absent commuters into an equal number of absent cars.[4] The first study undertaken to measure the extent of transportation substitution by telecommunications, was performed by Nilles et al. in 1973. The study compared the average commuting distance of conventional workers in a particular company with those who telecommuted from a telecenter. They

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1 John Gehl, Edupage, March 7 1995, listproc@educom.edu, from U.S.A Today (March 7 1995) B1

2 In 1982 Jack M. Nilles reported that a rate of 25% to 30% annual improvement in the performance of microcomputer and digital information technology per dollar invested will likely continue into the 21st Century, Exploring the World of the Personal Computers (Englewood Cliffs, NJ, Prentice Hall Inc., 1982)

3 Jack M Nilles, Transportaion Research (22A,1988), Patricia Mokhtarian, Environment and Planning A (volume 26, 1994)

4 Jack M. Nilles, Traffic Reduction by Telecommuring: A status review and bibliography, Transportation Researh-A, (Vol. 22A, No.4, 1988) 301-317

found that telecommuters reduced the average commuting travel distance for the company by 65 percent.

A number of other studies have since been performed linking telecommuting from home with reduced travel. Pendyala et al., for example, reported that on days during which the conventional commute was substituted with telecommuting, the total distance traveled by the telecommuters in the State of California Telecommuting Pilot Project was 75 percent less than on regular commuting days.[1] A less substantial decrease in trip reduction was observed in a survey of the Puget Sound Telecommuting Demonstration in Washington State. In this case telecommuters reduced the trips they made on telecommuting days by only 40 percent. Nevertheless, the survey also tabulated the distance traveled in relation to the time it took to travel that distance. This demonstrated that beyond the direct gains of reduced trips, there was another indirect gain in the form of increased travel efficiency. On average, trip velocity was increased from two miles to three miles per minute. Hamer et al. found that in the Netherlands' Pioneer Telecommuting Program, total travel was reduced by 17 percent.[2]

These surveys shed some light on what telecommuting critics have long claimed to be the *latent travel demand* that would arise in place of commuting traffic. This is indicated by the amount by which reduced travel falls short of a 100% reduction. Aside from the household or work related trips that telecommuters used to make on the way to and from work, which would now necessitate autonomous trips, it was argued that other trips which were previously prohibitively time-consuming are now taking place.[3] There is also the possibility for traffic to always tend towards maximum capacity, in which case reduced trips tabulated in one household could directly translate into increased trips in

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[1] Ram M. Pendyala, Konstadinos G. Goulias & Riyuichi Kitamura, "Impact of Telecommuting on Spatial and Temporal Patterns of Household Travel," Transportation, (18, 1991) 383-409

[2] Rebecca Hamer, Eric Kroes, & Harry van Oostroom, "Teleworking in the Netherlands: An Evaluation of Changes in Travel Behaviour" (Transportation 18, 1991) 365-382

[3] Susan Herman, Confessions of a Teleworker, Telework '94 Symposium. (CMHC,Unpublished Paper)

another.[1] Essential to sustainability is the degree to which the surfacing of these new trips neutralises the total reduction achieved as a result of telecommuting. This remains unclear, thus necessitating new research that specifically targets latent travel patterns.

Two areas that do indeed show promise of positively impacting sustainability are travel efficiency and travel behaviour modifications. Quaid et al. reported increased travel efficiency in the way of home workers' tendency to spread their travel trips over non peak periods.[2] Hamer et al. found non-peak traffic to be reduced by 26 percent. The temporal boundaries of a peak period varies from city to city, but the particular targeting of non peak times on the part of telecommuters, suggests a keen sensitivity to traffic and congestion. In the area of travel behaviour modifications three different studies have independently found that telecommuting reduces the distance traveled by telecommuters, and their families, even on days during which telecommuting does not occur.[3] These findings may be somewhat distorted due to the proportional relationship between the incidence of telecommuting and commuting travel distance to the conventional workplace.[4] Nevertheless, they are significant findings in that they show a tendency on the part of telecommuters to localise their pattern of travel. Pendyala et al. provide an informative graphic analysis documenting a change in travel patterns (Fig. 10). Telecommuters' travel destination points are presented in spatial reference to the home. The first diagram indicates travel before telecommuting commenced, the second is after telecommuting commenced, and the third is on regular commuting days after telecommuting commenced.[5]

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[1] Susan Herman, Confessions of a Teleworker, Telework '94 Symposium. (CMHC,Unpublished Paper)

[2] Maureen Quaid, and Brian Lagerberg, Puget Sound Telecommuting Demonstration, (Olympia, Washington: Washington State Energy Office,1992) 31

[3] Quaid et al. (1992) Pendyala et al. (1991) and Hamer et al. (1991)

[4] Maureen Quaid, and Brian Lagerberg, Puget Sound Telecommuting Demonstration, (Olympia, Washington: Washington State Energy Office,1992) 29

[5] Pendyala et al. Impact of Telecommuting on Spatial and Temporal Patterns of Household Travel. (Berkeley: The University of California Transport Center, 1991) 23

The causal relationship between telecommuting phenomena and the different incentives to telecommute, is essential in determining the future impact of the practice. For it can be argued that because remote dwellers are more likely to telecommute than workers living near the city, then by virtue of previous commuting experience, these telecommuters are likely to be more sensitive to driving long distances. If however, more middle distance commuters who are more tolerant of driving long distances begin to adopt telecommuting, current findings of reduced travel distance may begin to change.

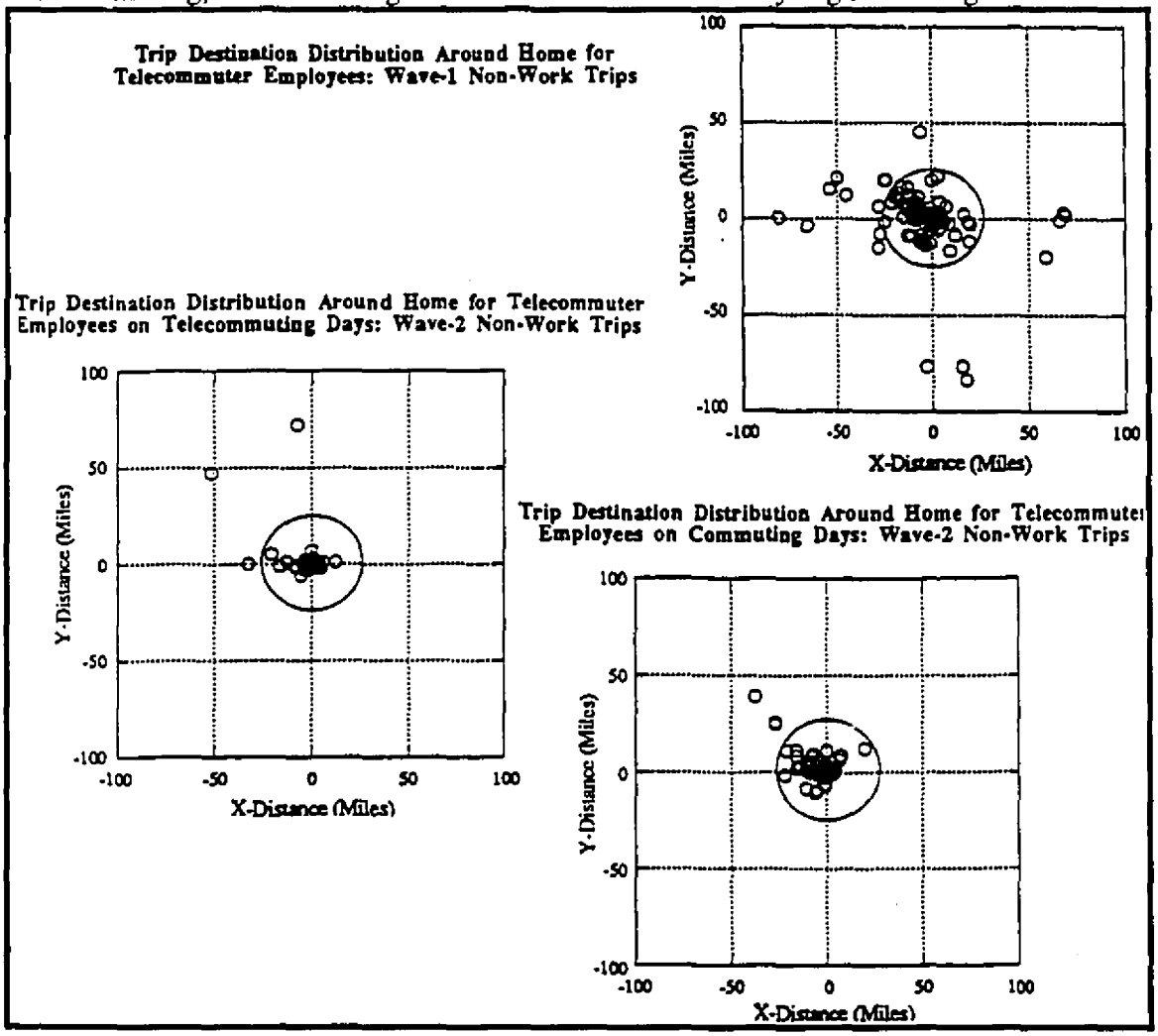

Fig. 10 Trip Destination Distribution Around Home, from Pendyala et al. Impact of Telecommuting on Spatial and Temporal Patterns of Household Travel. Berkeley: The University of California Transport Center, 1991. 23 *

* Wave-1 before telecommuting commenced, Wave-2 after telecommuting commenced.

The propensity to telecommute in relation to travel is an important factor in the sustainability discussion. Workers who commute long distances have been found to choose to telecommute and to continue to telecommute more than short distance commuters. Some authors have linked the propensity to telecommute to the distance or duration of the current commute. A disproportionately high number of telecommuters, it was reported, are those who live farthest away from their employer.[1] Other authors, however, have found that the duration of the commute plays only a minor role in the decision to telecommute.[2] Any research on the future popularity of working at home and its subsequent travel implications must explore this issue further.

The freedom gained through information technology will allow workers to move further and further away from city centres. In addition to the potential for a revolutionary change in the structure of urban centres, which will be discussed in chapter six, there is a potential for outward migration to cause an increase in the total distance traveled using automobile transportation.[3] Exhaust emissions would actually increase if the added distance part-time telecommuters have to drive (having moved away from city centres) on non-telecommuting days, is more than the distance saved by not driving on telecommuting days. If resident movement out of the city is indeed a result of telecommuting, and the resultant impact is increased automobile use, then its effects on sustainability are detrimental as far as transportation is concerned.

The discussion on the sustainability of telecommuting is further compounded by the direct relationship between automobile exhaust emissions and the number of trips taken. Regardless of the reduction in distance traveled, if the number of cold engine starts increases then so too will harmful exhaust emissions. Up to 80 percent of the pollution caused by an automobile is emitted when the engine is first ignited.

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[1] Jack M. Nilles (1991) and Maureen Quaid (1992)

[2] Patricia Mokhtarian, "Telecommuting and Travel: State of the Practice, State of the Art," Transportation (18, 1991) 319-342.

[3] Jack M. Nilles, Telecommuting and Urban Sprawl: Mitigator or Inciter?, Transportation (18, 1991)

Outside air temperature further influences the extent of this initial emission. The colder the air temperature the more pollutive the engine start is.[1] Therefore, any outcome of telecommuting that increases automobile trips is in opposition to the goals of sustainable development.

This touches upon a form of telecommuting that is often considered to be a comfortable balance between working at home and working in an office. The neighborhood center, otherwise known as the telecenter or the corner office, has the potential to maintain current number of cold engine starts. If people continue to drive to work when telecommuting from a neighbourhood center, as they now do in the majority of pilot cases, then telecommuting will have no significant impact on total gas emissions.[2] Further if, as Mokhtarian conjectures, the shorter distance to the telecenter will diminish the incentive to use public transit or to share commuting rides, then telecommuting might actually increase exhaust emissions.[3]

The direct reduction in exhaust emissions as a result of telecommuting have also been found to be rather insignificant. In 1993 The United States Department of Transportation reported that emission savings as a result of telecommuting for various chemicals are between 0.23 percent and 0.36 percent.[4] Overall traffic reduction was also found to be minimal. In 1992 Rathbone calculated that telecommuting at the time resulted in a peak-period vehicle reduction of only 0.9 percent.[5] In the case of home-based business owners Gurstein found that automobile trips actually increased when businesses relocate to the homes of their operators.[6] It was found that home-based businesses

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[1] Warren Romine, "Rural Economic Development," Telework '94 Symposium (CMHC,unpublished paper)

[2] Warren Romine, "Rural Economic Development," Telework '94 Symposium (CMHC,unpublished paper)

[3] Patricia Mokhtarian, "Telecommuting and Travel: State of the Practice, State of the Art," Transportation, (18, 1991) 339

[4] Department of Transportation, Transport Implications of Telecommuting (Washington, Department of Transportaion, 1993) 78

[5] Daniel Rathbone, "Telecommuting in the United States," ITE Journal (December 1992) 44

[6] Penelope Gurstein, "Housing and Urban Design," Telework '94 Symposium (CMHC,unpublished paper)

continue to rely on services and clients that are centrally located. They were essentially making the conventional daily round-trip commute two or three times a day.

These findings were supported by the author's case studies. The Richmond home-based business employed three workers that commuted from the City of Vancouver out to the Richmond suburb. Although these employee trips constitute a reverse commute that would probably have little impact on congestion, they do consume fuel and emit exhaust. One of the employees relied on public transportation, but found it inconvenient. The trip was time consuming as he had to travel by train from East Vancouver into the central business district where he had to catch a bus out to Richmond. In addition, the business relied on continual almost daily courier service that came out from the city centre and delivered parcels back to the city centre. Almost all the services upon which this particular suburban home office is dependent are centrally located.

By contrast the West Vancouver home worker made almost no work related trips on a regular basis. He occasionally traveled to visit clients in person but normally only spoke to them on the phone. Although he is a self employed telecommuter his work situation more closely resembles that of a salaried telecommuter in that he does not solicit work: he is a stock broker with a set number of clients with whom he works. All work related activity takes place using a personal computer and conventional phone lines. The only physical transport that is necessary for the functioning of his office is the daily delivery of a financial newspaper.

It is apparent that telecommuting is inherently a less travel intensive home work option than home-based businesses. Indeed it can be concluded that whereas telecommuting is more sustainable from a fuel consumption and exhaust production point of view, home-based businesses are not. The significance of this finding increases relative to the incidence of home workers that are operating businesses from their homes. In

Canada it is estimated that these comprise 48 percent of the total number of home workers, and in the United States 49 percent.[1]

The Potential Savings of Telecommuting

The savings that can potentially be incurred from telecommuting traverse many levels of personal and societal expenditure. An individual worker's time will be saved by not having to drive for an hour and a half every day to get to and from work.[2] Gasoline may be saved with its accompanying gas emissions. Although the cost of the production of pollutants is less direct than that of energy consumption, in the long run environmental costs will have to be paid.[3] Other less tangible savings include the potential for telecommuting to reduce traffic accidents as a result of reduced congestion, and the possible elimination of the physical and mental stresses associated with commuter driving. Long term savings on highway construction and maintenance, which are only two of several automobile subsidies, would be the most observable of savings, as they are of the magnitude of billions of dollars.[4]

Quaid et. al found that each telecommuter saved an average of 84 one way commuting trips per year resulting in a savings of 1,220 miles of travel.[5] Using a high efficiency rate of 30 miles per gallon each telecommuter saves an average of 40 gallons of gasoline. This translates into approximately US$ 50. This is hardly a significant saving especially when viewed alongside other energy measurements that Quaid et al. reported. Energy consumption in the home actually increased as a result of telecommuting, and

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[1] Canadian statistics from Barbara Orser and Mary Foster, Home Enterprise, Abbotsford, B.C.: The National Home-Based Business Project Committee, 1992, 115 and US statistic from Mike Gray et al., Teleworking Explained (Chichester: John Wiley and Sons, 1994) 25

[2] The average commuting time in the U.S. was reported to be 40 minutes by Phillip E. Mahfoud, Home Work: How to Hire, Manage and Monitor Employers Who Work at Home, (Chigaco, Probus Publishing Company, 1992) 19

[3] Meadows et al. compare the costs of cleaning up environmental pollutants with that of adopting pollution mitigation measures, Meadows, Meadows and Randers, Beyond the Limits (1992)

[4] Jeremy Rifkin, Entropy; into the Greenhouse World (New York: Bantam New Age Books, 1989)

[5] Maureen Quaid, and Brian Lagerberg, Puget Sound Telecommuting Demonstration (Olympia, Washington: Washington State Energy Office,1992)

although this increase is not large enough to neutralise the energy savings from reduced driving, it diminishes the magnitude of already meager gasoline savings.

It should be noted, however, that even though the energy consumption in the home office was found to increase the total consumption of the home, savings are still achieved in relation to conventional office energy consumption. The following figure (Fig. 11) presents a comparison of the average energy consumption of several different working situations. Heating and lighting energy requirements are almost identical in all modes of work except full-time home work. There is a reduction of approximately 2 MW hr achieved by working at home. As would be expected the most significant savings are from diminished transport energy consumption.

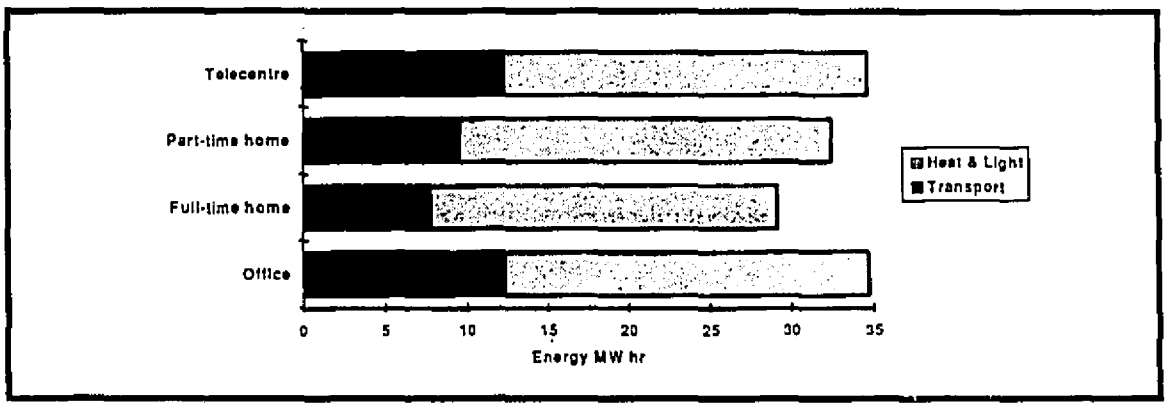

Fig. 11. Personal annual energy consumption for different work modes, from Mike Gray et al., Teleworking Explained, Chichester: John Wiley and Sons, 1994, 126.

Given that 50-60 percent of the work force is currently employed in the information industry and that only 80 percent of those workers will be able to telecommute, the potential number of telecommuters in the United States is 40 percent of the work force, or 45 million people.[1] This number is large enough to have enormous impact on urban economy and urban development. Even if only half this full potential is realized the savings would be tremendous. Therefore, any minuscule change in

[1] Jack M. Nilles, Traffic Reduction by Telecommuting, Transportaion Research (22A, 1988) 301-317

consumption would multiply and become more significant as more people begin to contribute to the total societal savings.

The future potential for traffic reduction, for example, increases relative to the increase in the number of telecommuters. Nilles estimated that in a nominal case scenario, in 1995 1.5 million commuters would disappear from the roads each day as a result of telecommuting.[1] He estimated another twelve million would commute to telecentres, in which case traffic reduction as a result of telecommuting can be calculated to be in excess of 10 percent.[2]

Using figures for the per capita cost of traffic congestion for different cities, one can calculate the potential per capita savings due to telecommuting in individual cities. During the Olympic Games in Los Angeles in 1984, the city reported a 60 per cent decrease in traffic congestion as a result of a 7 percent decrease in traffic.[3] If a 7% reduction was found to reduce congestion by 60 percent, then a 10 percent increase would likely annihilate traffic congestion. If in LA.. congestion cost $730 per capita in 1987,[4] and we assume an average annual inflation rate of 2 percent, all things being equal the 1995 cost of congestion would be $855 per capita. If telecommuting actually eliminates congestion, then this would translate into a minimum direct savings of $855 per capita for every individual living in a congested city.

Gordon and Kelly's estimated that in 1986, in the United States, it cost an average of $4,000 to $6,000 to house a single worker in a downtown location, excluding the cost of electricity.[5] Lozano cites the example of the Rank Xerox networking scheme in

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[1] Jack M. Nilles, Traffic Reduction by Telecommuting, Transportaion Research (22A, 1988) 301-317

[2] The precise number of telecommuters today is difficult to ascertain, but the most recent estimate in the United States shows 2.88 million workers who telecommute from home, and another 3 million who are termed "mobile" telecommuters. Mike Gray et al., Teleworking Explained (Chichester: John Wiley and Sons, 1994) 25

[3] Gary Ritter and Stan Thompson, The Rise of Telecommuting and Virtual Transportation, Transporation Quarterly (48, Summer 1994) 243

[4] Peter Freund and George Martin, The Ecology of the Automobile, (Montreal, Black Rose Books, 1993) 23

[5] Beverly Lozano, The Invisible Workforce (New York: The Free Press, 1989)

the United Kingdom which experienced a savings equivalent to $ 800,000 per annum in office overhead when 42 staff members were moved out of the central London office and into satellite offices.[1] The viability of this kind of corporate decentralisation is increasing with improvements in communications technology. Video-conferencing for example, is poised to revolutionize the manner in which business meetings are conducted, and to do so at a savings to its users.

With the use of video-conferencing two or more parties at any distance from each other are be able to have a meeting in which video images of one boardroom can be viewed live at another, and vice versa. Long sites an early example of this type of conferencing by Aetna Life and Casualty Insurance in Connecticut. After the first year (1981) of using video-conferencing in two rooms at two different locations, management reported an estimated savings of $300,000 in travel time alone.[2]

The flow of dollars in the shift to home employment does not occur in a single direction. Although there are savings to be made at the central office location, there is considerable investment to be made at the new home office. The start-up costs for running a small business from the home or simply being the employee of a company and working at home varies with the level of communication necessary for the proper functioning of the home office. Estimates for the start-up cost of a home office range from under $5,000 to over $20,000 depending on the sophistication of the equipment and furniture desired for the new home office.[3] Computer equipment alone will cost a minimum of US$ 2,000; and with increased computer speed, memory and high quality peripheral equipment, the cost rises to US$ 5,500.[4]

A study conducted by Finlay concerning the Greater Vancouver Regional District, demonstrates an area of traffic reduction savings that is less discussed than the

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[1] Ibid.

[2] Richard J. Long. New Office Information Technology (New York: Croom Helm, 1987)

[3] David Shoalts, Report on the Home Office: Here's what it costs to set up shop," The Globe and Mail, (June 13 1995) C1

[4] Jim Burton, Home Office to the Macs, MacHome Journal (May 1995) 36

typical areas of congestion mitigation and pollution reduction.[1] Finlay explores road construction and maintenance. It is estimated that two-thirds of the cost of automobile transportation is subsidised by the government. The bulk of this subsidy is in the form of road construction, closely followed by road maintenance.[2] Finlay estimated that if the population of full-time telecommuters reached five per cent of that of the entire work force, and if each of these telecommuters was equipped with a personal computer at a cost of $5,000,[3] the net road infrastructure savings achieved as a direct result of this level of telecommuting would be 1.4 billion dollars after only ten years . Needless to say this figure is of a magnitude that demands attention on the levels of both municipal and federal governments. It also leads us to believe that whatever the extent of savings that are directly relevant to reduced consumption and waste production there will undoubtedly be other less direct financial rewards.

The totality of issues that surround home work is vast and complex. Ranging from technological innovations to utopian visions to societal and demographic changes, all the different factors that enter into the overall home employment equation, are too diverse to be combined into a singular definition. Both the study and regulation of home employment are therefore inherently difficult. There is however sufficient evidence to suggest that there is a slow but definite rise in the number of home workers in the labor force. Facilitated by technology and the contemporary nature of work, this rise is expected to continue. It has been shown that in the case of telecommuters this will result in savings across many levels of society. Although overall energy consumption and pollution emissions reductions have been found to be minuscule, future growth of telecommuting promises to increase the relative magnitude of these savings.

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[1] Stephen Finlay, Benefits, Costs,and Policy Strategies for Telecommuting in Greater Vancouver (M.B.A. thesis, Vancouver, Simon Frazer University, 1991)

[2] Peter Freund and George Martin, The Ecology of the Automobile, (Montreal, Black Rose Books, 1993)

[3] Finlay also allowed for a further $1,000 per year to maintain and upgrade computer equipment.

GRAPHIC SUMMARY

AREA OF STUDY		FINDINGS	SUST. DIR.	RECOMMENDATIONS
TRAVEL PATTERNS	HBB	• Increase	f,h,i,j,q	Provide local services
	TELE	• Decrease		Facilitate, provide electronic services
ENERGY & EMISSIONS	HBB	• Increase	f,h,i,j,q	Encourage electronic communication
	TELE	• Negligible		Facilitate telecommuting growth
POTENTIAL SAVINGS	HBB	• Energy (small)	f,t,u	Facilitate alternative transport
	TELE	• Substantial		Promote & show benefits

SUST.DIR.: Sustainability directives that influence area of study. Letters refer to directives taken from Chapter Two p. 36 (copied below) HBB: Home-based business TELE: Telecommuter

URBAN SCALE	SUSTAINABILITY DIRECTIVES	
SUSTAINABLE DEVELOPMENT	a	• Reduced consumption and waste production
	b	• Multi-disciplinary,economy,society,environ.
	c	• Localization of consumer products life cycle
	d	• Environmental accounting
	e	• Proximity to natural environment
SUSTAINABLE PLANNING	f	• Alternative transport (non-automotive)
	g	• Pedestrian planning
	h	• High density
	i	• Mixed use
	j	• Inhibit lateral development (urban sprawl)
	k	• Preserve natural "features"
	l	• Urban farming
	m	• Ecological waste management
SUSTAINABLE ARCHITECTURE	n	• Reduce excessive const. consumption & waste.
	o	• Select local and low impact materials
	p	• Recycle buildings and materials
	q	• Provide opportunity for community
	r	• Preserve natural elements
	s	• Allow for gardens, composts, water treatment
	t	• Utilise alternative energy (solar wind etc.)
	u	• Adopt energy efficiency

CHAPTER FOUR THE RESIDENTIAL ACCOMMODATION OF WORK

Spatial Configuration

In the previous chapter an important distinction arose between the telecommuter and the home-based business owner regarding travel patterns and sustainability. This division continues indoors in the sphere of the home. The most important difference is that of client visitation. Home business owners often rely on their homes as important business meeting places or show rooms for their products. In one extreme home workers operate retail outlets that are open to the public and in the other they never invite a customer into their home. However the possibility exists for an unannounced work related visitor arriving at the doorstep. Telecommuters on the other hand are electronically networked to clients and employers who need not even know where they live. This distinction will obviously influence the design of the home office. One work option has a public face and the other need not have one at all. The division between the two may begin to pale however as consulting work which combines both self employment and place anonymity increases.

The most public face that a home office has, and in many cases the only exterior element that reveals its presence is an exterior sign. The issue of signage is a delicate one. Orser et al. reported that 78 percent of respondents had received complaints regarding their home offices. These complaints however, where not related to the presence of a business with its accompanying "unsightly" neighbourhood appearance as one might expect. Rather, they revolved mostly around the fear of unfair competition by nearby other businesses.[1] This is an area for potential conflict. Conventional businesses paying commercial overhead rates will be undermined by home businesses who are able to provide similar services for lower prices due to their lower overhead costs.

[1] Barbara Orser and Mary Foster (Abbotsford, B.C.: The National Home-Based Business Project Committee, 1992) 26

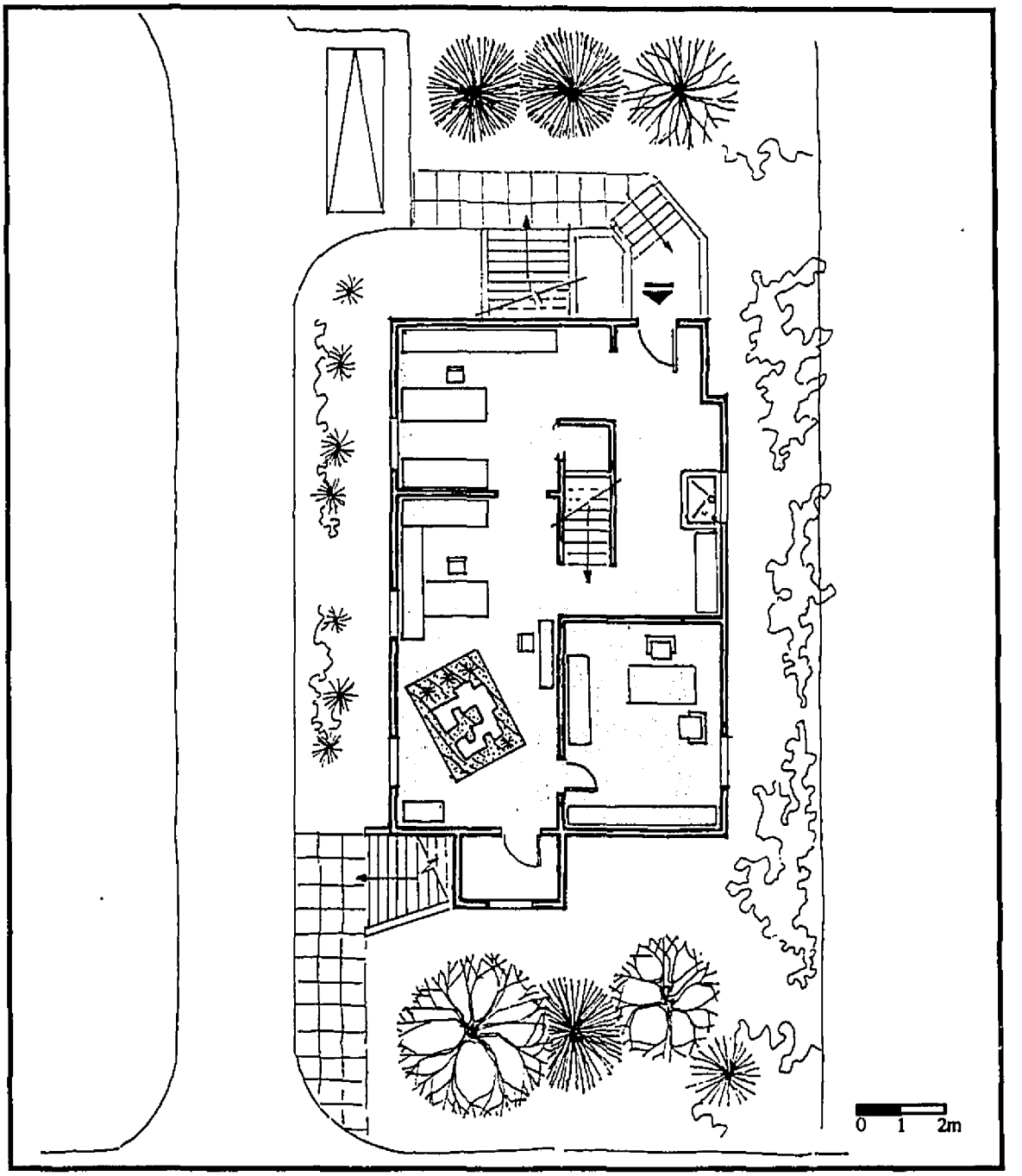
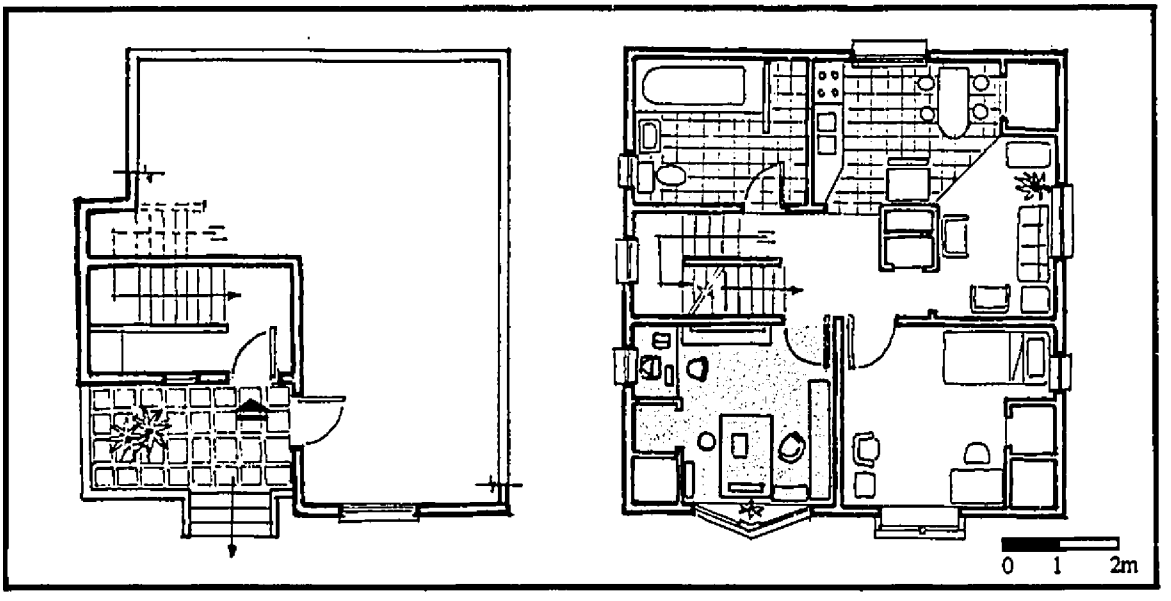


Fig. 12. Site and interior plan of the Richmond home office, by author.

None of the home offices studied by the author have ever received complaints, yet the Richmond home worker was rather self conscious about his business especially after he started hiring extra help. He is the only office studied that actually had a sign. This sign was a small make-shift one however, and was only hung in place when a

courier was expected. The entrance is at the back of the house which is difficult to find (Fig. 12). The owner reported having to give detailed directions for the office, to avoid being overlooked. Without the sign couriers would "never find us," it was stated. Home offices and their accompanying signs are prohibited in Richmond. Indeed commercial signs in residential zones are prohibited in most municipalities in Canada, and when they are allowed they are limited to around half a square meter.[1]



(Fig.13) The East Vancouver home office, by author.

Synonymous with the issue of signs, is that of a separate entrance that might call attention to the home office. Ahrentzen reported that a separate entrance was not necessarily desirable for home workers.[2] It should be noted however, that her sample contained a disproportionately low percentage of home-based businesses. The Richmond home office was the only one studied that had a separate entrance. This was considered to be very important for receiving clients without having to bring them through the home. Whether there is a separate entrance for the office or not, researchers agree on the importance of the route taken between the entrance and the office. Domestic clutter,

[1] Jeffrey J. Celentano, "Hard Times, High Tech and Home-Based Business," Plan Canada (November 1994)

[2] Sherry Boland Ahrentzen, Blurring Boundaries: Socio- Spatial Consequences of Working at Home. (Milwaukee, Wisconsin The School for Architecture and Urban Planning, 1987)

especially when children live in the house, has been cited as a constant worry.[1] Home workers constantly clean up after their children in anticipation of a surprise client visit.

The East Vancouver office does not have a separate entrance but has a successful circulation pattern nonetheless (Fig. 13). The dual entrance is on one level with the office being upstairs from it. The procession up the stairs was found to provide ample time for introductory small talk. At the top of the stairs the landing provides a circulation node that links the separate rooms while allowing for separation and privacy by virtue of closed doors. The proximity of the office to other rooms also works well for the home worker as he uses the kitchen and living room to entertain clients. The Vancouver home workers have never received work related visitors in their home, but have planned for it anyway. They installed swinging bar doors to section off the kitchen and bathroom areas (Fig. 14).

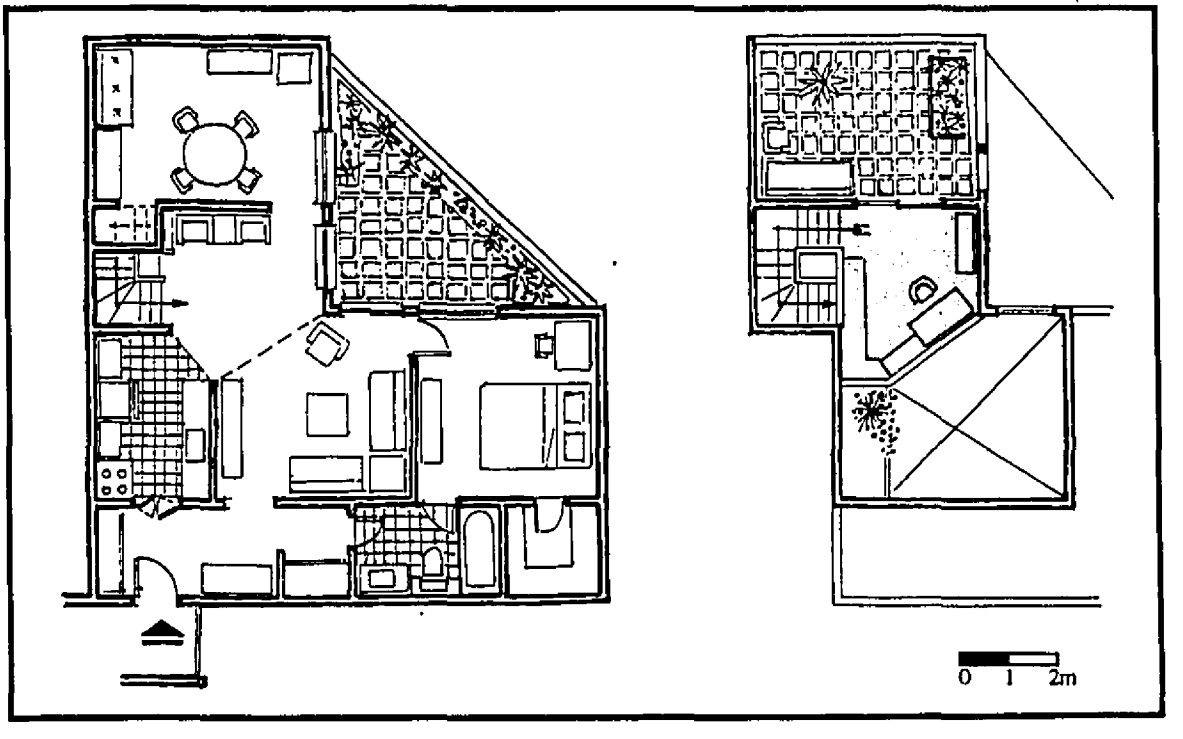


Fig. 14. The Vancouver home office main floor and loft, by author.

[1] Jennifer Lin, Work at Home, Home at Work, (unpublished Master of Architecture thesis, Department of Architecture, MIT, 1992) 19

Once inside the sphere of the home, demarcation becomes very important in directing clients through the house. A separate entrance is more appropriate for home-based businesses that rely on heavy customer traffic. In its absence however, a neutral vestibule that clearly indicates the office is adequate. This insures that the informal domestic look of the home does not taint the professional image of the business. It is therefore important in home-based businesses to place the home office in close proximity to the entrance of the house to avoid having clients traverse private space.

When planning the location of the home office another important consideration is the environmental comfort of the office and its ensuing energy requirements. Quaid et al. found annual energy consumption to increase by about 1 percent in her sample of telecommuters.[1] The sample surveyed for the study covers a wide range of telecommuting scenarios and therefore mimics the possible composition of a societal telecommuting work force. An average household energy consumption increase of a single percent may seem minuscule, but it is an average of both part and full time telecommuters, and a full time telecommuting household would experience more noticeable increases. What is informative here is that increased power use has been attributed to space heating rather than equipment requirements.[2]

While the members of a typical working North American household is uninhabited for the majority of every week day, home workers will spend the majority of that time in the home. As a result the air temperature of the house has to be maintained at a level comfortable enough for human occupancy for the majority of every day. Furthermore, environmental conditions must be conducive to working in an immobile seated position for extended periods of time.[3] Sustainability directives demand that in a cold climate the work room be situated facing south to take advantage of solar radiation. It

[1] Maureen Quaid, and Brian Lagerberg, Puget Sound Telecommuting Demonstration (Olympia, Washington: Washington State Energy Office,1992) 33

[2] Ibid.

[3] Optimum working conditions temperature is between 20°c and 24°c, and relative humidity 30 % to 60 %, Thomas B. Cross and Marjorie Raizman, Telecommuting: The Future Technology of Work, (Homewood Illinois: Dow Jones Irwin, 1986) 95

may receive direct solar gain or be situated directly adjacent to a greenhouse. This would save on energy as well as provide visual and experiential variety.

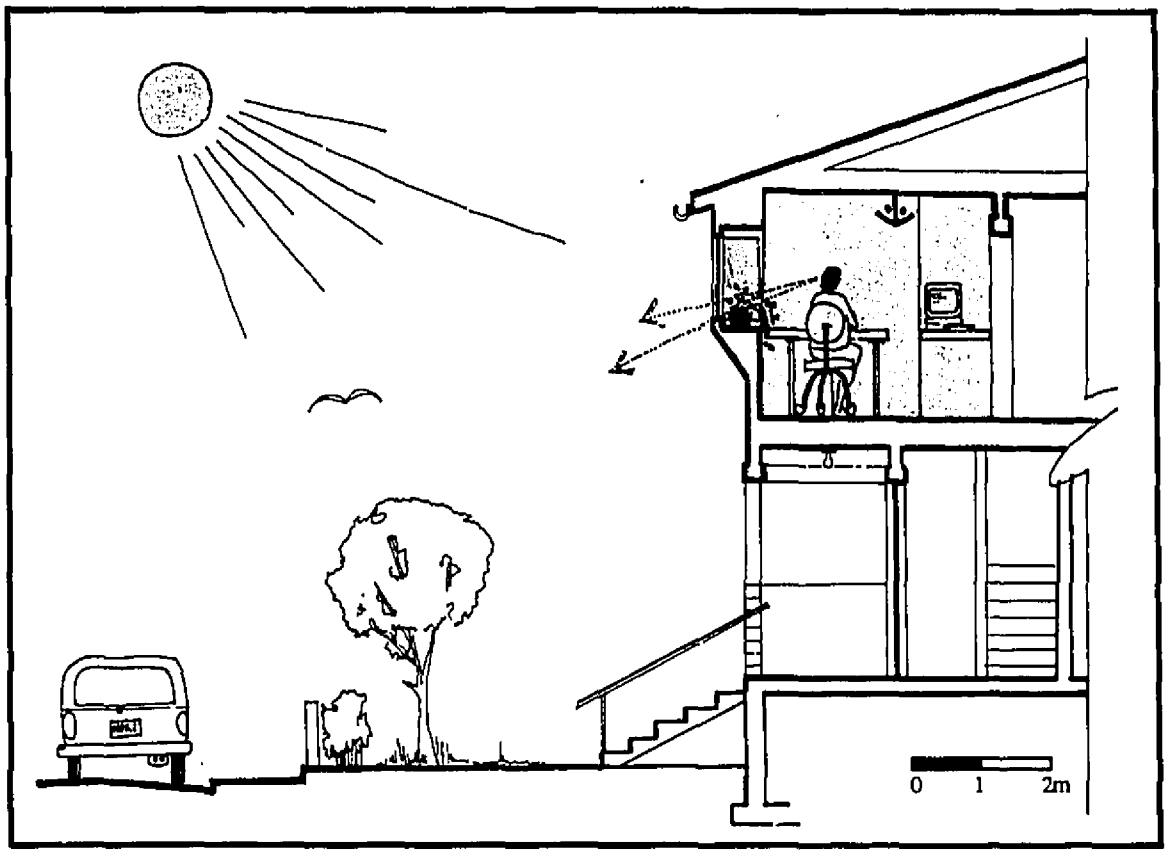


Fig. 15. North-south section through East Vancouver home office, by author.

The East Vancouver home office faces directly south with a large bay window. Although solar gain has increased energy efficiency, the savings could not be realised in this particular situation. The home worker actually blocked the heat vent into the office room. Reportedly, it rarely ever needs heating and the heater controls are in the downstairs apartment and therefore inaccessible. The renovation that split the house into three apartments should have included a mechanism for heater control in the upstairs apartment. The environmental accounting directive would eliminate such short-term cost cutting and ensure more sustainable construction and renovation.

Caution must be exercised when dealing with large amounts of direct sunlight: problems of heat and glare may arise. The East Vancouver home office was often

too warm for comfort and glare was a common problem. The continuous occupancy of the home worker however, allowed for the constant manipulation of ventilation and shading devices. Blinds and operable windows mitigated the intensity of the heat and glare. In this manner solar gain devices could function even more efficiently than if left unattended all day long.

This brings to light another environmental control design consideration. Environmental control in the conventional sense involves quantitative measurements of humidity and air temperature. Yet in the interests of sustaining the practice of home work beyond the immediate future, the qualitative and emotive environments must also be addressed. This will be discussed in the following chapter in the context of the physical and mental health of home workers.

Due to the idiosyncrasies of each individual home worker, coupled with the uniqueness of individual family dynamics it would be rather myopic to attempt to define the "ideal" design for an office in the home. Nevertheless, one feature of the home office has been almost unanimously desired; a separate workroom.[1] This is supported by all of the home office case studies with the exception of the Tofino work space. The home worker operated a massage business and desired the rustic character of her cottage home to be a part of her clients' experience.

The author's questionnaire further proves the desirability of a separate work room. Fifty-seven percent of respondents would rather work in a separate room towards the perimeter of the house (Fig. 16). This may be a matter of personal choice or, as one respondent pointed out, a reflection of tax codes that demand that if the office area percentage of the mortgage or rent is to be claimed as a business expense, then that office has to be separate and clearly defined. Regardless of the reason for separation, as the next chapter will demonstrate, a separate room is the most psychologically tolerable arrangement, and therefore the most sustainable in the literal definition of the word.

[1] Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990) 135

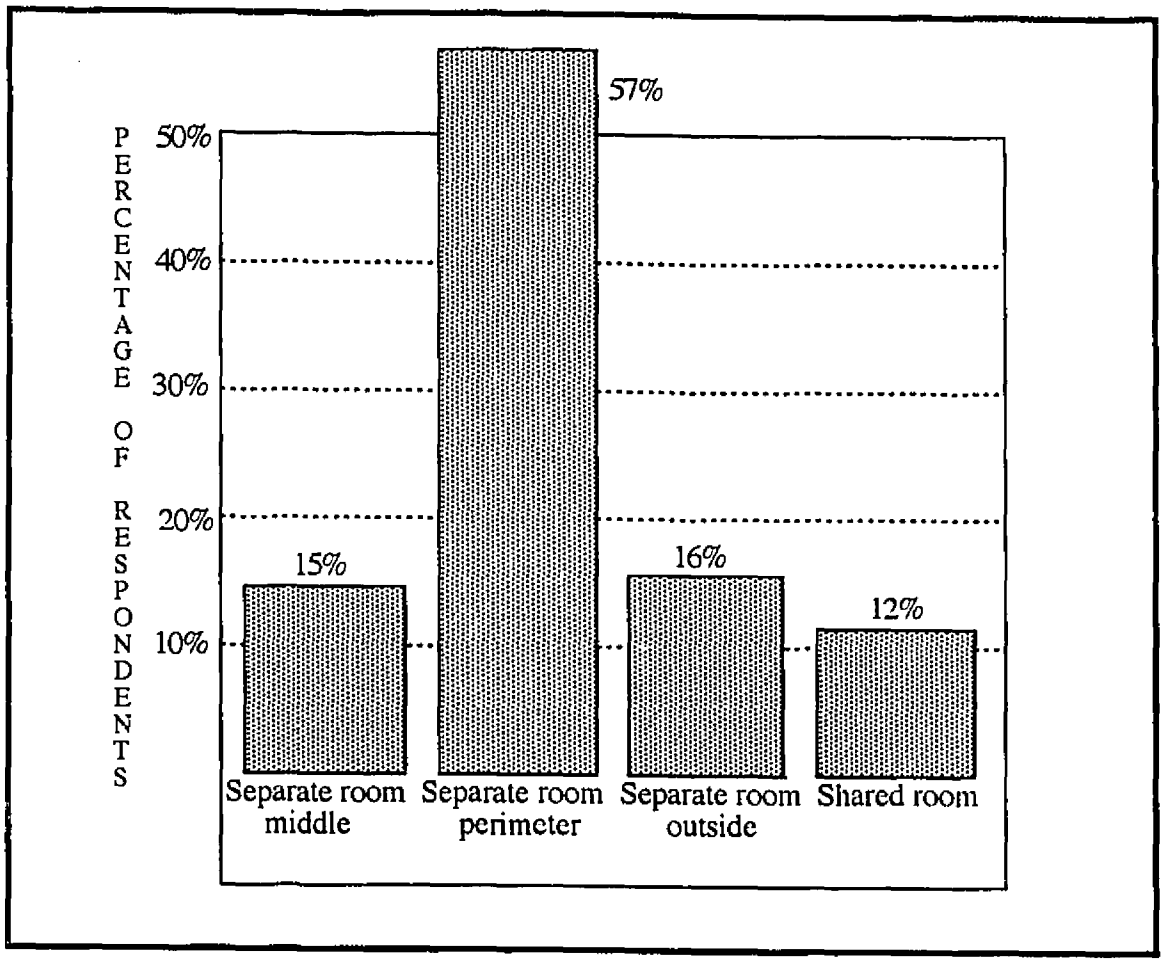
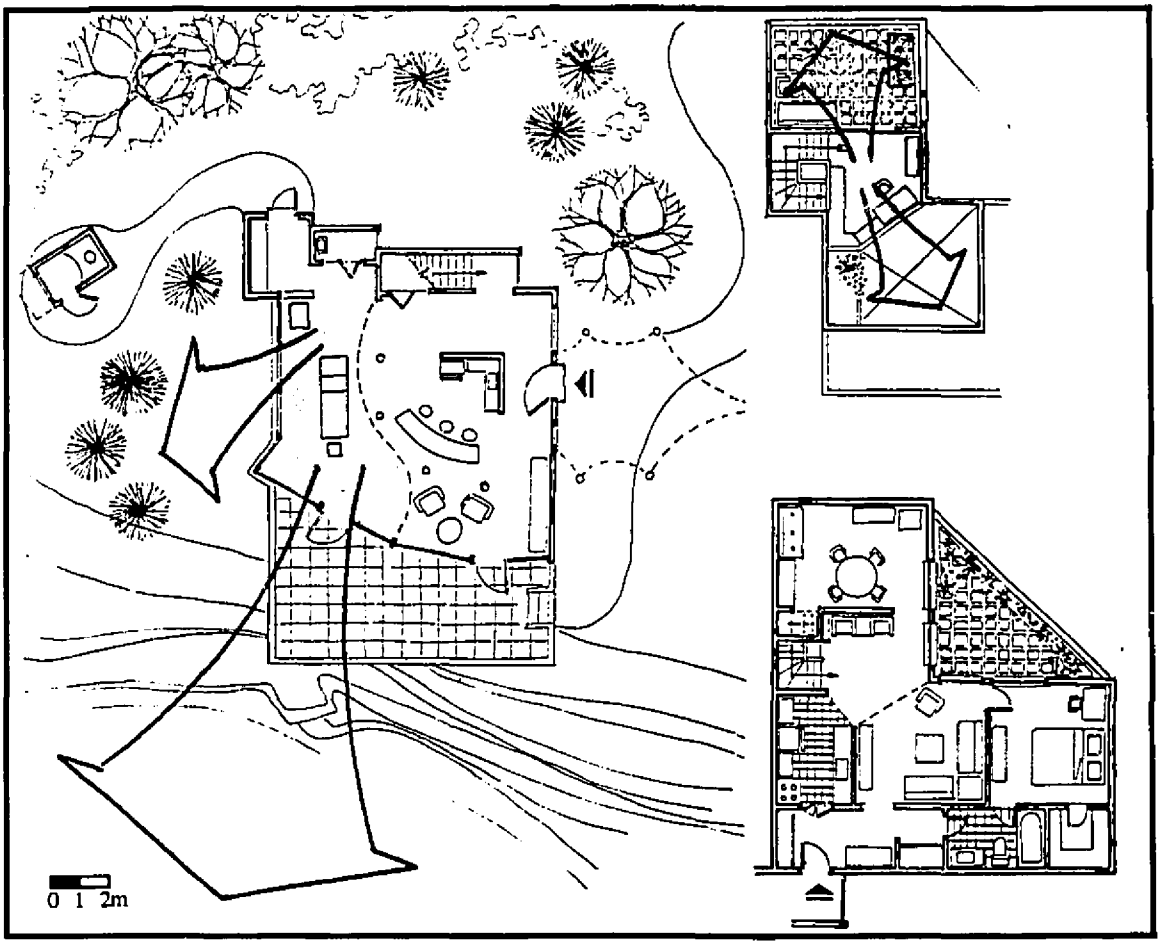


Fig. 16. Respondents choices of ideal home office placement.

Having determined the general location of the office in the home the next design issue that arises is the degree of definition and demarcation between the working and living zones of the house. The case studies provided some insight into this area. The Richmond home office was most separated because it occupied the entire basement level which was both acoustically and physically defined. It was also large enough to operate independently of adjacent spaces. The worker never felt "claustrophobic" or confined even though he commonly spent twelve to fifteen hours a day working at home. The washroom was the only exception to this functional separation. It was situated upstairs next to one of the children's bedrooms which was an inconvenience. This was not a problem for the outside employees but when clients were expected the home worker always scouted the route to the washroom and cleared it of "domestic debris."

The Vancouver home office is spatially defined by being the sole function occupying a loft. A terrace immediately adjacent to it provides relief for the worker as well as a sense of space. The size of the workspace itself is problematic. It is rather small and is shared by two people. Even though they work at different times they limit themselves to the use of their individual work areas. The added visual space provided by the terrace and the double height ceiling seem to compensate for the lack of physical space in the loft itself (Fig. 17). The Tofino home office, although occupying the living areas of the house feels the most open as it is defined by a canopy of trees on the north side and by the ocean on the West side.



(Fig 17) Vancouver and Tofino home offices, shading represents actual space while arrows represent apparent spaces, by author.

Spatial Requirements

The fundamental demands of the home office are the space requirements and the organizational demands necessary for the proper functioning of work. The optimum size of a home office was found to be 25 square metres by Ahrentzen and 20 square metres by Gurstein.[1] Given such requirements, space emerges as the primary constraint behind establishing a home office. Single-family-home dwellers are therefore typically better equipped for absorbing an office into their homes. Other house types by virtue of their small areas will have to sacrifice some of space prieviously allocated for living functions.

Telecommuting is the least space consumptive of the home office categories. By virtue of its reliance on the computer for information storage the telecommuting home office will create the least impact on the living space of the house. As is indicated in Figure 18, the two home workers that depend on a computer for their operation, have the smallest home offices (West Vancouver, telecommuter; Montreal, writer). What is also informative in this spatial comparison is the ratio of office area to the overall dwelling area. Once again computer reliant home offices are less demanding than home based businesses.

The Richmond home office, which is a single family home, was the only one to exceed the prescribed 25 square metres. The only other single family home studied, (West Vancouver) was only 5.5 square metres. The main difference between the two home workers of course, is that one is a home-based business operator while the other is a telecommuter. This may suggest that perhaps the figures that Gurstein and Ahrentzen arrived at will become outdated with the increasing replacement of cabinet storage with electronic storage.

[1] Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990) 137

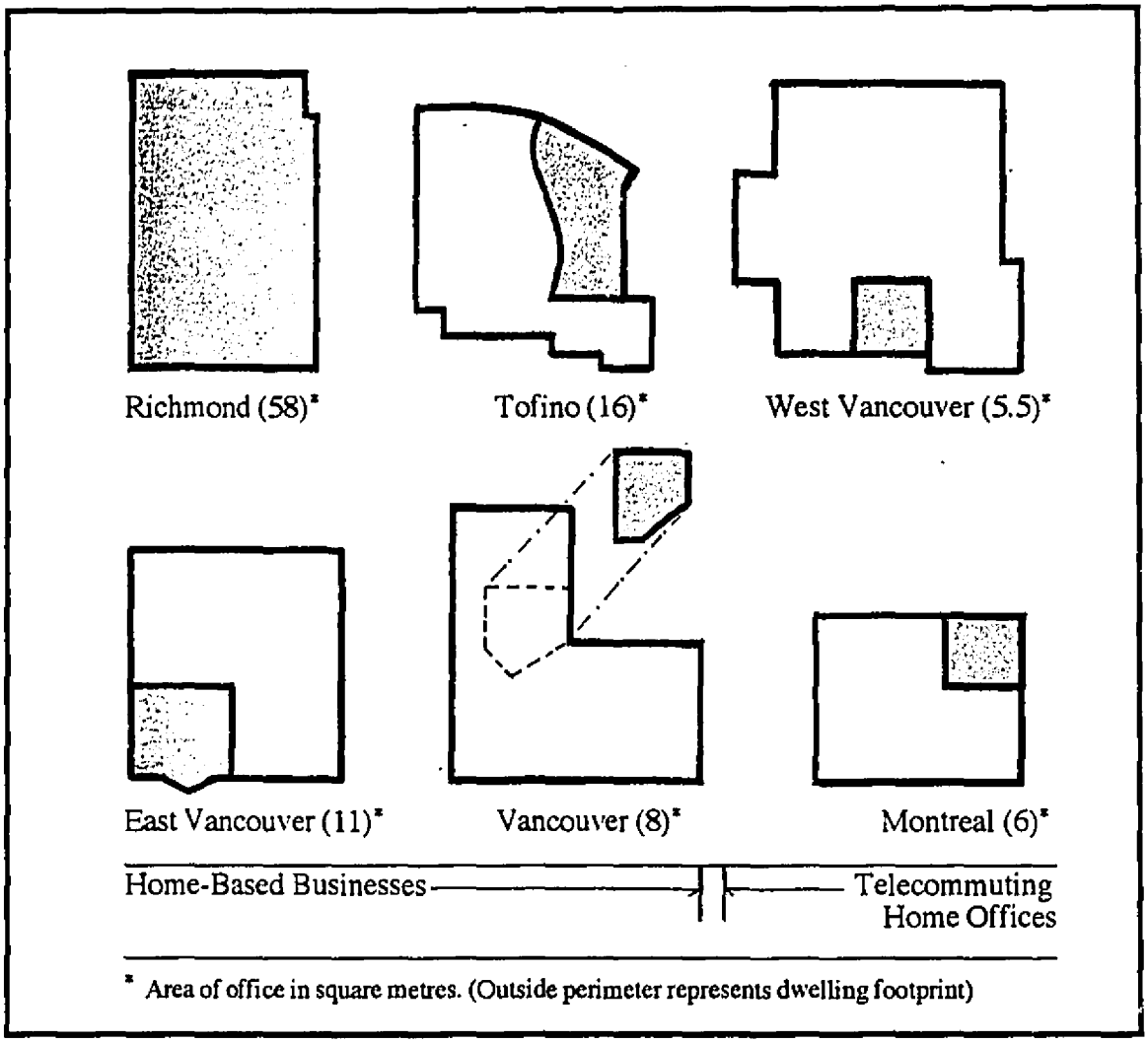
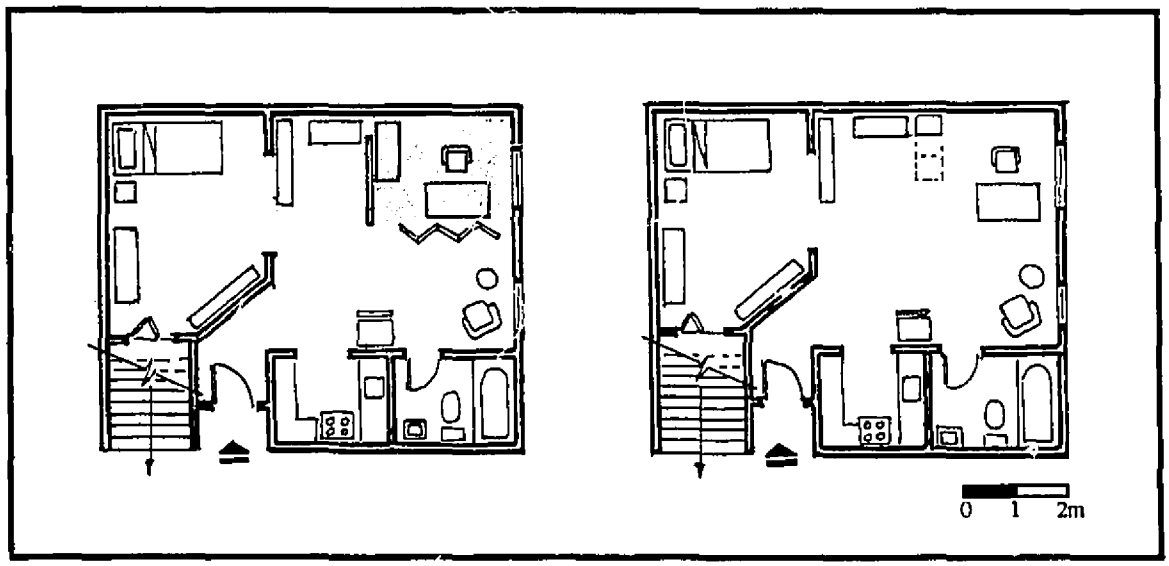


Fig. 18. An area comparison of the home office case studies, by author.

Until we are completely immersed in the *age of information* storage will continue to be an important design consideration. All the home workers interviewed expressed a desire for more storage space. Storage is especially problematic for apartment dwellers who have to exercise a great deal of creativity in meeting the same office needs in a much smaller area. Partitions and items of furniture have to take the place of walls in defining the work area. A dining table may double as a work surface for example. Murphy beds (beds that fold up against the wall) and rolling cabinets are commonplace. The choice of furniture also requires a certain decorative sensitivity. After all, the private sanctuary of the bedroom may be exposed to the scrutiny of a complete stranger.

The Montreal home office was observed through a transformation that occurs on a regular basis. At least once a week, usually on week-ends, the working arrangement of furniture is transformed to a living arrangement. A folding partition and folding table are removed, while a large wooden chest that functions as paper storage is wheeled away to become a bench (Fig. 19). The small studio apartment thus supports two functions without compromising the integrity of either function. Flexible and movable items of furniture can therefore relieve some of the restrictions of a small confined space.



(Fig. 19). The Montreal home office in working mode to the left and in living mode to the right.

Gurstein found that the work area should be organized in such a way as to define and separate the areas in which distinct tasks are performed. This is consistent with conventional office research.[1] Each task can be made more efficient by ensuring that the immediate environment surrounding that task is conducive to its proper functioning. In light of space constraints many home offices function much the same way as a one person band. Perhaps the instruments are not all "played" simultaneously but they all share the same locale. A single desk may be home to the computer, the printer, the telephone and

[1] James E. Rappoport et al. Office Planning and Design Desk Reference, (New York, John Wiley and Sons, 1991) and Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990)

the fax and answering machines; while simultaneously providing for the traditional functions of task performance and storage.

The balance between having equipment within easy reach, and being cluttered and crowded by that same equipment is critical in facilitating smooth task performance. The home offices studied indicate that there is a direct relationship between the size of area available for the office and the area that will be claimed by each function or equipment. The Richmond office provided the most insight as it is by far the most spacious (Fig. 18). The large area of the office allowed for a sparse distribution of four workstations. Yet those individual stations were perfectly defined by a dense arrangement of tools that occupy an area within the circumference of arms reach, and in one case, within a two "step" motion of a chair on castors. Workstation design will vary from occupation to occupation and should be tailored to the needs of the individual so as to permit the smooth operation of tasks. Excessive twisting of the trunk, neck, shoulders and arms should be avoided.[1]

The greatest change confronting almost all office environments today is the onset of the *age of information.* Information that has previously been scattered in filing cabinets all over world, can be stored electronically and is accessible through a few strokes of the keyboard.[2] With the advancement of micro-chip and semiconductor technology not only has the price of personal computers and their support equipment been steadily decreasing, but so too has their size. This has positively impacted the ability of a home to absorb the office function. The increased affordability and decreased space requirements of computers renders the transition to home work sustainable from the point of view of individual household budgets.

This not only allows workers to be located almost anywhere that they choose, but it also brings vast pools of information, resources and contacts to within arms

[1] Michael J. Smith, Health Issues in VDT Work, ed. John Bennett et al, (Englewwod Cliffs, New Jersey, Prentice-Hall, Inc., 1984) 212

[2] Wilbert Galitz, The Office Environment, (Willow Grove Pennsylvania: Adminstrative Management Society, 1984) 16

reach of any computer operator.[1] Furthermore, the effects of other technologies such as fiber optics are yet to be fully realized. Where the micro-chip revolutionized the world of computation fiber optics promise to revolutionize the world of communication. Rather than being able to conduct a single mode of communications along a single phone line, the transmittal that fiber optic cables will allow are multi-directional and multi-modal. One will be able to send graphic information, verbal messages as well as a video image all along a single cable infrastructure.[2]

Even though all the advancements in office technology discussed thus far will ultimately influence the functioning of a typical office scenario, only a handful of these innovations will affect the ergonomics of office design. It is the computer with its accompanying visual display monitor that will affect the spatial configuration of a work station and not the amount of memory that it can hold, or the amount of information that it can access. However, the degree to which workers rely on electronic databases for the performance of their work will affect how much human contact they experience in the course of their work. This will in turn affect the design objectives of the work place in terms of facilitating or enhancing human contact to compensate for that which was replaced by the computer. These issues will be touched upon in the following chapter in light of the personal and social consequences of working with automation in isolation. The following section of this chapter will discuss those technologies which have caused a direct physical change in the ergonomics the office.

Computer use in offices has grown to such an extent that it demands consideration as an integral part of office design, and, by extension, home office design.[3] The computer has thus become the heart of most office functions and the command center

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[1] Wilbert Galitz, The Office Environment, (Willow Grove Pennsylvania: Adminstrative Management Society, 1984) 48

[2] Michelle D. Gouin and Michael B. Cross, Intelligent Buildings: Strategies for Technology and Architecture, (Homewood, Illinois: Dow Jones Irwin, 1986)

[3] 55 percent of all work-at-home households use computers, Jeff Meade, Home Sweet Office (Princeton: New Jersey: Peterson's, 1993) 9

for almost all office tasks. All the different computer office functions enabled through the various software programs are conducted through the mouse or keyboard. The space requirements of a computer are therefore far less demanding than the filing cabinets that it replaced. The computer, or more accurately, the visual display monitor (VDT), has to be integral to the desk or workstation.[1] The keyboard must be positioned in such a way that renders its use comfortable for hours on end. Workspaces must be designed with this in mind not only for the satisfaction of the physical demands of having everything within arm's reach, but also for the creation of an environment that is psychologically conducive to extended hours of work in a single position.

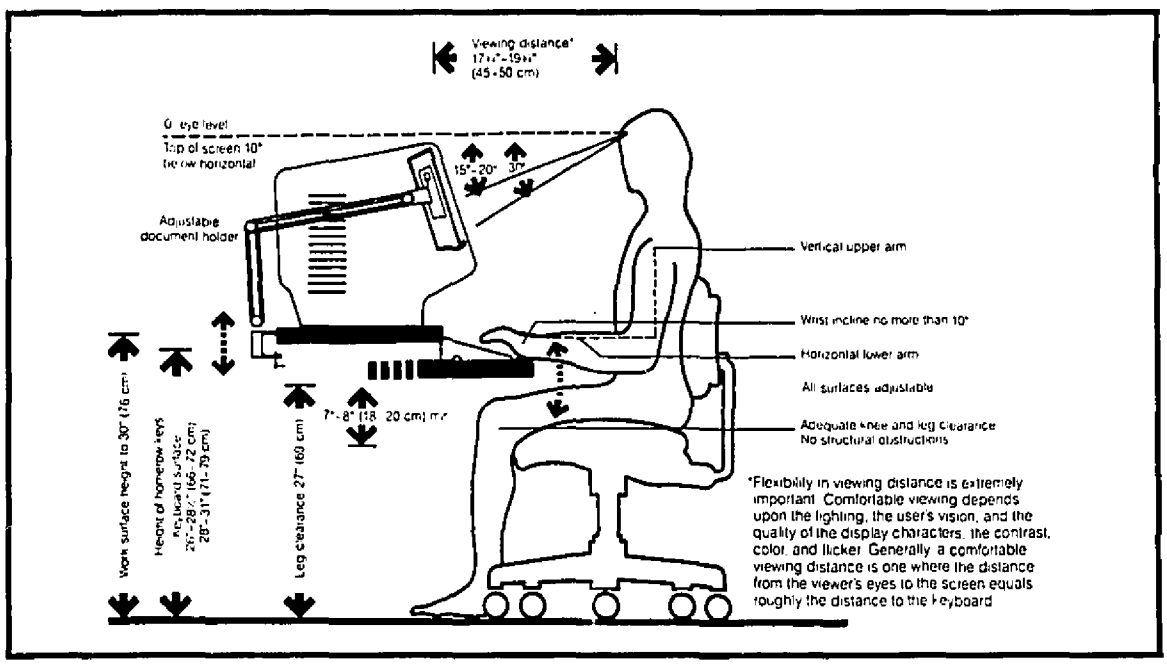

Fig. 20. Ergonomics of workstation design, from William L. Pulgram and Richard E. Stonis, Designing the Automated Office New York: Whitney Library of Design, 1984.

Several authors have written extensively on the subject of workspace requirements and there are a number of design guidelines that are common to all of these

[1] Computers or central processing units need not be within reach of their users as long as the disc drive is within reach.

authors.[1] There has also been much rhetoric but considerably less research and unanimity in design guidelines that target the psychological implications of office design. The most commonly discussed element of office ergonomics is the profile of the office worker seated at his or her desk. The critical dimensions most frequently used for office workers are summarised in Figure 20. As the figure indicates, there is a wide range of specific dimensions for various surface relationships of work station configurations. Each work area should be designed around the specific dimensions of the person that is to use that area. Wagoner and Ruprecht suggest a rule of thumb procedure by which an individual's particular dimensions could be determined.[2] According to them, the seat height should allow the feet to rest flat on the ground while the thighs are at a slightly upward angle. The back of the chair should then be adjusted to support the lumbar concavity (the concave arch in the lower back). From this comfortable seated position the work surface height can be established by ensuring that the workers forearms are at ninety degrees or slightly greater.

Office Infrastructure

The mechanical demands of the modern automated office reflect its complete dependence on electricity for its operation. From computers to fax machines to photocopiers the office is a consumer of electricity. Not only does this demand more sophisticated wiring systems than that of the average house, but it also requires more attention to heating, cooling and ventilation. The high concentration of electronic equipment and lighting in a place that is occupied for long hours requires delicate temperature control mechanisms.

Intensive electrical demands require the installation of separate circuits for the home office that are completely independent of the rest of the house. Certain household appliances such as heaters, water heaters, refrigerators, freezers and vacuum cleaners

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[1] Bruce Christie (1987) 52, Dennis Jarrett (1984)132, Wilbert Galitz (1984) 56, Wagoner and Ruprecht (1987) 317, Richard Long (1987) 277

[2] Kathleen P. Wagoner and Mary M. Ruprecht. Office Automation: Technology and Concepts. (New York: John Wiley and Sons, 1987)

require large doses of electricity that can threaten computer operation and threaten the integrity of sensitive computer circuitry.[1] Gehl reports that "something as simple as plugging a vacuum cleaner into the same circuit as a computer or fax machine can cause an electronic device to go haywire."[2]

In the interests of sustaining the home office and its needs for long periods, flexibility of equipment placement should be integral to wiring design. This requires either an adjustable socket system or system of extension chords of sufficient current carrying capacity and insulation. The proximity of children to office equipment adds an extra challenge in designing the infrastructure of the home office. Conduits and power bars must be hidden for aesthetic reasons as well as for the safety of the children that might otherwise come into contact with them. Once again much can be learned from office interior design. Access to electrical sources has been achieved in a variety of different ways ; dropped ceiling systems, raised floor systems, under floor ducting, floor drilling, flat wires and base board panels.[3]

Base board panels require the least amount of new construction while still using conventional wiring. This system is slightly more restrictive than the others in that it requires equipment to be placed towards the perimeter of the room where there are baseboards. This will not be a problem in the typical home office housed in a relatively small room. Furthermore, its lower installation cost makes this option more affordable yet sufficiently flexible to be sustainable in the long run.

Conventional residential wiring has thus far been sufficient for the operation of standard office equipment including personal computers and photocopiers. Nevertheless additional phone lines are helpful for the smooth operation of the business. Interviewed

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[1] Thomas B. Cross and Marjorie Raizman, Telecommuting: The Future Technology of Work, (Homewood Illinois: Dow Jones Irwin, 1986) 93

[2] John Gehl and Susan Douglas, Edupage, (listproc@educom.edu, March 21, 1995) from Tampa Tribune, March 19, 1995, B1 and F1

[3] Thomas B. Cross and Marjorie Raizman, Telecommuting: The Future Technology of Work, (Homewood Illinois: Dow Jones Irwin, 1986) 94

home workers have found that the ideal scenario would include four separate phone lines: a dedicated modem line for the computer, a fax line, a business line and a personal family line. A major breakthrough in communication technology that promises to positively affect the sustainability of home offices will eliminate the need for household fibre optics. This technology allows almost as much data as fibre optic cables to be transmitted through conventional copper wire. This would bring simultaneous two-way video and voice transmission to every home at a cost of about US$ 500: one quarter of the price of fibre optic cable installation. It would also save approximately US$ 600 billion that would otherwise be spent digging up existing copper lines and replacing them with fibre optic cables.[1]

The conventional approach to office design incorporates flexibility as a primary objective. Flexible workstations with flexible support systems have been developed to accommodate the changing needs of a dynamic work environment.[2] As a result, construction technology for the interior architecture of offices has developed furniture systems that are light, movable and adjustable. The nature of a home office is not of course as dynamic as an open plan office building, nor does it have the same demands for flexibility. Nevertheless, providing home workers with the ability to adapt their home offices to their changing needs is conducive to the sustainability directive of conservation. Flexible panels utilized in office buildings can be used to partition home offices that are otherwise not separated from living spaces.

The infrastructure of the home itself is being influenced by office building technology. The concept of an intelligent building that has a central computer that monitors and automatically adjusts environmental controls and levels of illumination in each and every room, was first introduced in office buildings before it was exported as the "smart

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[1] John Gehl and Susan Douglas, Edupage, (listproc@educom.edu, March 16, 1995) from Investor's Business Daily, March 15, 1995) A13

[2] James E. Rappoport et al., Office Planning and Design Desk Reference. (New York: John Wiley and Sons,1991)

house."[1] Aside from the advantages of energy efficiency and environmental comfort, the single-system approach of the smart house can be united with communications and information systems allowing the home office to be situated in any room in the house.

Proper lighting was cited by the interviewed home workers as being one of the most important design considerations, second only to sufficient space. It is essential for the performance of tasks and for the ability of the home worker to sustain prolonged hours of work. Lighting levels must fall within a comfort range that provides sufficient light to avoid eye strain yet not enough to cause glare. In the home office, especially one with a personal computer, direct glare from a VDT or light source will be encountered as well as indirect glare reflected off the working surface. To avoid light source glare, lighting fixtures must be placed in such a way that creates an angle of light between 30° and 60° from the vertical (Fig. 21).[2] In addition, surfaces without glossy finishes and paints should be chosen to further inhibit glare problems.

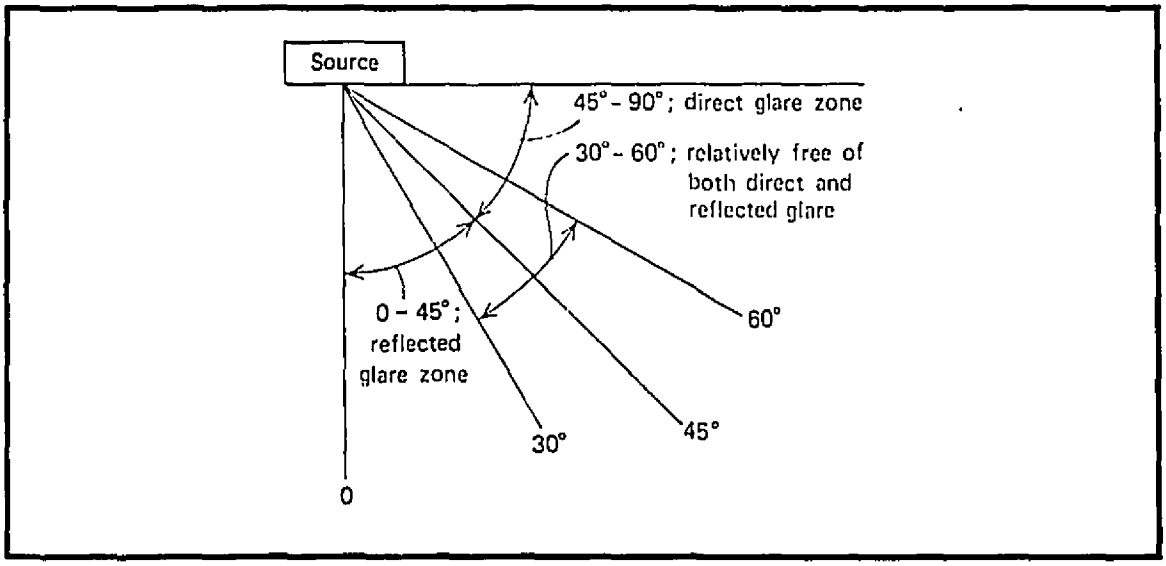

Fig. 21. Recommended light source angles, from Stein et al. Mechanical and Electrical Equipment for Buildings, (New York: John Wiley and Sons, 1986) 903

[1] James E. Rappoport et al., Office Planning and Design Desk Reference. (New York: John Wiley and Sons,1991)

[2] Stein et al. Mechanical and Electrical Equipment for Buildings, (New York: John Wiley and Sons, 1986) 903

VDT glare can be minimised by ensuring a level of contrast between the monitor and the surrounding field of vision that is a minimum of 3:1.[1] While peripheral brightness caused by individual light sources causes eye strain, so too does the absence of light sources other than the VDT.[2] This is especially important with respect to home offices that share their space with other living functions. It is not recommended, for example, to turn off the light to allow a spouse to sleep while continuing to work with a VDT in a dark bedroom.

The actual lighting levels recommended for work areas vary with the type and intensity of the individual task. If a task involves only on-screen reading then 300 lux is recommended. If hard copy reading is interspersed with on-screen reading then 500-700 lux is recommended. Back and forth movement between VDT and hard copy must not involve a change in lighting levels. While contrast and glare are reduced by overhead dispersed lighting, some tasks are better served by individual task lighting.[3] Those tasks that are visually difficult and prolonged require 600-900 lux, and tasks that are prolonged, visually difficult and critical in nature require 800-1200 lux.[4]

Another home office design issue that is only partly related to equipment use is static electricity. Although it is usually nothing more than a nuisance, static electricity can be a problem around electronic equipment. Long before it reaches a level that is noticeable or annoying to humans, static electricity can cause computer circuits to be disturbed.[5] Static electricity is cause by the abrasion of synthetic materials with waxed, painted, varnished and otherwise finished surfaces. Therefore, the unfinished surfaces

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[1] Michael J. Smith, Health Issues in VDT Work, ed. John Bennett et al, (Englewwod Cliffs, New Jersey, Prentice-Hall, Inc., 1984) 210

[2] Maggie Spilner, "New Help for Terminal Vision," Prevention, (March, 1994) 115-116

[3] Michael J. Smith, Health Issues in VDT Work, ed. John Bennett et al, (Englewwod Cliffs, New Jersey, Prentice-Hall, Inc., 1984) 210

[4] Stein et al. Mechanical and Electrical Equipment for Buildings, (New York: John Wiley and Sons, 1986) 886

[5] It takes 10,000 to 15,000 volts for humans to be disturbed and as little as 3,000 volts for computers. Thomas B. Cross and Marjorie Raizman, Telecommuting: The Future Technology of Work, (Homewood Illinois: Dow Jones Irwin, 1986) 94

conducive to comfortable lighting are also helpful for reducing static electricity in the home office. Polystyrene materials and electrostatic photocopiers should be avoided and comfortable humidity levels which limit static electricity should be maintained.

The home office inherently has to operate on a much lower per person overhead cost than a corporate office. Therefore, the energy consumed by computer equipment and office lighting warrants the employment of energy conservation practices in the home office. The following methods were used by the surveyed home workers to control and conserve lighting.

- Maximizing the use of natural lighting, both direct and indirect.
- Lighting design that puts greater emphasis on task lighting and less on overall overhead lighting.
- A balance between the level of illumination of the computer screen and that of the surrounding area.
- Shading devices for a finer tuning of the level of light required.

It was found that air temperature manipulation contributes more to overall energy consumption than any other office necessity. If sustainability directives of conservation and alternative energy use are included in the design of the home office energy performance would improve. In addition environmental accounting would indicate the long-term sustainability of inefficient and consumptive heat sources such as electric base board heaters. These should be avoided and replaced by more sustainable heat sources, such as *geothermal heat pumps* that tap into underground heat.[1] It is recommended that every decision during the design and construction of the infrastructure of the home office should reflect sustainability directives as well as the performance requirements of human habitation.

[1] Avi Friedman et al. Sustainable Residential Development: Residential Development Planning and Design Construction Principles. (Montreal: McGill University, 1993) 1.7.3

SUMMARY OF FINDINGS

The construction and mechanical demands of the home office were found to be relatively minor relative to the overall demands of house construction and maintenance. Therefore home office installation can only be a minor factor in the sustainability discussion. Home office set-up costs were discussed in the previous chapter and these have to be balanced against any monetary savings that working at home achieves. The sustainability and indeed the initial viability of a major shift towards home work will ultimately be dependant on the ability of the home to accomodate the space demands of the home office. The responces responces seem to indicate however that ample space is available. Forty six percent of respondents are already working in a separate office space. If this is in any way similar to the overall work force, then perhaps home office space can easily be absorbed by the average dwelling. This may be due to the fact that the majority of society's residents are suburban dwellers.[1] Given the excessive consumption typical of suburbs, having them be the neighbourhood type that is most able to accomodate home work is a significant finding in the context of sustainability.

It was found that home-based businesses have many more spatial requirements than telecommuting home offices, in terms of both office location and size. If the shift to home work is to avoid requiring a simultaneous shift in the size of the home, then the typical spatial and functional structure of homes has to be revisited. Interior home design has to enable a certain overlap of functions and sharing of spaces. Rooms catering to functions that previously seemed necessary might have to be claimed by the home office. The degree to which this role overlap is sustainable will be further discussed in the next chapter. In the cases in which a dwelling is simply too small to accomodate an office neighbourhood telecentres could become an alternative working location that offers similar benefits to working at home while providing ample office space and related supportive services.

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[1] Refer to Chapter Two p. 21

GRAPHIC SUMMARY

AREA OF SUDY		FINDINGS	SUST. DIR.	RECOMMENDATIONS
OFFICE LOCATION	HBB	• Perimeter	n,o,p,t,u	Close to entrance Solar access
	TELE	• Perimeter	n,o,p,t,u	Solar access
OFFICE SPACE REQUIREMENTS	HBB	• High	q	Allow overlap with living Shared community offices
	TELE	• Low	N/A	Demarcate
INFRASTRUCTURE	HBB	• N/A		
	TELE	• Low	n,o,p,t,u	Encourage copper cable innovations Separate office wiring

SUST. DIR.: Sustainability directives that need to be incorporated. Letters refer to directives from Fig. 9 Chapter 2, p. 35 (copied below) HBB: Home based business TELE: Telecommuter

URBAN SCALE	SUSTAINABILITY DIRECTIVES	
SUSTAINABLE DEVELOPMENT	a	• Reduced consumption and waste production
	b	• Multi-disciplinary, economy, society, environ.
	c	• Localization of consumer products life cycle
	d	• Environmental accounting
	e	• Proximity to natural environment
SUSTAINABLE PLANNING	f	• Alternative transport (non-automotive)
	g	• Pedestrian planning
	h	• High density
	i	• Mixed use
	j	• Inhibit lateral development (urban sprawl)
	k	• Preserve natural "features"
	l	• Urban farming
	m	• Ecological waste management
SUSTAINABLE ARCHITECTURE	n	• Reduce excessive constr consumption &waste.
	o	• Select local and low impact materials
	p	• Recycle buildings and materials
	q	• Provide opportunity for community
	r	• Preserve natural elements
	s	• Allow for gardens, composts, water treatment
	t	• Utilise alternative energy (solar wind etc.)
	u	• Adopt energy efficiency

CHAPTER FIVE : THE QUALITY OF LIVING AND WORKING IN A SINGLE LOCATION

Quality of life

One of the most popular reasons cited by home workers as their primary incentive for working at home is the sense of control that it affords them.[1] Control may also be termed freedom, independence, or reduced stress. Whatever the term, its meaning revolves around the issue of the quality of life. This is an abstract concept triggering different meanings in different people. It varies with culture and personality. The term itself, however, implies an aspiration for that which is desirable. This chapter will entertain several aspects of the notion of desirability. The final two sections will cover issues affecting the mental and physical well being of the home worker. The desirability of these "qualities" is self-evident in most ideological contexts. The first section, however, will attempt to grasp qualities that are more difficult to define.

Canada Mortgage and Housing Corporation identifies a number of issues that it considers to be important indicators of housing *livability*. These are economic vitality, social well being and environmental integrity.[2] These indicators will be used with some modification to discover the relative livability of the home working lifestyle. The social well being indicator will be discussed in the context of family life and the isolation aspects of social activity will be seen in light of the mental health of the home worker. The relative productivity of home workers will be considered not necessarily as a measure of happiness, but more as an indicator of job satisfaction. Environmental integrity is an issue broader than the scope of this chapter and is discussed throughout the thesis.

Home workers have, for the most part, reported an improved quality of life. Most workers interviewed by Quaid et al. felt more in control of their lives and

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[1] The home workers interviewed chose it for this reason similar to the findings by Robert E. Kraut,"Telecommuting: The Trade-Offs of Home Work." Journal of Communications, summer 1989, 34 and Jeff Meade Home Sweet Office. Princeton, New Jersey: Peterson's, 1993, 36

[2] David H. Sherwood, "Identifying the Quality of Life in Your Community: Quality of Life Indicators." Plan Canada (November 1993) 12

happier as a result of telecommuting.[1] Positive affects of telecommuting on the quality of life have also appeared in the neighbourhood center or telecenter. In the case of workers from various departments and various hierarchical levels within a single company, telecommuting from a single telecenter created a diversity of in-office contacts which was very much appreciated. Other studies, however, have found a certain level of segregation occurring in similarly diverse office environments.[2]

Work productivity could further indicate the level of work place satisfaction. There is considerable difference in the range of home worker productivity increases cited by researchers, but they are in agreement that the change is always a positive one. Productivity changes range from minimal increase to 100 percent increase. Gordon states that an increase of 15 percent to 25 percent is virtually assured.[3] Mckittrick reported a 10 to 30 percent increase in a pilot program at Bell Canada.[4] Quaid et al. reported that 88 percent of the telecommuters they surveyed said their productivity had improved, and 70 percent said that their personal time management had increased. Some of the qualitative research they conducted on productivity improvement estimated a tenfold increase.[5] In addition, a survey conducted by Nilles in 1987 found that telecommuters generally reported an improvement in their working relationships.[6]

An interview by the author of a Boston investment banker revealed that 30 percent of his time at the office was wasted by either participating in, or being disturbed by, office "small-talk." He reported being far more productive when he works at home. This aspect of more efficient use of time use is supported by the findings of several researchers. According to Ramsower these people are choosing to work "self-determined hours" at

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[1] Maureen Quaid, and Brian Lagerberg, Puget Sound Telecommuting Demonstration, 1992, 25

[2] Jack M. Nilles, Traffic Reduction by Telecommuring: A status review and bibliography, Transportation Researh-A, (Vol. 22A, No.4, 1988) 306

[3] Jeff Meade Home Sweet Office. Princeton, New Jersey: Peterson's, 1993, 42

[4] Marcey Mckittrick, "Confessions of a Teleworker," Telework 1994 Symposium (Unpublished conference proceedings, Ottawa: CMHC, 1994)

[5] Maureen Quaid, and Brian Lagerberg, Puget Sound Telecommuting Demonstration, 1992 1

[6] Jack M. Nilles, Traffic Reduction by Telecommuring: A status review and bibliography, Transportation Researh-A, (Vol. 22A, No.4, 1988) 306

home at a "self-determined pace." People have fewer distractions and fewer opportunities for socialization, and are therefore able to concentrate for longer periods and produce more work in a shorter period of time than when they work in a conventional office.[1]

In the case of salaried telecommuters increased productivity has resulted in a relative increase in pay. Pratt reports that on average, salary gains for telecommuting men are between US$ 1,694 and US$ 3,383. Women telecommuters experience an increase of US$ 1,552. In the case of home-based business, it does not have a significant effect on women and negatively affects men.[2] These findings suggest that perhaps the productivity achieved by working at home is offset by the financial burden of operating an independent business. This may also be related to Pratt's findings that it is only the self employed that have the possibility of child care "presumably because the owner has control over the time and place of work."[3] Perhaps home-based business owners sacrifice a relative drop in income simply to be more attentive to family members, in which case a drop in income cannot be construed to be synonymous with a drop in the quality of life.

Nevertheless, a certain type of home work definitively diminishes the quality of life of those who practice it. It has been termed the *electronic sweatshop.* The International Labour Organisation monitors the conditions under which home workers operate around the world and their report warns of everything from exploitation to appalling living conditions.[4] Contemporary literature on telecommuting has for the most part avoided the issue of worker exploitation. This may be due to the fact that it is generally confined to the poorest segments of the population, and that this particular segment is not typically equated with significant use of advanced technology.

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[1] Reagan Mays Ramsower, Telecommuting: The Organizational and Behavioral Effects of Working at Home. (Ann Arbor, Michigan: UMI Research Press,1985)

[2] Joanne H. Pratt, Myths and Realities of Working at Home: Characteristics of homebased business owners and telecommuters (Dallas: Joanne H. Pratt Associates, March, 1993) 42

[3] Joanne H. Pratt, Myths and Realities of Working at Home: Characteristics of homebased business owners and telecommuters (Dallas: Joanne H. Pratt Associates, March, 1993) 15

[4] International Labour Organization. Social Protection of Homeworkers (Geneva: International Labour Office. 1990)

Swardson sheds some light on the erroneousness of this assumption. Due to corporate restructuring in the wake of the latest economic recession companies are replacing $12-an-hour employees with $6-an-hour temporaries. These are essentially the same workers doing the same work for less money.[1] The general weakened condition of both national and international economies have caused companies and corporations to cut their costs and minimize their overhead by shifting their salaried employees to temporary contractual workers, many of whom operate out of their homes. Workers are hired according to need and are dismissed as soon as that need declines. This increased efficiency of the company transfers the costs of office overhead, unemployment and health insurance to the individual contracted on a temporary basis.[2] Health and safety of home workers in federal telecommuting programs in Canada, for example, are the responsibility of the worker.[3] These factors will undoubtedly affect the quality of life of the telecommuter.

Family Life

Demographic trends are important in understanding the family life issues encountered by the home worker. One of the biggest demographic changes in the last three decades was the amount of women that joined the financially remunerated work force. The number of self employed women grew by seventy five percent compared to twenty five percent for their male counterparts. Half of these self-employed women have businesses in their homes.[4] Popular literature suggests that home work is ideally suited for those mothers who want to continue a successful career while participating in the growth of their children.[5] It has also been suggested that if the children of aging baby boomers

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[1] Roger Swardson, "Greetings from the Electronic Plantation," Utne Reader, (March/ April 1993) 88-93

[2] Thomas B. Cross and Marjorie Raizman. Telecommuting: The Future Technology of Work (Homewood, Illinois: Dow Jones Irwin, 1986) 9

[3] John Baglow, "Concerns of Organised Labour," Telework '94 Symposium, (Toronto:unpublished conference presentation)

[4] Beverly Lozano, The Invisible Work Force: Transforming American Business With Outside and Home Based Workers. (New York: The Free Press, 1989)

[5] Barbara Orser and Mary Foster. Home Enterprise: Canadians and home based work. (Abbotsford, B.C.: The National Home-Based Business Project Committee, 1992) 85

choose not to entrust the care of their parents to nursing homes, and cannot afford professional nursing care, then working at home might enable them to care for their parents while continuing to work.

Empirical findings suggest that this is not always the case. Only 17 percent of the home workers surveyed by Ahrentzen were the sole caregivers for their children, while 57 percent did not take care of children while working.[1] Gurstein found that in the majority of cases work and child care cannot be performed simultaneously.[2] A Vancouver architect interviewed by the author initially attempted to care for her daughter while working but always felt like she was either neglecting her work or neglecting her child. Hiring a baby-sitter to care for her daughter at home did not work either. She found that she could not resist her daughter's cries even though she knew she was being taken care of. Finally she resolved the conflict by using a local day care centre and working at night after the child had gone to bed.

Dawson and Turner found that the ability to earn an income while being involved in child rearing was the major reason for choosing to work at home amongst the women that they studied .[3] Pratt found this dual responsibility to be possible only in cases where the home worker is self-employed.[4] Other authors have alluded to the advantages of home working in relation to general family life and the health and well-being of children.[5] By being at home all day a home worker can better manage his or her time to get the most out of both worlds. Work would be scheduled when their is least disturbance from family members, while breaks from work need only occur when family obligations necessitate.

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[1] Sherry Boland Ahrentzen, Blurring Boundaries: Socio- Spatial Consequences of Working at Home (Milwaukee, Wisconsin The School for Architecture and Urban Planning, 1987) 82

[2] Penelope Gurstein, "Telework: Housing and Urban Design, " Telework 1994 Symposium, (Toronto: unpublished conference proceedings)

[3] Wendy Dawson and Judy Turner, When She Goes to Work She Stays at Home (Canberra: Australian Government Publishing Service, 1990) 20

[4] Joanne H. Pratt, Myths and Realities of Working at Home: Characteristics of homebased business owners and telecommuters (Dallas: Joanne H. Pratt Associates, March, 1993) 15

[5] Silberstein and Benton (1985), Silver (1989), Ahrentzen (1987), Gurstein (1990), Allen and Wolkowitz (1987)

There is also some evidence to suggest that people are becoming more attached to their place of residence and are less motivated to disrupt their families lives by moving for the sake of a job. Cross and Raizman claim that twenty five percent of the of the population and forty two percent of executives in 1986 were unwilling to move to were jobs were located. They also claim that more parents are remaining in the home. More fathers are participating in child rearing and that the parents of teenagers are trying to be at home to help in what is being considered to be *vital adult guidance* during the after school hours.[1] Meier claims that the trend in the United States is to schedule more "Quality time" with family and close friends.[2] If home work does indeed allow people to experience greater satisfaction by allowing them to cater to both their work and family needs then, by definition, it contributes to the quality of life of those who practice it. The following discussion will shed some light on some of the less positive aspects of combining family and work.

Although combining the functions of living and working into a single location gives rise to greater satisfaction in both family life and work life, it can also lead to an overlap of roles which will in turn lead to conflict. When and where does the worker stop being a worker and becomes a parent? What are the physical and temporal boundaries that allow each role to be performed without invasion by the other? Even though statistical evidence demonstrates that work done at home is more efficient than work done in a conventional office setting, interviewed home workers have repeatedly complained about the distractions of working at home. Everything from proximity to the refrigerator to the playful clutter of children threatens to persistently interrupt the home worker.

Lefcourt conducted an experiment in which he assigned two similar groups of people an identical task to be performed under the duress of a loud annoying sound transmitted through a personal head set. One group of people was supplied with a button

[1] Thomas B. Cross and Marjorie Raizman. Telecommuting: The Future Technology of Work (Homewood, Illinois: Dow Jones Irwin, 1986)

[2] Meier, Richard. Ecological Accounts. Berkeley Planning Journal (Volume 9, 1994) 32

which, if depressed, would stop the sound. Needless to say the group with the button performed the task with more speed and fewer mistakes.[1] What is interesting however, is that not a single person actually used the button. This suggests that perhaps it is the freedom of control over one's distractions, and not necessarily control itself, that motivates one to ignore those distractions and work right through them.

There are both physical and behavioral methods for achieving this sense of control. A temporal claiming of territory was observed by some researchers as a method of segregating different roles. Workers have restricted themselves to only answering the business line during working hours and the personal line after work hours.[2] Another method is to erect physical barriers and partitions between the working and living functions.[3] Some degree of connection is essential, however, if the home worker wants to feel the presence of family members.

With regards to spatial demarcation Gurstein found a distinction along gender lines. Female home workers wanted a separate room to work in but wanted that room to be close to the active areas of the house. Male workers on the other hand, tended to want as much separation as possible.[4] The author's survey, however, found no such distinction between men and women. Although women constituted only 15 percent of those who responded the percentage of those wanting a separate room was not different to the percentage amongst men.

Another form of separation that was found to be necessary is a psychological one. The mental transition from informal patterns and habits associated with home to the formal discipline demanded by work, has been found to be of considerable importance. Home workers in studies by both Ahrentzen and Gurstein have had to adjust

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[1] National Research Council, Office Workstations in the Home, (Washington D.C., National Academy Press, 1985) 13

[2] Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990) 81

[3] Mike Gray and Noel Hodson and Gil Gordon, Teleworking Explained, (Chichester: John Wiley and Sons, 1994) 260-265

[4] Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990) 135

to the absence of the daily commute and the mental journey that it allowed. One home worker had to get fully dressed, walk around the block and come right back into his house to work. Another has to get formally dressed and unlock his work room.[1]

Gurstein's survey findings indicate that more often than not the problem is not isolation: it is a lack of separation between the serenity of the office and the noise and clutter of the rest of the house. Offices situated in lofts or finished garages with a direct connection to living areas provide a comfortable balance between the two extremes. The loft in the Vancouver home office for example, succeeds in achieving this balance. The loft was defined and separated by virtue of its occupying an independent level but was acoustically linked to the rest. The person working is able to call and talk to the person not working and vice versa. In a noisier household, however, such a degree of separation would be insufficient. Individual cases have to be considered for an optimum use of space that creates the desired degree of connectedness and separation.

Gurstein found that home workers can typically be defined as belonging to one of two groups in accordance with their lifestyle priorities; those who are domestically inclined, and those who are professionally inclined. The split has no relation to gender and members of both sexes have been found to belong to each group. Those who put their families ahead of their work when making choices feel that their careers suffer as a result, and vice versa. This implies that the key to merging family and work lies in achieving a fine balance between the two, which according to Gurstein is extremely rare.[2]

A workspace in which connection and separation can be simultaneously achieved requires a balance of physical proximity and movable partitions. The physical closeness would provide the connection and partitions would provide the option of visual

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[1] Jeffrey J. Celentano, "Hard times, High Tech and Home-Based Business," Plan Canada, November 1994.

[1] Sherry Boland Ahrentzen, Blurring Boundaries: Socio- Spatial Consequences of Working at Home (Milwaukee, Wisconsin The School for Architecture and Urban Planning, 1987) quoted by Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990) 81

[2] Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990) 72

and sound separation. Level changes and lofts would also create a balance of having a defined space that is still connected to the rest of the house.[1] As the following section will show, connecting the home office to the living areas is not necessarily conducive to the mental well-being of the home worker.

Mental Health

Electronic mail is an information age tool that promises to revolutionise work, and especially remote work. The term traditionally includes such technologies as facsimile and telex transmissions but the new manifestation of *e-mail* is cheaper, quicker and less consumptive.[2] E-mail is only one of many services that are made available on the Internet or the *Information Highway* . These terms describe a whole range of different electronic interactions that are possible using a personal computer, a modem and a number of different electronic services. These services include; retrieving data files from different computers around the world, accessing recent news and information, subscribing to newsletters and discussion groups dedicated to specific topics, accessing drawings and video images through interactive electronic pages and sending and retrieving mail to individuals or groups.[3]

Sixty-two thousand people from 75 countries participated in a recent electronic workshop conducted by a student at the University of Alabama entitled "Roadmap for the Information Highway."[4] The power of this new technology is such that it can cause individuals to become addicted to being connected to computer networks.[5] This

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[1] Refer to Figure 14, Chapter 4, p. 58 for an example of a loft providing connection and separation.

[2] Electronic mail uses no wood by-products and relies on local phone connections rather than on long distance ones, however it would be informative to tabulate exactly how much electric energy it takes for every page of text to be sent to a local gateway, on to the internet, to the destination network and finally to be accessed and read by the reciever.

[3] "Today's Internet is a global resource connecting millions of users that began as an experiment over 20 years ago by the U.S. Department of Defense. While the networks that make up the Internet are based on a standard set of protocols (a mutually agreed upon method of communication between parties), the Internet also has gateways to networks and services that are based on other protocols." Patrick Crispen, Roadmap, University of Alabama (listserv@ualvm.ua.edu, 1994)

[4] Patrick Crispen, Rdmwkdistrib, University of Alabama, listserv@ualvm.ua.edu, November 2, 1994

[5] Chidley, Joe. "Seduced by the Siren Call of Computers." McLean's (March 27, 1995) 50-51

fact, in addition to the seeming popularity of information technology and its relative youth, requires further research into the possible long-term personal and social consequences associated with its use.

Feelings of isolation and loneliness are common symptoms of working at home.[1] The lifestyle of typical full-time home workers is such that they sleep, eat and work under a single roof. They have little reason to go out and when they do go out, to buy groceries for instance, there is little opportunity for social interaction. The problem is exasperated with single home workers living alone. They have been found to experience feelings of isolation more than multiple resident households.[2] In addition, homeworkers have not increased the social function of the home in terms of entertaining visitors or friends.[3] Gurstein warned that if isolation is not dealt with it could lead to serious personal problems such as secret drinking. This is contradicted by Pratt's findings of home workers consuming less alcohol, drugs and cigarettes than those who do not work at home.[4]

Ahrentzen found behaviour modification to be a tool that home workers use to combat role conflict and isolation. According to her survey, the behaviour modifications resulting from a shift to home work include an increase in social activities outside the home.[5] Furthermore, as much as the information highway promises to diminish face-to-face interpersonal contact, it also has the effect of bringing people together in ways that have previously been unimaginable. "Women and other marginalised people in many places and occupations are using the electronic networks to maintain easy, quick connections to kindred souls with shared interests, nearby or far away."[6] A new

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[1] Daniel Wood, "Telecommuting: Stress and Social Support," Psychological Reports, 1994,74)1312-1314

[2] Refer to p. 89 second paragraph for a description of the isolation felt by the Montreal home worker.

[3] Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990) 95

[4] Joanne H. Pratt, Myths and Realities of Working at Home: Characteristics of home based business owners and telecommuters. (Dallas: Joanne H. Pratt Associates, March, 1993) 6

[5] Sherry Boland Ahrentzen, Blurring Boundaries: Socio- Spatial Consequences of Working at Home (Milwaukee, Wisconsin The School for Architecture and Urban Planning, 1987) 31

[6] Cheris Kramarae and Jeanie Taylor, Women Information and Technology. (Urbana, Illinois: WITS Colloquium, 1993) 52

technology named *Telepresence* which is currently being developed in Ontario, seeks to replicate face-to-face meeting through a computer interface. One will be able to hear and see multiple other users from across the globe and together they will be able to manipulate and work on any form of data.[1]

Technology enthusiasts have often countered the deterministic argument that considers telecommuting to be synonymous with isolation. They claim that the very machinery that facilitates remote work can provide a vital link to the outside world. The communication facilitated through computer networks such as those described above allow users to interact with colleagues outside the confines of national boundaries. Indeed the world is their limit. Although these advancements will contribute significantly to alleviate some of the feelings of isolation, digital communication cannot be expected to provide the same rewards that direct human interaction provides. It is difficult to imagine a computer terminal replicating the more intuitive sides of interpersonal communication.

The electronic sweatshop has already been described in light of its potential for worker exploitation. Another potentially negative effect of this type of home office is its propensity to isolate and consume the individual. The inherent privacy of the home inhibits the opportunities for worker support and creates a cocoon in which the refuge qualities of the home are diminished. If exploitation occurs outside the home, then at least the home can act as a haven to which the worker can escape. However, when the home is the place of long exhaustive underpaid labour, and also the source of many a domestic chore, then feelings of claustrophobia and entrapment such as those reported by Gurstein will inevitably arise.[2]

Although the problem of worker exploitation involves a complex web of socio-economic factors and can only be prevented through regulatory institutions it brings to light the general issues of stress and overwork. As the physical and mental boundaries

[1] Bell. Teleworking, the Technology, the Vision (Ontario: Bell Teleworking Sales Operations Support, 1994)

[2] Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990) 70

between work and leisure begin to fade, work hours begin to infiltrate every spare moment of the day. A common ailment afflicting home workers is overwork. The Montreal home worker interviewed by the author complained of feeling "trapped in a cycle of depression and overwork, ...every time I come home I feel like my pile of work is staring at me and I have to start working. Then when I work whenever I'm home, I get depressed that I don't have a life... I just can't get away from it." These feelings are rather severe but seem to be heightened by the small size of the home worker's apartment which is essentially a home office with a bed in one corner.[1] The relatively young age of the home worker also adds to the pressure she feels to have a more vibrant social life.

Wood found stress levels to be higher amongst people who work at home than it is amongst both telecommuters and conventional office workers. The distinction here is between exclusive home work and part time telecommuting. It is suggested that frequent trips to the office keep telecommuters from feeling isolated and forgotten. Duxbury found a marked difference in stress levels between men and women. Thirty-nine percent of the men interviewed perceived less work stress as a result of telecommuting compared to 4 percent of the women.[2] She also found that life satisfaction declined by approximately 7 percent for women and increased by 15 percent for men. This distinction along the lines of gender may possibly be due to spousal expectations that regard domestic and familial roles to be primarily the responsibility of the mother, even when both parents are income earners. Dawson found that 80 percent of the women she interviewed "indicated that they or their partner (and usually both) believed that the woman's primary responsibility was for the children and household management.[3] If traditional family roles evolve into a more equitable balance in the distribution of responsibilities between the parents it will probably be achieved through societal and public education. In the meantime

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[1] Refer to Fig. 19, Chapter 4, p. 66 for a plan of the Montreal home office.

[2] Linda Duxbury, "Telework: Enhancing the Quality of Life," Telework '94 Symposium, Toronto, unpublished conference proceedings.

[3] Wendy Dawson and Judy Turner, When She Goes to Work She Stays at Home, (Canberra: Australian Government Publishing Service. 1990) 20

architectural design sensitivity can provide some relief. By better defining the physical domain of income generating work in relation to that of family work stress associated with dual roles may be somewhat alleviated.

Another problem commonly faced by home workers is the lack of understanding on the part of other family members. Expectations are often conflicting regarding the exact role of the newly initiated home worker in the sharing of house chores and responsibilities. A spouse or neighbour may feel that since a home worker is at home, then they are available for providing child care or receiving social visits.[1] The East Vancouver Home worker was often interrupted by well-meaning friends who "drop(ped) by hoping to go for coffee on the drive." Workspace demarcation may begin to address this issue within the home itself, but it is important that spouses, friends and neighbours be made to appreciate the serious nature of the work done at home and that it is not time off work.

Psychological shortcomings are potentially the most detrimental consequences of working at home. Psycho-social factors will ultimately determine the extent to which telecommuting is adopted by society as a whole.[2] Needless to say this is not a problem with home based-business owners who are continually interacting with customers and clients, whether in the home or outside. However, researcher after researcher has found isolation and loneliness to be common problems amongst homeworkers in general.[3] Indeed it was found that some people simply cannot work at home due to lack of motivation.[4]

The futurist vision of the home as a hearth and source of a revived community consciousness has found no validation through empirical studies. Home

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[1] Mike Gray and Noel Hodson and Gil Gordon. Teleworking Explained (Chichester: John Wiley and Sons, 1994) 116

[2] Jack M. Nilles, Traffic Reduction by Telecommuring: A status review and bibliography, Transportation Researh-A, (Vol. 22A, No.4, 1988) 307

[3] Wendy Dawson and Judy Turner, When She Goes to Work She Stays at Home (Canberra, Australian Government Publishing Service. 1990)

[4] Francis Kinsman, The Telecommuters (Chichester: John Wiley and Sons, 1987)

workers have repeatedly been found to have no change in the perception of their neighborhood as a community. Their awareness of the ongoings of the neighborhood have not increased as a result of being at home for the majority of their time. The dream of neighborhoods becoming self-policing interactive communities has given way to the reality of work and its demands for undivided attention for long stretches of time. What has changed however, is the awareness on the part of home workers of the extent to which their neighborhoods are composed of isolated indifferent individuals.[1] Perhaps these are the beginnings of a self-motivated movement towards the very vision that the futurists described.

Physical Health

The question of health is given added weight by virtue of the highly inactive lifestyle of the new information worker. The automation of the office is a relatively new occurrence in the history of the workplace. Not enough time has elapsed since computers first became full-time tools to provide conclusive evidence of the long-term effects of Visual Display Terminals (VDT) on office workers. There is, however, enough evidence to prove that there are adverse side-affects to working on a computer eight hours a day and five days a week. What is not fully understood is how harmful this form of work can be if it continues for an entire lifetime.

With the percentage of the population in North America working with information technology increasing, it follows that the number of people who are continuously looking at a computer screen while working is also increasing. The situation may be such that people use a screen all day for work and continue to use a screen for leisure and entertainment. A common symptom of using VDT for excessive amounts of time is eye strain. This includes burning sensations, redness, headache, blurring of near

[1] Sherry Boland Ahrentzen, Blurring Boundaries: Socio- Spatial Consequences of Working at Home. Milwaukee, Wisconsin The School for Architecture and Urban Planning, 1987
Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990) 123

and far vision, double images and flickering images.[1] Even a deterioration of vision has been reported.[2] Other researchers however have found that there is no permanent eye damage associated with VDT use.[3] Many of these problems can be avoided through proper illumination and glare control. In addition, discomforts can be alleviated using behavioral modifications and workstation design.

For minimum strain the top of the VDT should be level with the eyes of the worker or lower. This not only reduces neck strain, but it also reduces tear evaporation as a result of the eye being slightly more closed. This also ensures that the eye lid covers the entire surface of the eye during the blinking motion. Thus the surface moisture of the eye is replenished. Furthermore, it is recommended that the worker rest his or her eyes every ten minutes. It is especially important to look away from the screen every thirty minutes to an hour. Looking into the distance causes the focal length of the eye to change which essentially flexes the muscles of the eye and allows them to relax from the strain of a continuous focal length. Providing a multitude of distances for the visual relief of the home worker, therefore emerges as an important design guideline for the home office.

This is consistent with Gurstein's findings that outside views and outdoor spaces are important relief features. By creating visual expansiveness and providing a temporal and seasonal reference, an outside view can also help mitigate the tedium of computer work and diminish feelings of claustrophobia and isolation.[4] It is impossible to prescribe a single ideal view to which all would aspire. Some homeworkers even prefer a

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[1] Lawrence Stark and Phyllis Grey Johnston, "Visual Fatigue and the VDT Workplace," Visual Display Terminals, eds. John Bennett et al., (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1984)

[2] Galitz, Wilbert O. The Office Environment: Automation's Impact on Tomorrow's Workplace (Willow Grove, Pennsylvania: Adminstrative Management Society, 1984)

[3] Maggie Spilner, "New Help for Terminal Vision," Prevention (Vol. 46, March 1994) 115-116

[4] Sherry Boland Ahrentzen, Blurring Boundaries: Socio- Spatial Consequences of Working at Home. Milwaukee, (Wisconsin The School for Architecture and Urban Planning, 1987) executive summary.

number of views according to their mental state.[1] Full-time workers tended to also desire a private outdoor space.

Other problems associated with working at a computer terminal include Postural Musco-Skeletal Strain. According to Long VDT users report more aches in the necks and shoulders than other office workers.[2] Being in a stationary seated position for extended hours stresses the body and the mind. Long reported that the majority of telephone operators, booking agents and word processing operators believed that the use of a VDT had caused their health to deteriorate and their job related stress to increase.

Nevertheless, the propensity for video display terminals to produce adverse physical symptoms can be reduced through proper ergonomic design of both the equipment and the work place. Ergonomics is a field of study that takes both the physical and psychological aspects of a human being into account in the design and implementation of technology, the arrangement of the work environment and the organization of the job.[3] This multi-dimensional definition of ergonomics should be considered as an integral part of the design of a home office.

The most serious complaint about the use of VDTs is that they cause a disproportionately high rate of miscarriages amongst women who worked on VDTs during their pregnancy. In 1981 the Canadian Airlines Employees association stated that seven out of ten VDT operators miscarried during that year, while in British Columbia the Hospital Employee's Union reported that two out of six pregnant VDT operators miscarried and that only one out of the four babies born was normal.[4] The speculated theory is that electromagnetic radiation leaks out of VDTs and poisons the operators body. This theory has not been proven however. Extensive government and manufacturers testing has not

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[1] Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990) 177

[2] Richard J. Long. New Office Information Technology. New York: Croom Helm, 1987.

[3] Martin G. Helander and Thiagarajan Palanivel, "Ergonomics of Human Computer Interaction," Impact of Science on Society (Paris: UNESCO, no. 165 Vol. 42, 1992) 65-73

[4] Richard J. Long. New Office Information Technology. New York: Croom Helm, 1987.

shown any type of radiation hazard. Research findings by Schnorr published in the New England Journal of Medicine, indicate that there is no link between miscarriages and VDT work.[1] Even though health hazard tests seem inconclusive, the relative youth of the age of working with computers demands a degree of caution with respect to occupational health when designing a work station for full-time computer work.

The growth of office technology is so fast and varied that if one pauses for a moment to study the most recent changes in the technology another more advanced wave of technologies will have appeared making the study obsolete before it is even completed. The implications of the new technology are enormous. Not only is the nature of employment itself changing, but so too is the environment in which this work is done. More and more emphasis is being placed on the computer as a tool for all tasks. This emphasis should be matched by designers in the making of the setting in which this tool is used. Many of the changes taking place in computer technology are taking place inside individual central processing units and in the communication lines between them. Even though these changes do not directly affect the layout of the office they demand that more attention be paid to the physical and mental comforts of computer terminal workers.

Boudreau writes "Good physical space is without a doubt much more assured by the proper design of the urban environment, the work environment and by the educational system, than by the creation of an enormous specialized and parallel system that is exclusively preoccupied with physical activity outside the context of daily life."[2] Viewed from this light, architecural design can create oppurtunities for exercise and physical and mental replenishment during breaks from work. These could be integrated into individual dwelling designs or be grouped together for a more expansive space at the scale of the local community.

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[1] --, Science News, (v. 139, March 23, 1991) 190

[2] Thomas J. Boudreau, Physical Activity, Health and Social Policies, Landry et al. eds., Physical Activity and Human Well Being, Miami, Symposium Specialists,1978) 249

The most sustainable method for maintaining physical health is to view health and prevention as an integral part of our daily lives rather than to ignore until acute or chronic disease settles in.[1] Preventing disease through physical fitness and general good health is in the long run more affordable, and therefore more sustainable, than treating disease through drugs and surgery. In addition, the cost is spread out over the sustenance budget of an entire lifetime. Levels of physical fitness and regular physical exercise can also help reduce stress and increase the contentment of the home worker.[2]

SUMMARY OF FINDINGS

This chapter shifts the balance between the two categories of work. Whereas chapters three and four showed home based businesses to be less sustainable than telecommuting home offices, the findings of this chapter indicate that telecommuting is not devoid of problems. Isolation and loneliness are more likely to afflict telecommuters because home based business owners continue to have interpersonal communication in their work. An area of potential personal stress is the role overlap between domestic duties and work. Although many people may choose to work at home to be better able to juggle both roles, performing them simultaneously can lead to stress especially amongst women home workers. It is recommended that home office design allow a certain connection to the living areas of the house, but to do so only after being clearly defined with a removable option of complete separation.

Isolation problems can be addressed through architectural design in one of two ways. The entire home office can be transplanted into a neighbourhood telecentre where interaction with other workers will alleviate loneliness. For transportation advantages of working at home to be maintained the telecentre would have to be close enough for non-motorised transport. The following chapter will explore this point further.

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[1] Jeremy Rifkin, Entropy: Into the Greenhouse World, (New York, Bantam Books, 1989) 199-209

[2] Scott W. Donkin, Sitting on the Job: How to Survive the Stresses of Sitting Down to Work, (Boston, Houghton Mifflin Company, 1989) 78-81.

The second way of reducing feelings of isolation is to provide areas of relief on the scale of the local community. Here several home workers could come together during work breaks in a natural setting that is conducive to individual or communal relaxation.

Methods for achieving comfortable efficient office environments have been developed over the last twenty years and many of these can be directly imported into the home office to inform workstation design. There does seem to be considerably less certainty however, about the personal implications of working with a visual display terminal in terms of physical and mental health. Conflicting reports leave no conclusive evidence one way or the other about the hazards of VDT work. Temporary symptoms of eye strain and muscular aches have been more conclusively documented. These can be alleviated through proper ergonomic and architectural design.

GRAPHIC SUMMARY

AREA OF SUDY		FINDINGS	SUST. DIR.	RECOMMENDATIONS
QUALITY OF WORK LIFE	HBB	• High	N/A	Facilitate flexible work arrangements
	TELE	• Low	N/A	Legislate against exploitation
FAMILY LIFE	HBB & TELE	• Possible role conflict	i	Clear role distinction and office demarcation local day care
MENTAL HEALTH	HBB	• Unchanged		
	TELE	• Isolation	e,i,k,q,s	Facilitate social interaction
PHYSICAL HEALTH	HBB	• Unchanged		
	TELE	• Strain	e,i,k,q,s	Ergonomic design and provision of relief areas

SUST. DIR.: Sustainability directives that need to be incorporated. Letters refer to directives Fig. 9 p.35
HBB: Home based business TELE: Telecommuter

URBAN SCALE	SUSTAINABILITY DIRECTIVES	
SUSTAINABLE DEVELOPMENT	a	• Reduced consumption and waste production
	b	• Many disciplines,economy,society,environment
	c	• Localization of consumer products life cycle
	d	• Environmental accounting
	e	• Proximity to natural environment
SUSTAINABLE PLANNING	f	• Alternative transport (non-automotive)
	g	• Pedestrian planning
	h	• High density
	i	• Mixed use
	j	• Inhibit lateral development (urban sprawl)
	k	• Preserve natural "features"
	l	• Urban farming
	m	• Ecological waste management
SUSTAINABLE ARCHITECTURE	n	• Reduce excessive constr consumption &waste.
	o	• Select local and low impact materials
	p	• Recycle buildings and materials
	q	• Provide opportunity for community
	r	• Preserve natural elements
	s	• Allow for gardens, composts, water treatment
	t	• Utilise alternative energy (solar wind etc.)
	u	• Adopt energy efficiency

CHAPTER SIX : SUSTAINABLE HOME WORKING COMMUNITIES

The neighbourhood work center or telecenter was recommended in Chapter Four as an option for individuals whose homes are too small to accomodate an office. In Chapter Five it was recommended for telecommuters who feel excessively isolated and lonely. In relation to community formation this telecentre already begins to define an area around which other activities and services could be located. Home workers have been reported to use local services such as banks, copy centres and post offices.[1] These, along with other providers of goods and services, could be situated in close proximity to telecentres, where they would contribute to the economic livelihood of the local community.

The kind of local community advocated by proponents of sustainability as discussed in chapter two is more than just a physical entity or a needed service. The sustainable community is one which facilitates cooperation and sharing and a general sense of shared destiny. This is not out of any moral obligation to be good to neighbors, but rather out of a need for efficiency. Cooperation whether it is in the caring of the young and the elderly, or whether it is in the sharing of a composter will add to the efficiency of the individual lives. Efficiency in this sense refers to conserving resources. The less waste of time and energy the more sustainable a commodity. This can be applied to communal services much the same way as it is to manufacturing. In order to envision a community in which a sustainable home working lifestyle takes place we must first realise the extent to which current regulatory restrictions prevent the formal adoption of home work.

Municipal Zoning

Zoning by-laws are by definition preventative measures that seek to preserve and stabilise communities, thus confirming and perpetuating the status quo. Almost all residential areas are covered by restrictive by-laws that prohibit any form of land

[1] Denys Chamberland, "Home Work and Residential Environments," Perspectives (Fall / Winter 1994) 12

use that is not already existing.[1] While this ideology may be rooted in the desire to create residential havens that are safe from the toil and grime of industry, it is now grossly incongruent with the evolving nature of work. Sewell states that "there is no reason for a rigid segregation of work-places into industrial or business and commercial zones."[2] Alexander et al. take an even stronger stance, " the artificial separation of houses and work creates an intolerable rift in people's lives."[3] Added to these social concerns is the new reality of the workplace and the millions of people that are already working at home.

Pressure is mounting on municipal regulators to address this issue. This is especially so in the case of telecommuting, in which the office receives no outside visitors, and there is no perceived increase in traffic in the neighbourhood, the office will be difficult to detect. If enough of these offices go undetected and if they continue to operate for any length of time then they may well become culturally ingrained before they become legal. They would be difficult to control if these offices were to suddenly become more visible and have more of an impact on the neighbourhood.

The past few years have indeed witnessed a surge of concern on the part of municipalities about what seems to be a growing trend.[4] Parallel to this concern is a wave of new government pilot programs in both Canada and the United States which aim to test the viability of home work.[5] Countless custom homes with fully functional offices are continuously being built, but the world of mass housing has yet to adopt the concept of the home office. Several experimental developments seem to be probing the market for buyer

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[1] John Sewell, Houses and Homes: Housing for Canadians (Toronto: James Lorimer and Company, Ltd. 1994) 62-63

[2] Geoffrey Speyer, Architect and Community: Environmental Design in an Urban Society (Londin :Peter Owen, Ltd.,1971) 120-121

[3] Christopher Alexander et al. A Pattern Language (New York: Oxford University Press, 1977) 52

[4] Raymond Hernandez, Making It Easier to Do Business at Home: More Suburbs Revising Their Zoning Laws for Residential Entrepreneurs, New York Times (March 20 1995) B1

[5] The federal governments of both Canada and the United States have initiated telecommuting pilot programs involving tens of thousands of workers, Pierre Rondeau, database manager, Industry Canada. Ed Weiner, senior policy analyst, U.S. Department of Transportaion, respectively.

demand, but there has been relatively little effort to integrate the needs of this new lifestyle into residential and neighborhood design.[1]

Municipalities are perhaps the cause of developer timidity towards the concept of home working.[2] Planners and elected officials are holding on to traditional neighbourhood values of functional segregation, in part due to uncertainty about the extent to which the practice will grow. It is difficult to ascertain which condition gives rise to the other. Is the lack of interest on the part of developers responsible for the reluctance on the part of municipalities to introduce new by-laws ? Or does municipal restriction and the potential to enter into a costly and lengthy approval process deter developers from scouting the uncertain ground of home work?

Orser has found considerable opposition to home based businesses by city planners. These businesses have been variously described as , "transient traders,.. a headache,.. low impact and low skill,.. home business(es) just don't fit,..Pandora's Box."[3] There has also been some reactionary mobilisation on the part of suburban dwellers worried about the values of their properties dropping as a result of increased traffic in the neighbourhood.[4] Revising zoning regulations is therefore a complex matter that needs to incorporate neighbouring residents' fears and desires as well as home workers' needs and aspirations.

> For a host of reasons, the traditional separation of land uses within neighborhoods and within communities must be revisited- although this will likely be resisted by planning professionals, residents, the invested community and local elected officials., ... rethinking the traditional approach to neighbourhood design, policy development

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[1] Denys Chamberland, "Home Work and Residential Environments," The Journal of the Ontario Association of Architects (Fall/ Winter 1994) 11-13

[2] Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990) 133

[3] Barbara Orser, Home Enterprise: Canadians and Home-Based Work (Abbotsford, B.C.: The National Home-Based Business Project Committee, 1992) 23

[4] Raymond Hernandez, Making It Easier to Do Business at Home: More Suburbs Revising Their Zoning Laws for Residential Entrepreneurs, New York Times (March 20 1995) B1

and regulation in favor of the home-based business will be a small but significant step in the right direction.[1]

Recommendations abound on how zoning requirements should be revised to accommodate home work. Ferrera, Celentano, Frank, Ahrentzen and Gurstein have all made recommendations for model codes and regulations.[2] They are generally inclined to group homeworkers and distinguish them by occupation, thus forming the basis of regulation. Gurstein recommends the lifting of zoning restrictions and the inclusion of commercial activities within residential neighborhoods. She calls for a distinction between high and low intensity home occupations.[3] If however, complete homogeneity is to be avoided, and character and variety are to be attained, then a mixture of different types of home work should be considered. Indeed, if homework is seen as an economic revitalization tool, including some professions in the neighborhood but not others, may be construed as discriminatory.

Furthermore, labeling a profession as high intensity or high impact, may unfairly exclude it from a residential neighbourhood. Some municipalities consider hat making to be a light industry for example. On this basis it is prohibited in residential zones. The same municipality may consider work done by licensed professionals to be permissible.[4] The municipality of Anjou in Quebec for example, would allow an architectural practice to operate heavy machinery, such as table saws and belt sanders, to build architectural models, while a hat maker operating a sewing machine is prohibited by virtue of being an unlicensed profession.

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[1] Jeffrey J. Celentano, Hard times, High Tech and Home-Based Business, Plan Canada, November 1994. 26-30

[2] Ferrera (1994) Celentano(1994) Frank (1993) Gurstein (1994) and Ahrentzen (1987)

[3] Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990) 183

[4] The municipality of Anjou, Quebec allows professional practices as described under the Quebec Code de Prefession, but prohibits any manufacturing businesses however light or small, personal interview of planning official conducted by author.

There are numerous proposals and several built projects that integrate the two activities of working and living on the level of the community.[1] These projects incorporate mixed-use as a primary design feature. Although offices where not located in or adjacent to the home, commercial and office space were designed to be within walking distance from residential units. In doing so designers have provided for the demands of sustainability while simultaneously maintaining a purely residential character within neighbourhood sub zones. Ferrera prepared diagrams for two types of interface zoning which were adopted as a zoning strategy for the Town of Markham (Fig. 22).

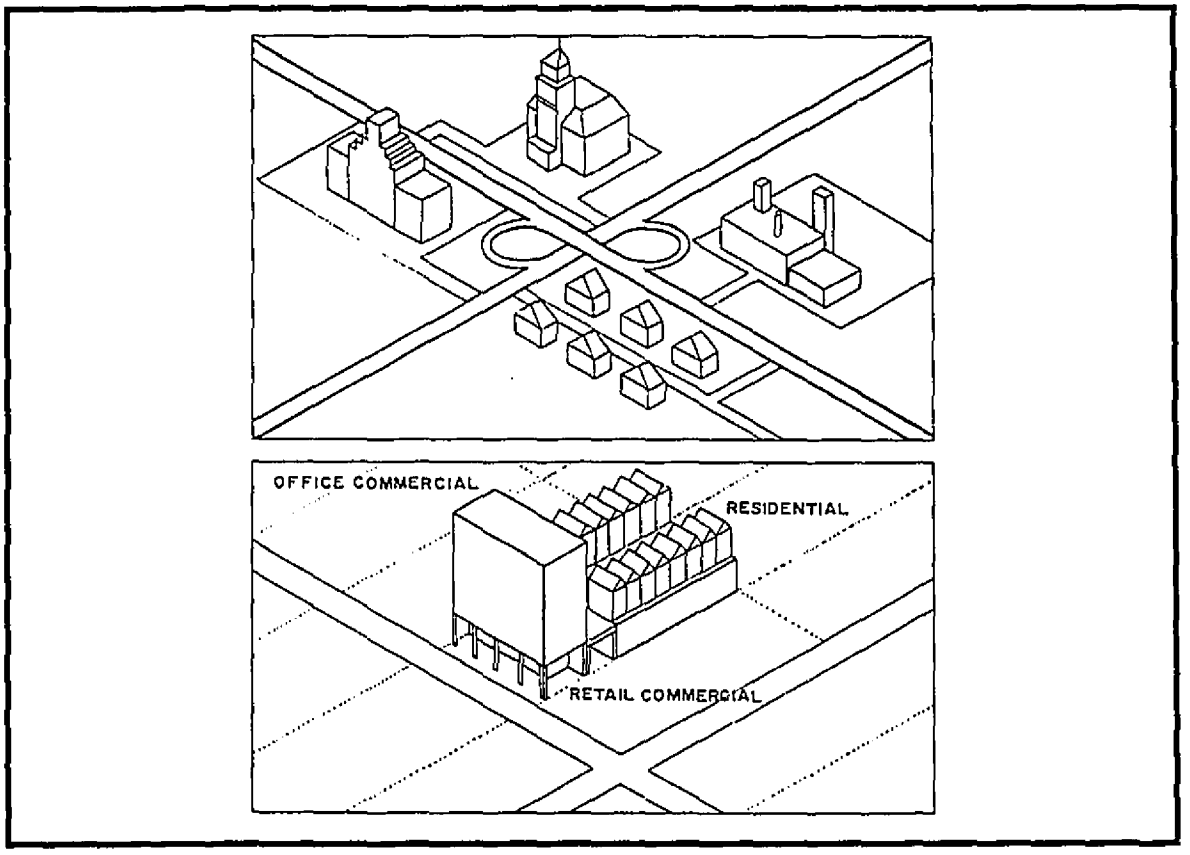

Fig. 22 . Interface zoning as adopted by the town of Markham, from Luigi Ferrera, "Why Not Implode," Perspectives: The Journal of the Ontario Association of Architects, Fall/Winter 1994, 13

Also in Markham, Ontario, a residential community of townhouses with home offices was designed. The community focuses inward in a horseshoe shape onto a

[1] Penelope Gurstein, Working at Home in the Live-in Office, (Unpublished Ph.D. Dissertation, UC Berkeley, 1990) 139-140

common green space (Fig. 23). The townhouses with home offices are in a straight line closing the horseshoe. In these units the office occupies the ground floor with the respective home occupying the space above. While the footprint of the development can be seen as conducive to communal activity, commercial activity is pulled out of the center of the community and towards the edge.

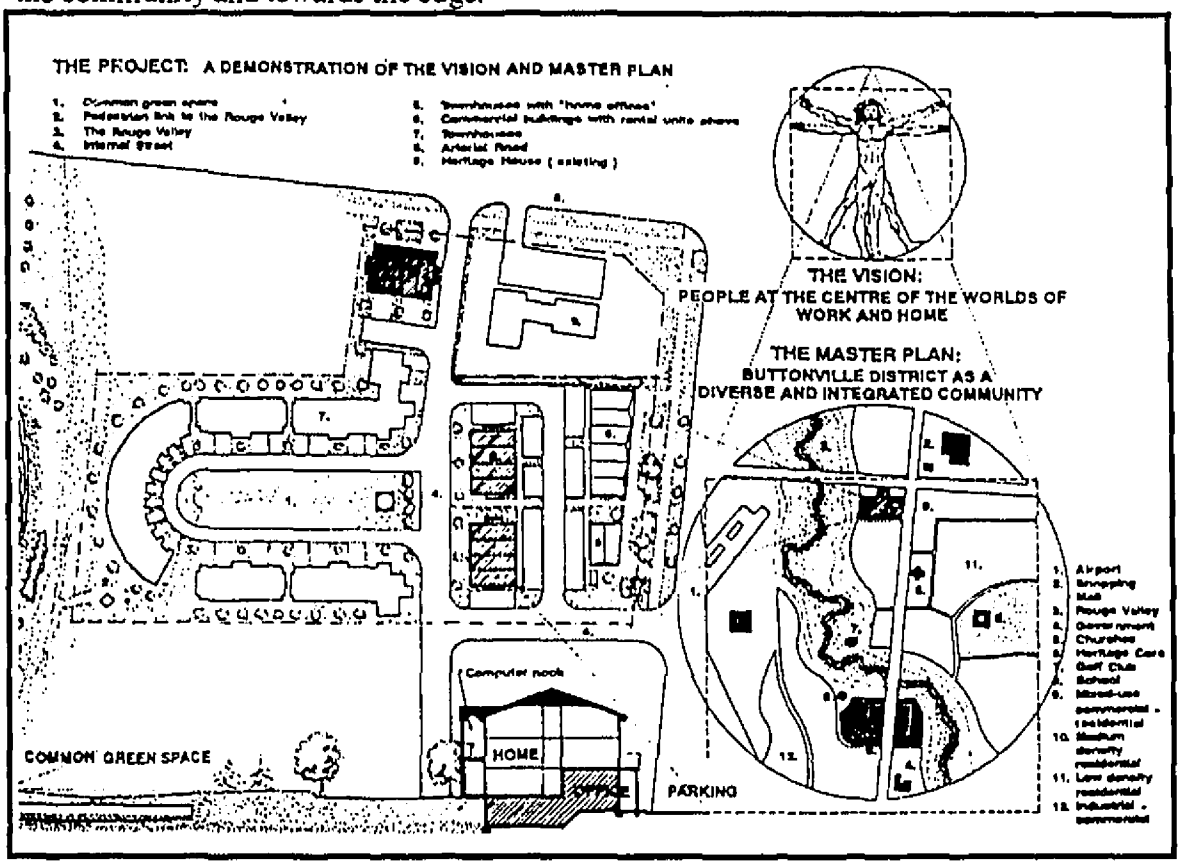

Fig. 23. Home Office Townhouse Complex Markham , Ontario, from Luigi Ferrera, "Home Sweet Office," Perspectives: The Journal of the Ontario Association of Architects, Fall/Winter 1994, 8

Parallel to the seemingly restrictive stance that municipalities have taken towards home work to date, is a more endorsing attitude on the part of legislators. Mokhtarian describes eight national and state policies and acts of legislation in the United States that concern telecommuting. Not only do they permit telecommuting as a viable work option, but they actively support it as a means to reduce emissions, reduce reliance

on physical transport, and as a way to facilitate the employment of differently abled people.[1]

California is leading the way in actively promoting home work, as a result of the combined efforts of earthquake planning and emissions reduction policy. According to Ed Wiener who is a senior policy analyst at the United States Department of Transportation, the Clean Air Act of 1990 has been the strongest driving force to date behind the institutional recognition and encouragement of home work.[2] The City of Los Angeles and several other smaller municipalities have modified their zoning codes to actively encourage home based telecommuting.[3] What is unique about these municipal initiatives is not so much their pioneering acknowledgment of home work, but rather their specific identification of telecommuting as the preferred work option.

While other municipalities are left pondering the negative impact of home-based businesses, and their potential for destroying the character of residential neighborhoods, these Southern Californian examples have avoided having to address the broader issue of home work and have targeted telecommuting specifically as the home work option that reduces automobile dependency, and therefore merits special consideration. Canadian examples of pioneering zoning include the Town of Markham's home occupation by-law which widens the parameters for home occupation to allow for "the customization of each individual home office."[4] While this seems to set an important precedent for addressing home work, it promises to be a labor intensive process for approval and regulation.

From both the architectural and planning points of view telecommuting home offices have been found to be the work option that makes the most gains towards

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[1] Patricia Mokhtarian, "Telecommuting and Travel: State of the Practice, State of the Art," Transportation, 18, 1991, 319-342.

[2] Ed Weiner, Telework: A vital Link Transportation Energy and the Environment. Unpublished paper presented at the Telework '94 Symposium in Toronto.

[3] Jack M. Nilles, Traffic Reduction by Telecommuting: A status review and bibliography, Transportation Research-A, (Vol. 22A, No.4, 1988) 307

[4] Luigi Ferrera, "Why Not Implode?" Perspectives: The Journal of the Ontario Association of Architects, (Fall/Winter 1994) 13

sustainability. Telecommuting will also have the least impact on homes and residential communities. It therefore seems logical for municipalities who wish to maintain residential characters to specifically allow for telecommuting in their zoning regulations. However, limiting zoning revisions so that they only allow telecommuting in an otherwise unchanged suburban neighbourhood would be a direct denial of the macroscopic directives of sustainability.

Community Size

Chapter Two demonstrated the importance of localisation and the strengthening of local communities as a sustainability directive. We saw that the demands of sustainability call for strong local communities that maximise their use of local resources and are as self sufficient as possible. If sustainability concerns are given priority over all others, then the size of the community will ultimately be determined by the average tolerable distance for non motorized transport. Cycling and walking will have to prevail over automobile and transit transportation, because of their minute impact on the natural environment.[1]

The definition of community is an elusive task. While it was traditionally territorially confined to a particular locale, it has now broken free of these physical restraints. Of course, other physical traits continue to prevail. If its not the fiber-optic cable buried in the ground it is the satellite that sends and receives transmitted waves. Whatever the physical limitations that bind the electronic transmittal of information may now be, they most certainly do not concern adjacency and geographical proximity. The standard television set has long proven the ability of technology to attain global access to identical information. Contemporary interactive media, such as global computer networks and touch-sensitive screens, have further secured the infiltration of information technology.

[1] Refer to Chapter Two, p.19, for a more complete discussion of the demands of sustainability regarding community planning.

In Chapter Three we saw that both home workers and their families have been found to reduce their overall patterns of travel on telecommmuting days as well as regular commuting days.[1] They have gradually modified their behavior and have come to choose services that are closer to home over the farther ones to which they were previously accustomed. The propensity to localise has therefore already been documented. The distances of this modified pattern of travel, as presented in Fig. 10 (p. 45), is important in that it begins to determine the size of community that suburban residents can naturally support . These reduced distances may, however, be limited by the proximity of services under current zoning restrictions, and may not necessarily be indicative of how small a travel radius people are willing to accept. The average distance that people currently drive to essential services, and the resulting size of residential community with its accompanying services, will both diminish if, the travel radius about the house is determined by cycling rather than driving, and even further if it is determined by walking.

A survey conducted by the Institute for Urban Studies in Winnipeg found that at least one third of survey respondents would bicycle to work in the summer if bicycle lanes were provided or if gasoline prices doubled. Eighty-five percent of respondents to the author's questionnaire said that they would consider riding a bicycle to go to work and to buy groceries. The major objection indicated was the safety of cyclists. One respondent had lost a friend who was fatally wounded in a bicycle accident involving a car. Other concerns reported were the difficulty in transporting groceries by bicycle and the inconvenience of being sweaty upon arriving to work. These findings are significant not only in highlighting the willingness to adopt cycling as a primary form of transport, but also in indicating that the perceived problems associated with bicycle transport can be mitigated through proper planning. Continuous designated bike paths would alleviate motor vehicle hazards, and neighborhood telecentres that are a short bike ride away could be provided to reduce the likelihood of sweating and fatigue.

[1] Refer to Chapter Two, p.45

The positive attitude towards cycling as demonstrated by the survey seems too inflated to reflect upon society as a whole. This is due to the statistical insignificance of sample pool. Respondents may be more likely to accept change than non internet users. Since the internet itself is an innovation its current users may thus consider themselves to be pioneers and are therefore more willing to adopt alternative transport methods. It would be more prudent to consider walking as the primary form of non-motorised transport that is likely to be acceptable to the majority of people. Furthermore, cycling is restricted by extreme weather conditions and is not an option for some elderly and differently abled people.

In the interests of sustainability the outer limit of the area of a community must be considered as the largest possible area that can be serviced by walking to and from a single centre. The perpetuation of the idea of a centre, as opposed to diffused services, is for the economic viability and conglomeration efficiency of stores and work centres.[1] To determine the area that could be serviced by a single centre questionnaire respondents were asked how many blocks they would be willing to walk to go to work in a neighbourhood telecenter, and how many blocks they would be willing to walk to buy groceries.[2] The mean distances reported were 15 blocks and 6 blocks respectively. In this case however the mean is not as informative as the two extremes as people would naturally live in a range of distances from any given point. Distances for walking to work ranged from none to forty blocks, with 23 percent falling in the 20 to 30 block range. Distances for walking to buy groceries ranged from 0 to 25 blocks.

What emerges from this study is a community form that is based on two foci: the telecentre node and the shopping node. Since people will only walk six blocks to buy groceries then a store has to be located within a six block radius of every house.

[1] This issue is discussed in greater detail in the Sustainable Development Section of Chapter 2

[2] Distances were requested in blocks to avoid unit confusion between metric and imperial units as the questionnaire was transmitted to both Canadian and US respondents. In addition some people may not be as familiar with measured distances as they are with city blocks, hence a certain margin of error is inherent in this study due to the different sizes of different blocks.

Telecentres or neighbourhood work centres are must be within a 15 block radius. This would create a neighbourhood plan with stores interspersed every twelve blocks and telecentres every thirty blocks. Figure 24 graphically presents this arrangement. Other factors, such as the sustainability directives of preserving natural features, would undoubtedly affect the ultimate form of the community plan. Nevertheless, the figure demonstrates certain community dimensions that would enable sustainable modes of transportation.

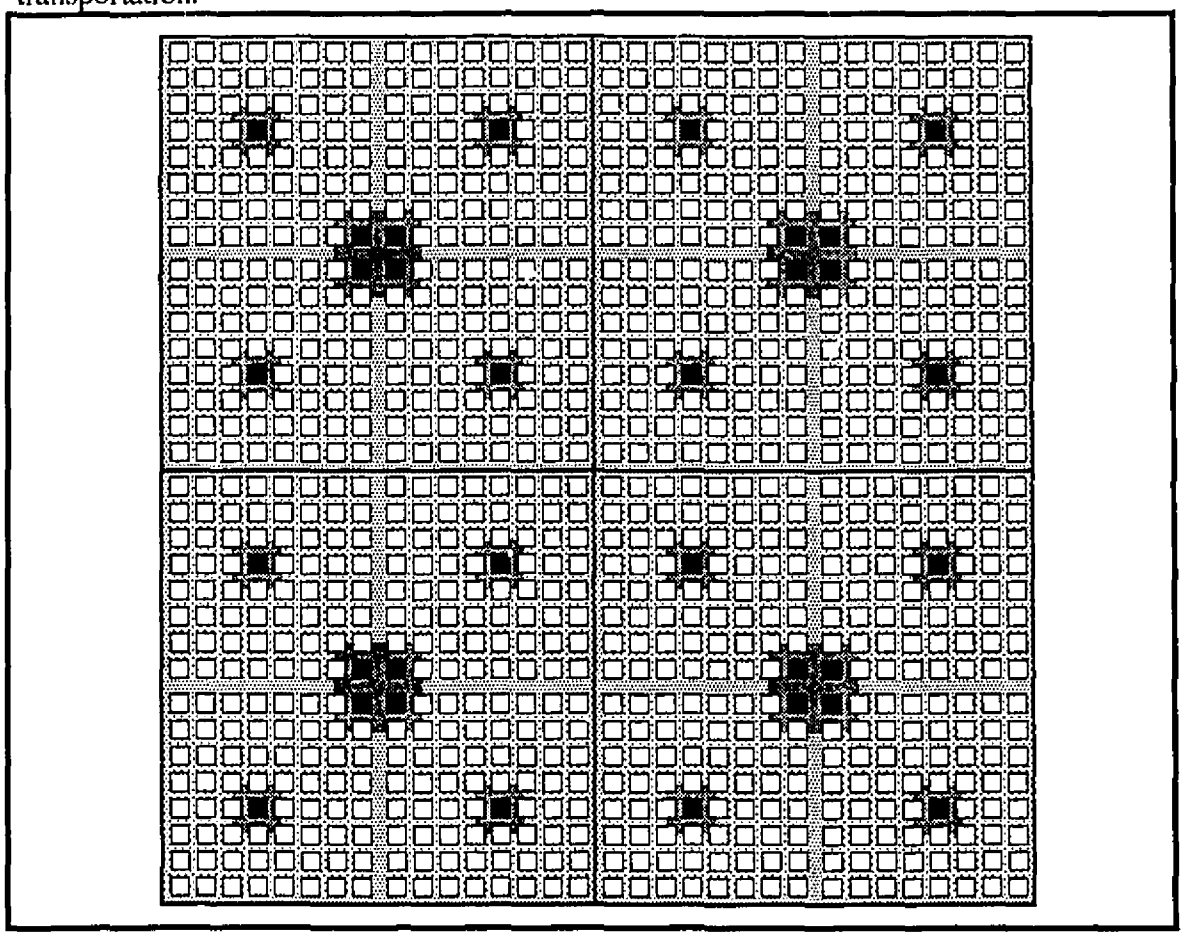

Fig. 24. The size of the local community as determined by respondents' acceptable walking distances, by author. Distances are in blocks, small nodes are grocery stores and large nodes are neighbourhood work centres.

Having determined the outer limits of the area of the sustainable community we are still left with the question of density. We saw in chapter one that high densities are important for limiting outward urban growth and preserving agricultural land and natural

ecosystems. There must however, be a limit to the density that can be supported by the sinks and resources of a particular locale. Although the precise optimum density is difficult to ascertain without more research, some residential typologies are less conducive to sustainability. The residential high rise for example is by convention a housing type that is rather consumptive in its infrastructural demands. It requires daily garbage removal services and renders it difficult to practice urban gardening and composting.

Chapter Two showed that this density limit is a variable that changes with the specific resources of the particular region and its ability to absorb and neutralise waste. Further research needs to be carried out to determine the carrying capacities of different regions in relation to applicable technologies. This will ultimately determine the size of what is deemed local. The directives of local self-reliance and high density have to be simultaneously considered and balanced against one another to arrive at a community size and form that would reduce transport dependency as well as enable residents to adopt land intensive sustaianability practices such as urban farming and composting. These conditions to also be infused with the space requirements of home offices to create sustainable home working communities.

Urban Migration

The discussion of sustainability and home working cannot be complete without addressing the issue of urban migration. The freedom to move away from central areas and to any remote location as enabled by information technology has the potential to significantly change urban population distribution. Identifying the factors that will cause or inhibit residential relocation and its consequences especially as it relates to sustainability is the primary focus of this section. Different viewpoints will be presented as well as the results of the questionnaire questions that pertain to urban migration.

A primary question that will have to be addressed in relation to telecommuting is its ability to transform the city. By virtue of telecommunication technology's facilitation of remote work, telecommuting has the potential to exacerbate

problems of urban sprawl. It is feared that the decentralization that was catalysed by the automobile will be propelled further by telecommuting. In which case the result will ultimately be a vacant lifeless city center. The extent to which this has already happened can be witnessed in many American cities.

Barring a handful of exceptions, city centers are devoid of people after five o'clock. Basic societal services such as the provision of food, clothing and entertainment have been relegated to the suburban mall. Current planning practices of segregated zoning are partly to blame. However an essential cause, and fundamentally the drive behind municipal regulation, is the aspirations of the public to own a detached single family suburban home. Roads and cars have allowed easy access to suburban homes despite the low density with which they are dispersed. The telephone has linked these homes to practically every other home and service in the industrialised world, but the growth of the suburbs was substantially fueled by the American dream of a detached home on a private plot of land.

The longevity of this dream and the degree to which it is entrenched in the minds of future house buyers will undoubtedly influence the rate of decentralisation resulting from telecommuting. Given the freedom to reside almost anywhere, regardless of the location of sources of employment, the dream of the single family detached home could turn into a nightmare of suburban sprawl. Status quo suburban residences are inherently less sustainable than any denser residential type that they might replace, by virtue of their lower rates of efficiency in the use of land, infrastructure and energy. Further, they are not as self-sufficient as less dense residential types, such as farms and estates, which have the potential for agricultural production.

A number of authors have attempted to determine the ultimate migration consequences of information technology. Castells and Nijkamp et al. share the view that location for firms will be around information nodes that have access to up-to-date

international data banks.[1] The resultant effect, it is argued, will be a continuation of the present economic distribution gathered around major centres. While Nijkamp et al. contend that there is no empirical evidence suggesting either centralisation or decentralisation, Castells argues that they will happen simultaneously. The "brain" mechanisms of the system will become increasingly centralised and the provision of services will become widely dispersed. Given the increasing ability of managers to be instantaneously connected to economic brain functions, it seems that although information flows will become more centralised, the people working with them will be free to decentralise. Leigh similarly reports that telecommuting has both centralising and decentralising effects and that evidence of how these will balance is inconclusive.[2]

There are those who view communication technology as a facilitator of residential relocation rather than an instigator.[3] Mokhtarian argues that the technology necessary for telecommuting has been available and affordable for decades. She sites a 1973 article that stated the unrealized potential for the telephone to cause urban decentralization. Even though the relative novelty of telecommuting renders its effects on the city, difficult to predict, Nilles attempted to use statistics from newly initiated programs to probe into the urban sprawl implications of telecommuting.[4] He studied the move patterns of telecommuters over a two year period. His findings are inconclusive however. Although he reported that 3 percent of his studied sample moved entirely out of town, and that telecommuting was cited as a significant factor in their decision to do so, he found that the majority of the telecommuters interviewed moved as a response to other

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[1] Manuel Castells, The Informational City, (Oxford: Basil Blackwell, 1989) 348, and Peter Nijkamp, "Telecommuication and the Tyranny of Space," Information Technology, Social and Spatial Perspectives, eds. Isao Orishimo, Geoffrey J.D. Hewings and Peter Nijkamp (Berlin: Springer-Verlag, 1988

[2] John G Leigh, "Societal Impacts of Telecommuting," Proceedings of the International Symposium on Technology and Society, Piscataway, New Jersey: IEEE, 1993) 223-226

[3] Jack Nilles Telecommuting and Urban Sprawl: Mitigator or Inciter?, Transportation, 18, 1991, 411-432, and Patricia Mokhtarian, "Telecommuting and Travel: State of the Practice, State of the Art," Transportation, 18, 1991, 319-342.

[4] Jack M. Nilles, Telecommuting and Urban Sprawl: Mitigator or Inciter?, Transportation, 18, 1991, 411-432

motivating factors. The median distance moved by telecommuters was found to be zero. This study is significant as a pioneering work that focuses on a pressing issue. Its findings shed some light on the extent of urban sprawl that will occur as result of telecommuting. A more informative study, however, would have used a longer time frame that would have been more sensitive to the relatively slow rate of home relocation.

The question remains, what will be the forces that will shape the evolution of the future city? If as Nilles and Mokhtarian believe, telecommuting is only a facilitator and not an instigator, then what will the instigator be? Perhaps a look into the historical origins of cities will shed some light on the natural forces that have let to human congregation. Bookchin traces these origins back to some of the earliest examples of city dwelling. Using the towns of Çatal Hüyük and Wadi Kubbaniya, dating back to 9000 BC., Bookchin disputes many urban theorists claims that the agricultural revolution and the economic structure that it demanded was the initial cause for city formation.

He contends that the first cities were formed many millennia before the agricultural revolution, and that its inhabitants relied on hunting and gathering for sustenance.[1] The primary cause for people to reside in such close proximity was found to be religious and social, but not economical. Although this finding suffers severe disfigurement when brought in to contemporary society, due to cultural incongruence, it illuminates an important factor that will invariably be considered when the time comes for an individual to choose a place of residence. Given an intrinsic human desire to congregate the economic freedom to move away from the city does not necessarily translate into a desire to do so.

An exploration of national ideals, mass aspirations and the power of media, is necessary when treating society and societal trends as the unit of discussion. It is even more necessary when this investigation is directly linked to media technology. A study of the urban implications of telecommuting therefore warrants research into the kinds of

[1] Murray Bookchin, Urbanization Without Cities: the Rise and Decline of Citizenship, Montreal, Black Rose, Books, 1992. 16-21

images portrayed through information technology, although such an investigation is not within the scope of this thesis. The internet survey does open a window into some of the thoughts and concerns of individuals who are already immersed in information technology. It is important to reiterate that due to the limited scope of the survey it is not statistically significant or representative of the general public. The results are merely an indication of one of many possible scenarios of urban migration.

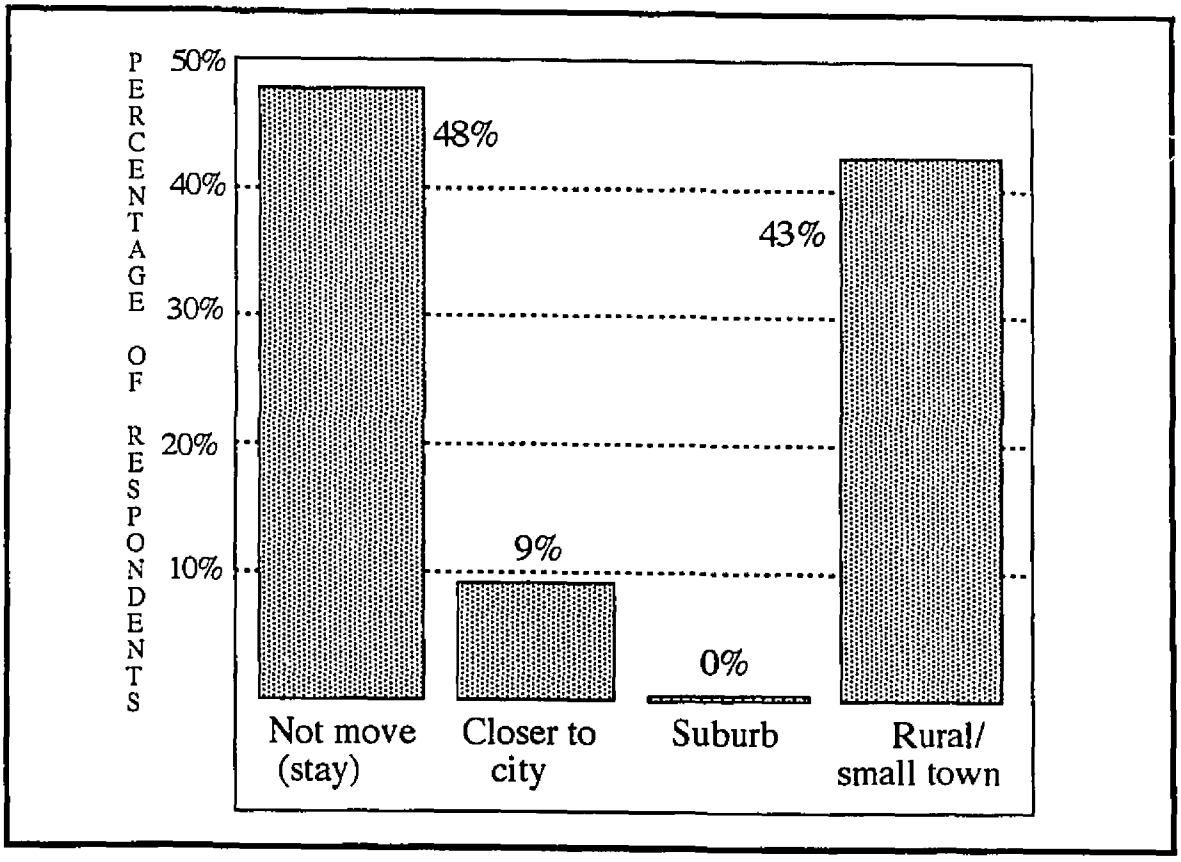

Fig. 25. Respondents choices of relocation as enabled by telecommuting, author's survey.

Given the economic possibility of decentralisation and the availability of the necessary technology, one can safely assume that rural migration or decentralisation are a realistic option for the information worker. Is this a desirable option however? Would information workers rather live away from the city, or will the city continue to be a magnet of human interaction? The answers to these questions can only be revealed with the passage of time. Nevertheless in order to have some indication of what the current

aspirations of current information workers are, the author asked survey respondents where they would choose to live if they are free of obligations and are willing to relocate.[1] Forty eight percent indicated that they would not move at all, while forty three percent would move to a rural area, and nine percent would move closer to the city (Fig. 25).

What is more informative in tracking urban migration than the overall percentage of people who would move or stay, is the percentage of current city dwellers that belong to these categories. Although 46 percent of current city dwellers indicated that they would remain where they are, 40 percent of those who now live in the city would move to a rural setting if given the opportunity.[2] Given the results of this study it seems inevitable that some degree of decentralisation will occur. What affect will this have on the city and on the urban dweller? Much the same way that it is difficult to predict with any precision the pattern of urban migration in the age of information, it is difficult to determine what effect this migration might have.

Bookchin argues mournfully that the ideals of city life, those of propinquity and community, are dead in today's cities. The ideals to which he refers are rather ambitious in their aspirations. Bookchin describes the essence of utopian urban theory as the ideal city in which communal relationships are formed free from the restraints of "custom, irrationality and the vicissitudes of natural contingency."[3] Here the city clearly takes on a civic role and is given a societal task. It is expected to provide a particular social setting in which individuals are free to form themselves and their personalities according to personal tendencies and not according to societal expectations.

If this role of the city is absent today, given the potentially lower population base of future urban centres, it will almost certainly be absent from the city of the information age. In addition, the directives of sustainability that encourage local self-reliance demand a scale of community in which anonymity is replaced by either unity

[1] For a complete version of the questionnaire questions please refer to the Appendix .
[2] Authors internet survey.
[3] Murray Bookchin, Toward an Ecological Society, Montreal, Black Rose, Books, 1980, 135,173

autocracy. Freedom from societal influence would be sacrificed. In its place the passing on of traditional values and customs take on vital roles. The sustainability imperative would be inherited from one generation to the next. In the context of sustainability the civic responsibility should give priority to the inheritance of environmental and human values over the evolution of the uninhibited self. Bookchin's viewpoint however transcends cultural heritage and relies on an ethic that is rooted solely in the rational pursuit of an ecological society. Indeed he supports tradition and culture,[1] but views a disentanglement from the rigid requirements of the past as the only method by which we can truly evolve towards a humanistic sustainable future.[2]

Given the significance of "like-mindedness" or shared activities as a prerequisite for forming communities that are not related to place, then people may choose to live close to those with whom they are naturally inclined to form a communal relationship. This would give rise to homogeneous communities. The precedent has already been set with residential compounds in exclusive neighborhoods, which are gated and guarded.[3] This can be construed as a certain economic class wanting to identify itself as such and wanting to shelter itself and its offspring from the undesirable elements of society. When viewed in this light it seems rather unhealthy, but if indeed this walling in provides a backdrop for community formation, and achieves meaningful social relationships then it may be inevitable. If by nature we are inclined to gather, and if we gather according to common interests, and finally, if we are free from occupational migration restraints, then we may inevitably settle in groups according to similar interests. There are of course profound cosequences of associated with this degree of inwardness and homogeneity but are outside the scope of this thesis. Racism, classism and general stereotyping will likely ensue giving rise to hostility and even aggression.

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[1] Ibid. 173

[2] Ibid. 284

[3] A gated community is situated across the street from the Richmond home office and is multiplying throughout the neighbourhood.

One of the questions in the author's survey sought to specifically shed some light on this specific area of potential migration. Respondents were asked to rate a variety of different motivating factors for residential location, in order of preference, from most to least important. The results are summarised in Figure 26. Given complete geographical freedom, it was found that the primary factor for choosing location is the climatic condition of the prospective location. This was closely followed by the geographical characteristics of the area. Then came the location of friends, the location of family, world view of neighbours, education or profession of neighbours and finally the cost of living.

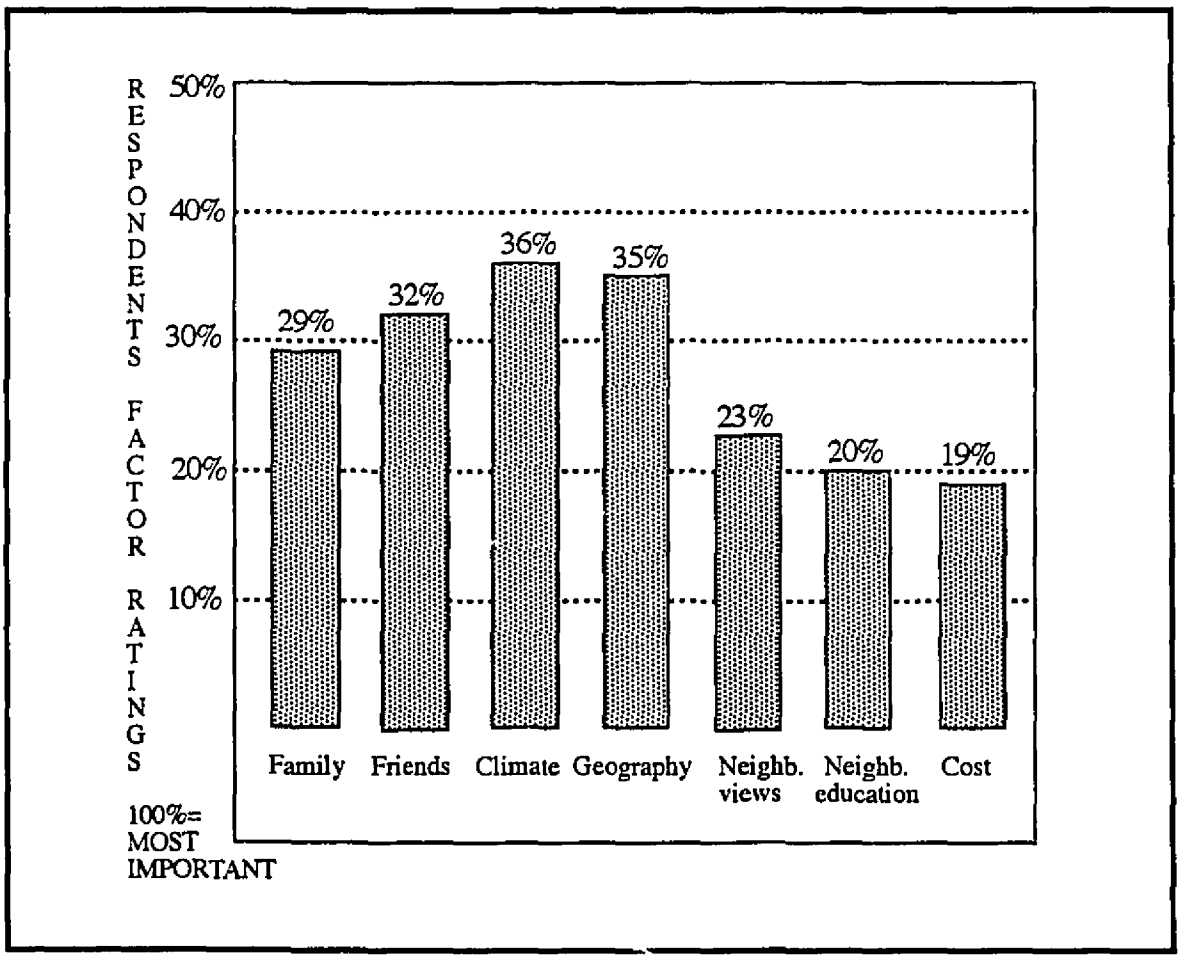

Fig. 26. Summary of respondents rating of motivation factors for residential location.

Human population distribution along the more moderate climate zones is not in itself contradictory to sustainability directives. Moderate zones tend to have a higher

number of sunny days allowing for a harnessing of the suns energy. Passive heating and cooling methods would also be easier to employ in a milder climate. What may be problematic, however, is the very idea of mass migration to a particular location. If human history is any indication, an uncontrolled influx of people to a certain area will undoubtedly exhaust the resource base and the sinks of that location. Migration to geographically appealing areas could also pose a serious threat to natural ecosystems. The so called "rural" setting would turn into a sparser version of suburban sprawl that groups itself around natural features rather than urban centres. As soon as these areas begin to fill up and lose their rural character, another location would be sought and on goes the vicious cycle. If indeed such migration patterns begin to occur, then the role of urban and regional planning rises to new levels of critical importance.

It must be noted that information workers, including telecommuters, continue to be physically attached to their places of employment even if only for occasional office visits. The situation that would give rise to uninhibited migration remains a future prospect and it is not yet an option for the majority of telecommuters. The vast majority of telecommuters continue to rely upon a certain physical proximity to business centres and informational nodes. The scale of migration that has been explored in this section will not likely happen in the near future and may, indeed, never happen. However, in attempting to define the powerful forces that are at play in the wake of the age of information, the author is hoping to contribute to an understanding of the urban implications of home work that will undoubtedly affect the workings of the built environment in the context of a new era in human history.

In this chapter the author has outlined the general characteristics of sustainable telecommuting communities. Although there are some indications of the nature of these types of communities many questions remain unresolved. The economic and physical dynamics of the fully blossomed information city remain largely speculative, and so too are the internal dynamics of communities that may one day inhabit these cities.

CHAPTER SEVEN : CONCLUSION

This thesis has touched upon areas of study that are wide and varied. The multi-layered nature of the research question has necessitated an equally multi-layered research approach. Beginning with the foundation of sustainability, then moving on to the practice of home work, we explored the different ways in which working at home coincides with the demands of sustainability. Beyond the initial identification of sustainability directives the research on home work took its own course as different issues began to unfold.

It was found that sustainability is a "loaded word" with wide parameters and ambitious goals. It touches every aspect of life and can be applied to many professional disciplines. Sustainability is fundamentally about the appreciation of the limits of the earth. Ultimately however, it has to do with combining economics, society and the environment into a single equation affecting all areas of human conduct. In another more rudimentary sense, sustainability has to do with conservation and the reduction of resource consumption and waste production. Beyond these definitions, several practical directives of sustainability were identified.

One of the two most important sustainability directives that affect the planning of residential areas has to do with the strengthening of local communities to facilitate greater self-reliance and resource autonomy. The other important directive that touches upon every scale of consumption is environmental accounting. Together they demand that the current form of North American suburbs be changed. Introducing alternative modes of transport was found to be an important first step in implementing change. This is to be followed by pedestrian planning, neighbourhood densification and mixed-use zoning.

After achieving these transformations, which would automatically reduce reliance on motorised transport, and in turn the problems associated with its use, it was found that the entire life cycle of organic matter should be reintroduced into urban areas.

Urban farming, composting and ecological waste management are three ways in which this directive could be implemented. These issues were also found to touch upon sustainable architecture. In addition, architectural design can integrate the directive of sustainable accounting to affect the choice of building materials and building strategies. The area of solar heating and energy efficiency were identified as important features of sustainable architecture.

The sustainability of working at home when applied to the directives mentioned above was found to be split into the two categories of home based businesses and telecommuting home offices. Telecommuting has indeed lived up to its name. To the extent to which it occurs, it has replaced the physical commute of human beings with an electronic commute of information. Telecommuters have been found to drive shorter distances both on telecommuting and regular commuting days. It was also found however that neither traffic congestion nor emissions were significantly reduced as a result. The only savings that were found to be significant were economic ones in the areas of office overhead and long term infrastructure maintenance.

Home-based businesses were found to negatively impact sustainability. Home workers in this category drive more than they would if their businesses were centrally located. It is therefore recommended, that the local neighbourhood provide some of the services on which these businesses are dependent. The sustainability directives of mixed use and localisation would allow basic office services to be provided using minimum reliance on motorised transport. A rich client base for these businesses could also become locally available through the sustainability directive of high density living.

A variety of different estimates make it difficult to determine with any degree of precision the number of individuals who are presently involved in home work. Between ten and forty percent of the labour force are believed to work at home. Regardless of the exact numbers, using consecutive figures from an identical source indicates that both telecommuting and home based businesses are on the rise. It was therefore concluded that

if current growth patterns persist, currently meager environmental savings will become more significant in the future, indicating a potential for increased sustainability.

The spatial integration of the office and the home also rendered home-based businesses to be the less sustainable of the two categories of home work. It was found that the space requirements of home offices in general, and home-based businesses in particular, are the most demanding aspect of home work. Because of the reliance on computers telecommuting home offices were typically found to be easily incorporated into a dwelling. Home-based businesses however, demand considerable amounts of space that may only be available in single family homes. In apartment dwellings, adjustable and movable furniture was found to be useful in allowing the sharing of space between the living and working areas. It is suggested that in cases where there is simply not enough space for a properly functioning home office, a neighbourhood work centre may be substituted.

While transport was found to be an area of excessive consumption at the scale of the city, environmental control takes on that role at the scale of the home. This is not however, a prohibitive factor and can be mitigated through energy conscious design. Ergonomic and work station design were not found to be particularly demanding from a sustainability point of view. Issues of lighting and surface height dimensioning were found to be important and it is recommended that they be tailored to the specific requirements of the individual home worker and the individual task.

The infrastructure requirements of the telecommuting home office were also found to be negligible. Innovations in communications technology will allow advanced multi-directional transmission using conventional copper wire, thus precluding the need for a network of fibre optic cables. Within the home itself it was found that a separate electric circuit with sufficient capacity is the only change necessary to accommodate office equipment. It was therefore concluded that aside from floor area requirements, a home office can be absorbed into the average home with only minor modifications.

A study of the quality of living and working in a single location shed some light on more architectural and planning considerations that should be incorporated into home office design. The electronic sweatshop was discussed as a situation giving rise to exploitation and isolation. Telecommuters were also found to be subject to loneliness and isolation. It is therefore recommended that the option be made available for those workers to be able to work close to home in a neighborhood work centre where they can enjoy supportive face-to-face interactions with other workers. Telecommuters were also found to suffer from physical strain as a result of extended work with visual display terminals. This could be alleviated through a combination of proper lighting and behavioural modifications.

The combination of family and work responsibilities was found to cause stress especially among female home workers. Although many women choose to work at home in order to be able to perform both roles simultaneously, it was found that one role or the other suffers as a result. It is recommended that some degree of separation be created between the two realms. Examples of architectural features that attain a balance between proximity and separation were presented. Because of the stress it induces, the long term sustainability of overlapping parenting and working is not readily apparent. It is therefore recommended that local services, such as day care centres and monitored playgrounds, be provided in the local community.

Using the aforementioned findings sustainable home working communities were envisioned and presented. Community dimensions were determined using walking distances tolerances as reported by questionnaire respondents. It was found that communities would provide a hierarchy of two nodes. One node includes grocery services, and the other and less frequent node includes a neighbourhood work center with other work related services. Sustainability directives of natural preservation, urban farming and composting were identified as other essential features that would affect the final community form.

Most planning officials have been shown to be reactionary in their integration of home offices into residential neighbourhoods. It is recommended that they address this issue not only to accommodate the needs of home workers, but also to attempt to regulate the larger urban consequences of widespread home work. Issues of urban migration were addressed and it was determined that telecommuting is poised to offer people the option of moving anywhere they choose, irrespective of employment opportunities. Questionnaire responses indicated that there will likely be a movement of residents out of urban areas and into rural ones. Climate and geography were cited as major attractions for residential relocation.

Home working has thus far not contributed significantly to reducing total transportation related resource consumption and waste production. It has done so within individual households, but has had little effect on society as a whole. Sustainability goals will therefore only be achieved if auto-centric urban patterns are fundamentally changed. For home offices to be truly sustainable they have to be integrated as a component of a larger change on the scale of the local community. Concepts of sustainable living demand that homes be carefully designed to achieve a combination of task facilitation and functional demarcation, while sustainable communities are ones that cater to the professional needs of the home office and the emotive needs of the home worker.

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APPENDIX : QUESTIONNAIRE

A questionnaire was sent out to two hundred and fifty two electronic mail addresses that were retrieved from various news groups on the internet. Two hundred questionnaires were sent by selecting the first news group from every other list page. Once in the news group, the first ten messages were replied to using the questionnaire as the body of the message. In some cases there where less than ten messages posted in the news group, in which case all messages where replied to. It should be noted however that due to the disproportionately low number of women found in the news groups, priority was given to any female name encountered while browsing the messages in order to obtain a more gender balanced base for the study.

Upon receipt of the first group of replies it became apparent that mixed feelings prevailed about the use of the internet for transmitting unsolicited messages. Although research librarians at McGill University had assured me that it was common practice to send out questionnaires using electronic mail, and indeed many respondents welcomed the questionnaire and expressed enthusiasm for my study, several recipients replied in a hostile manner indicating that this is a contentious issue. The remaining fifty-two surveys were therefore only sent to people who had posted messages in news groups that were related to the general topic of the questionnaire. Nevertheless the rate of reply was equal among all news groups regardless of topic. Seventy-eight replies were received in total giving a thirty percent rate of return. The following is a copy of the questionnaire as it was sent out via electronic mail.

Greetings;

I am in the final stages of conducting research on the viability of working at home as a more sustainable lifestyle option than the status quo, especially in North America. An area that remains largely unresolved in my study, revolves around the potential for people to move away from city centers and out into suburbs or rural communities.

I came across your e-mail address while surfing the internet, and I hope you don't mind me taking the liberty of using it. I have composed a little exercise which, if performed by a random sample of "internetters" will hopefully shed some light on some on the grey areas of my work.

If you have the time please, take a few minutes to imagine yourself in a work scenario that allows you to work at home. Further, imagine computer and communications equipment give you sufficient freedom to make it possible to live absolutely anywhere your heart desires.

Assuming all family members are equally flexible and are excitedly supportive of your
choice of location,

1 Would you

(a) stay where you are because you feel stable and settled

(b) move closer to the city center because now that many others are working at home the city is less congested and you would rather be closer to entertainment and cultural events

(c) move away from the city center to benefit from the tranquillity and safety of suburbs

(d) move out of the city to a rural or small town setting to enjoy clean air and a healthy life near nature

(Please choose only one response or create your own if none applies)

2 If you currently do some work at home where do you do it?

(a) office/den

(b) converted garage

(c) basement

(d) kitchen

(e) dining room

(f) living room

(g) bedroom

3 What would be your ideal work space in the home be?

(a) separate room in the middle of the house

(b) separate room on the perimeter of the house

(c) separate room outside the house

(d) a room in which some other activity is shared

4 If innovations in information technology allow you to live anywhere you want in the world, which of the following factors would govern your choice of location?

(a) location of family

(b) location of friends

(c) climatic conditions (sunny, warm, 4 distinct seasons, etc.)

(d) geography (mountains, lakes, ocean, forest, etc.)

(e) world view of neighbors (politics, religion, attitude, etc.)

(f) education or profession of neighbors

(g) cheapest location

(please rank these responses from the most to the least important)

5 What is the highest number of blocks that you would walk to go to work in a neighbourhood facility that provides you with office equipment?

- How far would you walk to buy groceries?
- Would you consider riding a bicycle? (y/n)

Thank you very much. I just have a few more mundane quickies, so please bear with me, are you

- female or male,
- a parent of a minor,
- living in a city or suburb, and
- how do you make a living?

Once again I thank you for participating in this little exercise. If you are interested in the final findings, I would be more than happy to share them with you. If you are generally interested in this topic and would like to discuss its many implications, let me know I'd love to chat. If on the other hand you feel that this entire message is an unwelcome invasion of your electronic space, then please accept my apologies!

maged senbel

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