TECHNOLOGY IMPACTS ON FUTURE URBAN CHANGE IN EGYPT: IMPLICATIONS FOR DEVELOPING COUNTRIES

A thesis submitted in partial fulfilment of the requirements of Sheffield Hallam University for the degree of Doctor of Philosophy

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I declare that no portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institution of learning.

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ABSTRACT

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Ph.D. Thesis

By: Antar Abdel-All Abou-Korin

September 2004

Since the Industrial Revolution, technology achievements, especially in transportation, have introduced significant changes to city structures and urban systems in both the developed and developing countries. Technology advancements of the Post-Industrial era, especially in telecommunications, are expected to introduce a new substantial wave of urban change. This research examines the future urban impacts of technology in developing countries and aims, in the light of these expected changes, to define the necessary approaches for managing the urban future in these countries.

Based on the theoretical examination of the relationship between technology and urban change, the urban impacts of different technology forces, the analysis of patterns and problems of urban change in Africa and in Egypt, and the analysis of the main problems of the increasing primacy of Greater Cairo Region, the thesis proposes three necessary approaches for managing the urban future in developing countries. These approaches are: urban decentralisation, small-size settlements, and the incremental planning and development of urban activities.

Although the review of current literature demonstrates that these approaches would be effective in managing the urban future in developing countries, and in a further step to confirm the validity of these approaches, the research carried out a forecasting survey of both technology and urban development experts' opinions and expectations. The statistical analysis of the survey results has revealed that the future impacts of technology on developing countries are expected to be substantial and confirmed that the proposed approaches are valid. Also, this analysis has revealed that existing cities, especially large ones, are expected to face considerable changes regarding their future size and function.

The research concludes by presenting a summary of research findings, brief recommendations for the application of each these approaches, a critique of methods, and potentials for further future research.

DEDICATION

To

My mother and my father

and

My sincere wife, Magda Mehanni

and my Children; Salma, Hossam, and Hazem

in appreciation for their considerable love and support

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All praise and thanks are due to Allah, my Lord and the Lord of all that exists.

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ABBREVIATIONS

CAPMAS .... Central Agency for Public Mobilisation and Statistics, Egypt
DGE .... Directorate-General for Energy, European Commission
DTI .... Department of Trade and Industry, UK
EIA .... Energy Information Administration, USA
FDI .... Foreign Direct Investments
GCR .... Greater Cairo Region
GLC .... Greater London Council
GOPP .... General Organisation for Physical Planning, Egypt
ICTs .... Information and Communications Technologies
IMF .... International Monetary Fund
InfoDev .... The Information for Development Program, World Bank Group
ITU .... International Telecommunication Union
kWh .... kilowatthour. An SI unit of energy measurement, 1 kW for 1 hour
LDCs .... less-developed countries
MENA Report ...... Middle East and North Africa, Business Report
MHNCU .... Ministry of Housing, New Communities and Utilities, Egypt
MoH .... Ministry of Housing, Egypt
MW .... Megawatt. An SI unit of power measurement (1,000 kW)
NICs .... Newly Industrialized Countries
NUPS .... National Urban Policy Study, Egypt
PV .... Photovoltaic
PWV .... Pretoria-Witwatersrand-Vereeniging metropolitan region, Johannesburg
RCP .... Rational Comprehensive Planning
RES .... Renewable Energy Sources
RO Units .... Reverse Osmosis Water Filtering Units For Safe Drinking Water
SAPs .... Structural Adjustment Programmes
SFD .... Social Fund for Development, Egypt
SIDA .... Swedish International Development Cooperation Agency
SIS .... State Information Service, Egypt
SPECTRE .... Spatial Planning & Emerging Communication Technology in the Regions of Europe
SPSS .... Statistical Package for the Social Sciences
SSA .... Sub-Saharan Africa
SSA .... Sub-Saharan Africa
TETC .... Transit and External Traffics Committee, Egypt
TIW .... Telesystem International Wireless
TNCs .... Transnational Corporations
TTP .... Technology Transfer Payments
UK- DFID .... UK Government Department for International Development
UN, DESA .... United Nations, Department of Economic and Social Affairs
UNCHS .... United Nations Centre for Human Settlements, Habitat
UNCTAD .... United Nations Conference on Trade and Development
UNDP .... United Nations Development Program
UNESCO .... United Nations Educational, Scientific, and Cultural Organisation
UNPD .... United Nations Population Division, Department of Economic and Social Affairs
US DOT, BTS ...... United States Department of Transportation, Bureau of Transportation Statistics.
US, CIA .... United States, Central Intelligence Agency
WBCSD .... World Business Council for Sustainable Development
WHO .... World Health Organization

INTRODUCTION: RESEARCH PROBLEM, HYPOTHESIS AND METHODOLOGY

1.1 STATEMENT OF THE PROBLEM

Throughout history, since the Stone Age through the Industrial Revolution and into the Post-Industrial era, civilisations have been characterised by the type of technology they use. In all civilizations, technology has played a significant role in shaping the city, both physically and socially. Technology has been, and is expected to continue being, a powerful dynamic force of change in city structure and urban systems (Mumford 1961; Morris 1972; Fathy 1991). The structural analysis of any old city clearly reveals the impact of the subsequent technological statuses on the city structure. Also, technology has significantly altered the city function within its regional settings. Although gathering people in cities was the best way for defending them during the pre-industrial era, this situation has completely reversed after the proliferation of mass-destruction weapons of the Industrial and Post-Industrial eras.

In Greco-Roman cities, improvements in basic infrastructure such as the introduction of sewerage systems and water supply networks greatly altered building arrangements and the urban environments of these cities. For the industrial city, the generation of electrical power and the motorcar brought about dramatic changes. Electricity has led to the creation new machinery and manufacturing techniques for mass production in large factories. It also led to the creation of new modes of transportation - the tramway, which dispersed social activities into wider areas. Motorcar radically altered accessibility between residents, materials, and markets. It broke down the existing pedestrian network patterns (Mumford 1961). The motorcar was the prime factor in the emergence and development of suburbs, satellite towns, and residential expansion at the growing edges of most metropolitan areas (Clawson 1971; Fathy 1991).

The major technological achievements of the industrial revolution; electricity, tram, car, train, aeroplane, and the telephone, which occurred in a span of only one century, greatly changed the time-distance and the urban-rural relationships and consequently affected the urban life in both the developed and developing countries. Old cities often failed to accommodate present demands rather than the future increase in car ownership. In cities like Cairo, car ownership increased sharply from 10 cars per 1000 inhabitant in 1974 to 75 in 1998 (Afifi 1991; CAPMAS 1999). These rapid changes have been reflected on cities and urban systems through a series of socio-economic problems and physical transformations.

Due to these rapid and impressive changes, almost all cities are currently suffering serious problems. Cities such as Cairo, Delhi, Tehran, which were very effective in meeting their population needs hundred years ago are now suffering very serious physical, socio-economic, and environmental problems on the local and regional levels. Moreover, some of Ebenezer Howard's planned garden cities in England; such as Letchworth built in 1903 and Welwyn built in 1920, are suffering serious problems nowadays. In addition, serious problems of urban concentration, as a result of acute regional imbalances in the distribution of urban population, are evident in almost all developing countries.

Although technological achievements of the 20th century was very rapid and impressive, future technological achievements, especially in the area of information technology, transportation, and infrastructure, are expected to be faster and more influential in shaping the urban future. Despite this, many new towns under construction in developing countries, such as Egypt, are planned according to the prevailing technical, economic, and social conditions without taking into account the impact of the future technological achievements.

Technology transfer to developing countries, especially in the areas of information technology and telecommunications, is very rapid. Despite its short age, Internet is widely spread in some of the developing countries at a rate that is higher than that it reached in some developed countries only five years ago. In areas of satellite channels and the cellular phone, the situation is not an exception. The TV, telephone, and car ownership rate in some of the developing countries such as Egypt is higher than that of some developed countries only ten years ago (CAPMAS 2000).

For Egypt, technology impacts have mounted sharply over the last 30 years. In the area of telecommunications, the number of telephone lines increased from 0.51 million in 1981 to 4.3 millions in 1997. The number of cities covered by automatic phone service increased from 7 in 1981 to 220 cities in 1994. Furthermore, the number of Fax lines increased by 63 fold between 1986 and 1994 (Huzayyin 1995; CAPMAS 1999). Cellular phone service is now covering the whole country with very high subscription rate - more that 8 percent in 2003 (MENA Report, 2000). In the area of transportation, Egypt is experiencing substantial growth in the number of motor vehicles of all types, especially intercity taxi and private cars. The vehicle fleet increased sharply from 126,000 in 1965 to 2,343,000 in 1998 (PADCO, Inc. 1982; CAPMAS 1999). Moreover, car ownership increased sharply from about 4 cars per 1000 inhabitants in 1965 to 38 in 1998 (Afifi 1991; CAPMAS 1999). To cope with this unprecedented growth of motor vehicles, lengths of paved road network increased from 17,700 km in 1981 (SIS, 2001) to 50,000 km in 2000/01 (CIA, 2001). In addition, Egypt constructed the Cairo underground metro to be the first in Africa and the Middle East. The first metro line was opened to service in 1987. This 42 km line is currently carrying about one million passengers every day. The second metro line, about 20 km long, was opened to service in 1999 and designed to carry some 4 million passengers every day. These few indicators show how much technological achievements have influenced urban development in developing countries (section 5.1.3).

Such trend of increasing technological capabilities of developing countries is expected to continue growing rapidly as technology transfer activities are considerably increasing (Kumar, N. 1997; UNCTAD, 2001-a). This is mainly because technology transfer is of mutual benefit for both the developed and developing countries. For developed countries, it offers good opportunities to open new markets, and for developing countries, it is a necessity to produce competitive products and exploit natural resources. Investments of technology producing companies in developing countries, especially through joint ventures, have increased in the last decades. Therefore, technology products and achievements of developed countries, especially in areas of information technologies, telecommunication, and transportation, transfer very quickly to developing countries (section 2.5).

The main problem here is that developing countries are not well prepared to deal with the expected substantial social and economic impacts of these technologies. These impacts are expected to be of considerable influence in shaping the urban future in these countries.

The analysis of the different urban change patterns and problems in the more, less, and least developed countries (presented in Chapter 4) shows that urban systems in less and least developed countries are suffering mounting structural imbalances. The ever-increasing size of large metropolitan areas, the mounting trend of urban concentration, and the declining role of small urban settlements are the most important of the imbalances. Controlling such imbalances requires the adoption of rational strategies that take into account the future impacts of technology and that employ these technologies in overcoming such imbalances. Moreover, the extensive analysis of urban problems in Egypt (presented in Chapter 5) confirms that: (1) the urban system of Egypt suffers high urban concentration levels in certain regions of the country; namely Greater Cairo, Alexandria, and Canal cities. To these three regions, all migration streams are heading from all over the country, from both the urban and rural areas. Upper Egypt regions are the main losers of both urban and rural populations, (2) new towns built in Egypt since 1977 were of very limited influence in correcting this pattern of urban concentration, (3) the urban system of Egypt suffers high differential growth of the different settlement sizes as large cities are usually growing faster than smaller ones, which usually lose their population in favour of larger cities. In 2003, 51% of the country's urban population were in only 2 large cities of over a million people in size: Greater Cairo 38 percent, and Alexandria 13 percent.

These mounting problems clearly demonstrate that developing countries are facing serious urban problems that are expected to be further aggravated if alternative approaches to urban development, that take into account the current and the future socio-economic and urban impacts of technology advancements, are not appropriately developed and applied.

1.2 RESEARCH OBJECTIVES

The main objective of this thesis is to find out how technology will influence the future of urban development in developing countries and to define the necessary approaches needed manage the urban future in these countries. But, it is not the objective of the thesis to forecast how the urban future in developing countries will be, but rather how it should be. In that context, the thesis has three objectives:

1. **To investigate the relationship between technology and urban change and to explore the urban impacts of technological achievements in the areas of transportation, telecommunication, and infrastructure.** Investigating such relationship is of considerable importance for the development of urban development approaches necessary to manage the urban future in developing countries.

2. **To examine the nature and extent of the main urban change problems in developing countries and how they are different from those in more developed countries.** Defining these problems is of considerable importance in devising and developing the necessary urban development approaches that could utilise future technological achievements in addressing these problems.

3. **To develop alternative urban development approaches that could be more effective in addressing the main urban problems in developing countries and that could efficiently meet the expected impacts of future technological achievements?** Also, these approaches should be designed to best utilise technological forces in achieving balanced and sustainable urban development. Meanwhile, these approaches should take into account the social and economical status of communities. Special recommendations are to be suggested to make these approaches more appropriate for developing countries.

Taking into account the fact that managing the development of new urban settlements is not enough to achieve a more balanced and more sustainable urban development process, the thesis aims to define the expected impacts of future technological achievements on existing cities and to define the most appropriate future function and size of these settlements.

1.3 SCOPE OF THE RESEARCH

Because the scope of the thesis is mainly about technology and urban change, it is important to explain how the thesis views the role of technology in society. Although there are many schools of thought on this subject, the thesis does not view technology as an autonomous or deterministic factor, but rather as a tool for human development that enables people to increase their incomes, improve their living standards, and participate more in their communities. In addition, and concerning urban analysis, considering technology as the prime cause for urban change seriously underestimates the social and political factors in this process (section 3.2.4.1).

The thesis focuses on developing countries, and mainly those experiencing increasing technological capabilities and improving economic and social conditions. This is mainly because these countries are facing or are expected to face increasing social and economic impacts of technologies and having a good opportunity to manage their urban future. The thesis focuses on Egypt, as an example of these countries, in defining the main urban problems in developing countries. Focusing on Egypt is mainly because the country represents a good example of developing countries experiencing increasing technological capabilities and mounting urban problems and because the researcher is of good experience about urban problems in Egypt. Despite focusing on developing countries, the thesis recommendations may be valid, to some extent, for some of the developed countries as well.

Concerning types of technologies studied, and because of studying urban development in developing countries, the thesis focuses on two main aspects of technology: the communications and infrastructure technologies, as they are the most influential technologies in shaping the urban future in these countries. In this regard, communications has two main facets: transportation and telecommunications. Transportation is seen as the physical aspect of communication, responsible for the movement of people and goods. Telecommunications, especially information technologies, is seen as the virtual aspect of communications responsible for the movement of data and information. On the other hand, infrastructure technologies especially in the areas of water and power supply systems and sanitary networks are expected to be of considerable importance in shaping future urban development in developing countries.

For the time horizon of this study, and because of focusing on urban future in developing countries, a time horizon of about 30-40 years is seen to be more appropriate for the purpose of this study. Taking into account the history of socio-economic change, the proposed 30-40 years time-horizon goes well with both the short- and the long-wave economic cycles of Kuznets and Kondratieff (Knox, P.L. 1994, 9). It is the double of Kuznets short-wave cycle (15-20 years) and slightly less than a single long-wave Kondratieff cycle (50 years). However, this time horizon can be regarded as the first phase in a continuous forecasting process to ensure the continuous evaluation and revision of the planning process (section 7.1.2).

Rationale of Studying the Future Urban Impacts of Technology in Developing Countries:

Some may argue that studying the future urban impacts of technology in developing countries is unrealistic or irrelevant, as many of these countries have limited technological capabilities when compared to developed countries. Although this argument may seem sound, it neglects the fact that the rate of technological change in developing countries is very high (see 2.5). For developing countries, the utilisation of new technologies is the most economic alternative to overcome the majority of its socio-economic problems mainly in areas of food production, health, energy, and education. This demonstrates the increasing need for technology and consequently its mounting future impacts in developing countries. Moreover, while developed countries are better equipped to utilise and manage its technological change, the sudden and accelerating rate of technological change in progressive developing countries makes the management of future technology impacts in these countries of considerable importance.

Concerning the expected future impacts of technology on urban development, it seems that developing countries currently have better chances to benefit from these technologies much more than developed countries could do. Developing countries have the opportunity to look at the future and to reshape its urban structure in a better way and not to go through the long way that urban development processes in many developed countries have been through. In developed countries, the huge investments made in urban infrastructure; such as regional highways, communications and energy networks, and business facilities; have made these countries less encouraged and less able to fully utilise the modern technological achievements in managing its urban future as these achievements may foster urban sprawl and urban decentralisation out of existing large urban centres. In contrast, progressive developing countries have better chances of managing their urban future on the basis of utilising future technological achievements. The utilisation of these achievements is expected to reduce the costs of their urban programs, especially concerning urban infrastructure.

Although there are many studies that have investigated the future urban impacts of technology in developed countries, this issue is poorly examined in the case of developing countries. This research aims to fill some of this gap through providing a rational assessment of these impacts and defining the necessary approaches for managing future urban changes in these countries.

1.4 RESEARCH HYPOTHESIS

Before formulating the thesis hypotheses, the relevant literature has extensively examined. According to many studies, hypotheses are tentative predication about the nature of the relationship between two or more variables (Gass, 2000; Dixon et al. 1987; Christensen 2004-a). Hypotheses could simply be stated in if-then sentences, that can be categorized in certain logical forms, such as no difference (null hypothesis), associated difference, directionality of difference, and magnitude of difference (Bryman, 2001; O'Connor, 2002, Janda 2001). Blaxter et al. (2001) and Christensen (2004-b) argue that hypotheses should be tested through subjecting them to some sort of empirical scrutiny methods that should be defined in advance.

Accordingly, and based on the review of literature about the nature and extent of technology impacts on urban change the thesis came to the following hypothesis:

That the future technological achievements of the 21st century will have considerable impacts on shaping the urban future in many of the developing countries, as the prevailing economic and social forces and institutions will undergo significant changes.

Based on this hypothesis, and taking into account that while technology has created some urban problems it has opened up new possibilities for urban management, the thesis proposes three complementary approaches, that could be highly facilitated by future technological achievements, for managing the urban future in Egypt:

First, decentralization and dispersion of urban population, mainly at the regional level, is a necessary approach for managing the urban future in developing countries. This approach is expected to minimise the ever-increasing concentration of urban population in certain regions and metropolitan areas, such as the Greater Cairo Region (GCR) in Egypt. Urban decentralization is also expected to correct the regional development imbalances that exist in most of the developing countries. The thesis argues that future technological achievements would increase population mobility and would introduce and enhance new forms of work, education, and entertainment, and consequently would facilitate the adoption of such an approach (section 6.1);

Second, Small-size urban settlement is seen as a necessary approach to avoid the problems of current large-scale urban centres and to implement the proposed urban decentralization approach. The thesis argues that small-scale urban settlements approach is more effective and more flexible in meeting the future technological changes and their associated socio-economic impacts. In addition, it argues that this approach ensures, to a reasonable extent, the wise use of investments as it enables the flexibility to build according to actual needs and changing socio-economic and technological conditions. Although there are some constraints on the application of such an approach; mainly concerning accessibility and the provision of infrastructure and basic services; future technological achievements especially in transportation, renewable energy, utilities, and telecommunication are expected to offer reasonable solutions to these constraints and facilitate the adoption of such an approach (section 6.2);

Third, the incremental planning and development of the future urban settlements is a necessary approach to deal with uncertainties that will always exist regarding the nature and extent of future technological change and its urban impacts, especially in developing countries suffering the lack of reliable and systematically organized data. The low occupancy rate in almost all the new towns of Egypt that have been built 25 years ago (section 5.2.1.4) clearly demonstrates that the incremental development could have been a more appropriate approach for the development of such cities. Therefore, the thesis argues that this approach provides better chances for the optimal use of financial and environmental resources as it continuously evaluates the socio-economic, technological, and environmental changes in the society. In addition, the thesis argues that this approach ensures the gradual transition from the existing to the targeted situations and consequently protects societies from the unexpected socio-economic impacts of sudden changes (section 6.3).

These proposed approaches have been developed through three consecutive stages: (1) the review of literature about the future urban impacts of technology; (2) the analysis of the different urban change patterns and problems in the more, less, and least developed countries (section 4.4) and the analysis of urban problems in Africa (section 5-1) and in Egypt (section 6.2); and (3) the theoretical examination of the main advantages and drawbacks of each of these approaches and the appraisal of their application in Egypt's case. Then, the importance and applicability of these approaches has been assessed through the survey of opinions of science and technology specialist and urban development experts. Through this four-stage process, it is expected that the proposed approaches have been properly developed and assessed.

1.5 RESEARCH METHODOLOGY AND ORGANISATION

If we knew what it was we were doing, it would not be called research, would it?[1]

Albert Einstein (1879-1955)

Before defining the appropriate methodology of this research, it is useful to start by exploring the main advantages and disadvantages of dominant social research types, approaches and methods.

For types of social research, two dimensions are particularly important in classifying types of research (Hakim, 1997; Borgatti, 2000). First: 'Applied' versus 'Basic' research. Applied research is research designed to solve a particular problem in a particular circumstance. Basic research is designed to understand the underlying principles behind human behaviour. Second: 'Exploratory' versus 'Confirmatory' research. Exploratory research is research into a relatively unknown area. Confirmatory research is research into a subject we have a good idea about it. That is when we have a theory (or several theories), and the objective of the research is to find out if the theory is supported by the facts.

For social research approaches to understand the relationship between theory and research, many writers on methodological issues, such as Alan Bryman, (2001) and Oppenheim (1992), classify these approaches into either 'deductive' or 'inductive' approaches. Deductive research usually moves from general ideas/theories to specific particular & situations: the particular is deduced from the general, e.g. broad theories. In such approach, the researcher, and on the basis of what is known about a particular domain and of theoretical considerations in relation to that domain, deduces a hypothesis that must then be subjected to empirical scrutiny. Inductive research moves from particular situations to make or infer broad general ideas/theories. In such approach, the researcher infers research findings for the theory that prompted the whole exercise. The findings are fed back into the stock of theory and the research findings associated with a certain domain of enquiry. However, Bryman, (2001) argues that it is useful to think of the relationship between theory and research in terms of deductive and inductive strategies. He also argues that it is possibly better, to a large extent, to think of deductive and inductive strategies as tendencies rather than as a hard-and-fast distinction.

[1] *The Quotations Database, www.quotedb.com.*

For social research methods, many writers on methodological issues classify social research methods to either 'quantitative' or 'qualitative' methods (Bryman, 2001; Gephart, 1988; and Oppenheim, 1992). Bryman (2001) argues that the status of the distinction between the two is ambiguous because it is almost simultaneously regarded by some writers as a fundamental contrast and by others as no longer useful or even simply as 'false' (Layder, 1993, 110). However, Bryman (2001) has identified a number of differences between quantitative and qualitative research. Quantitative research emphasizes quantification in the collection and analysis of data. Also, it embodies the view of social reality as an external, objective reality. By contrast, qualitative research emphasizes words rather than quantification in collection and analysis of data. It embodies a view of social reality as a constantly shifting emergent property of individual's creation. Generally (with many exceptions), confirmatory studies tend to be quantitative, while exploratory studies tend to be qualitative.

For this research, and because of its nature looking into the future, the thesis applied the inductive and deductive approaches and both the qualitative and qualitative research methods. A growing number of researchers argue that no method per se has the monopoly on inference and that quantitative and qualitative methods should not be considered antagonistic, but rather as complementary (Bryman, 2001; May, 2001; Pedersen, 1992; Cook and Reichardt, 1979). Moreover, Hofstede and Neuijen (1990) argue that in examining a complex social phenomenon it is better to start with a qualitative orientation and then followed up with a quantitative verification. Burns (2000) and Mouton (1996) identified four distinct phases any good qualitative research should have: conceptualisation, instrumentation, information gathering, and closure. The phases of quantitative research differ from those of qualitative research except for the conceptualisation phase. Figure 1.1 (adapted from Mouton and Marais, 1988; Neuman, 2000; Babbie and Mouton, 2001) clearly indicates the integration of the deductive and inductive approaches and the qualitative and qualitative methods followed in this research, and the conceptualisation and empirical research phases.

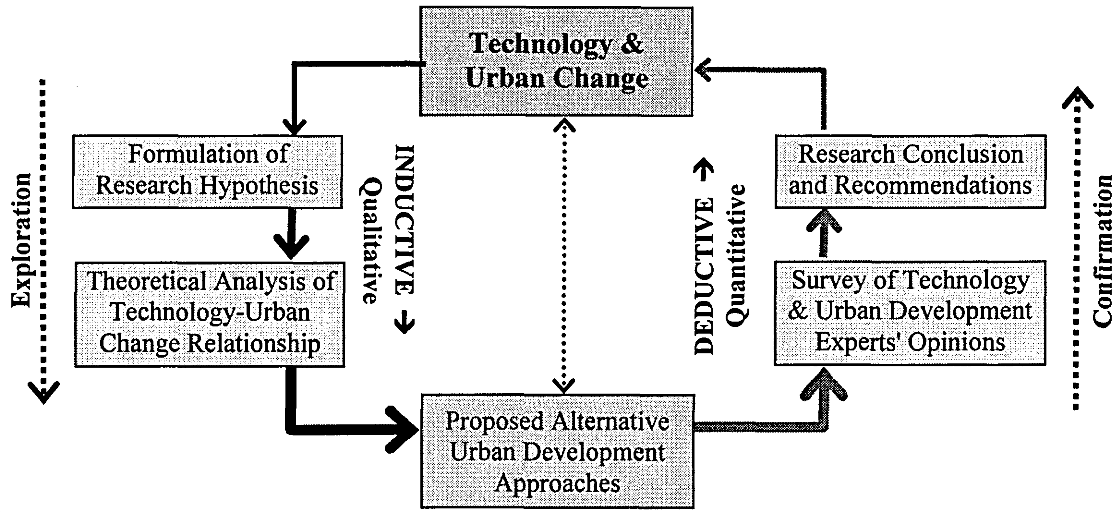

Figure 1.1: Conceptual Analysis of Research Approaches and Methods

The complexity of the construct and research questions of this study necessitated the use of a triangulation approach (multiple methods). Some researchers experienced in using a combination of qualitative and quantitative methods reported that blending and integrating methods and data in studying the same phenomena can "...capture a more complete, *holistic* and contextual portrayal" of the subject under study, by eliciting data leading to new hypotheses or conclusions, for which single methods would be blind (Pedersen, 1992). Many studies have pointed out the hidden assumption of triangulation: that the weaknesses and limitations of each individual method will be counterbalanced by the other method, exploiting the assets, and neutralizing, rather that compounding, the liabilities (Hilton, 2002; Jick, 1983, Van Maanen, J. 1983).

Regarding the research design, this research can be classified as an exploratory and confirmatory study. Although the thesis started by exploring the relationship between technology and urban change and the possible ways in which technology forces could affect urbanisation in developing countries, it then tries to confirm the role of the proposed approaches for managing the urban future in Egypt by surveying the opinions of both technology and urban development experts about these approaches.

Regarding research organisation, the thesis is organised into two parts (see Figure 1.2). Part One is mainly concerned with providing reasoned answers to the following questions: *what are the nature and the extent of technology impacts on urban change*? And *how technology affects urban change patterns*? In reaching these answers, Part One discusses the theoretical foundations of the relationship between technology and urban change and examines the main urban change patterns and problems in developing countries. It starts by an examination of the socio-economic impacts of technology and then it examines the urban impacts of the main technology forces. Then, it tries to examine the relationship between the levels of technology and the different patterns of urban change prevailing in different societies. In doing so, the thesis presents an analysis of different urban change patterns in the more, less, and least developed countries. Also, Part One presents a detailed investigation of urban change patterns in Africa as a group sample of developing countries, giving more emphasis for patterns of urban change in Egypt and South Africa as they are of the largest urban populations in Africa and having the first two 'Mega Cities' in the continent (UN, DESA, 2002). Finally, Part One presents an extensive analysis of urban change patterns in Egypt and the problems of urban primacy, taking Greater Cairo Region as an example.

Part Two is concerned with reaching an answer for the following question: *what range of urban development approaches can be proposed for addressing the process of urban change and the consequential multi-faceted problems which are associated with rapid and ongoing technological changes particularly in transportation, telecommunications and infrastructure?* In dealing with this question, Part Two starts by investigating the proposed urban development approaches through a theoretical examination of the main advantages and drawbacks of each of these approaches and the appraisal of their application in Egypt's case and the possible role of technological achievements in implementing them. Then, the thesis tries to empirically test the research hypothesis and to assess the effectiveness and applicability of each of these approaches through the forecasting survey of opinions and expectations of both technology and urban development experts. The survey methodology, design, sample selection and data collection are presented in Chapter 7. Finally, Part Two presents an appraisal of the proposed approaches in the light of the statistical analysis of forecasting survey results. Figure 1.2 depicts an outline of the research organisation and methodology.

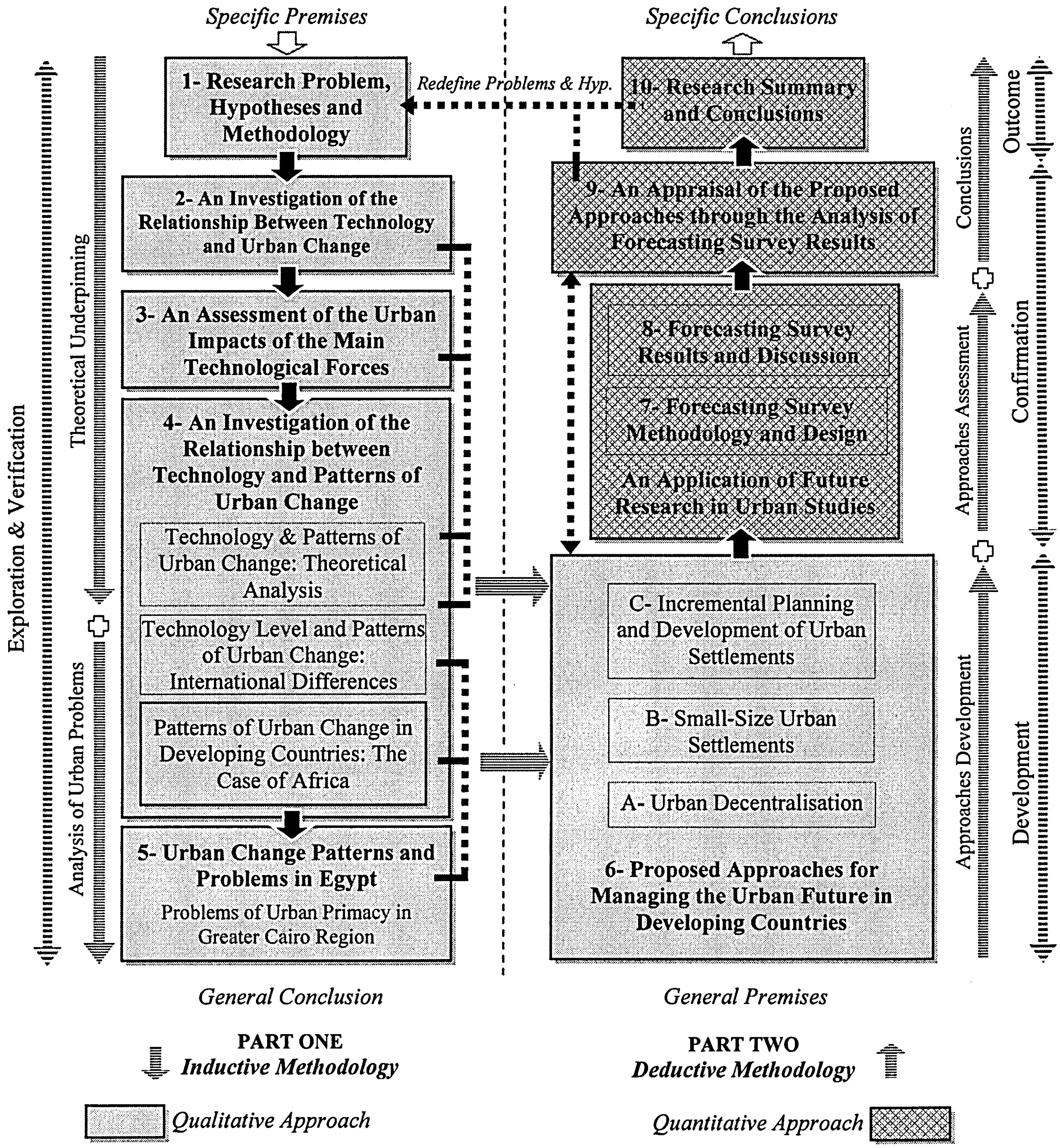

Figure 1.2: Research Methodology and Organisation

Organising the thesis in two parts relates to the combined deductive-inductive method of reasoning to research. The use of the combined method of reasoning is underpinned by a subjective research theory that is based on an ontological assumption of nominalism[1]; an epistemological assumption of anti-positivism[2]; and an assumption of voluntarism concerning man-environment relationship[3] (Cohen and Manion, 1989). Such methodology usually starts inductively from observations or specific premises in a particular context to form the hypotheses and then deductively from these hypotheses to its application and implications, assessing its validity against the givens of such context. Accordingly, Part One follows an inductive methodology and tries to provide the theoretical and analytical underpinnings of technology and urban change relationship in developing countries. Part Two adopts a deductive methodology that utilises the conclusions of Part One as a basis for proposing alternative urban development approaches for developing countries and to assess the validity of such approaches. Generally, the thesis methodology and organisation can be summarized in the following four points:

First, to investigate the theoretical foundations of the relationship between technology and urban change, the current literature on the different schools of thought about technological change and its impacts on the socio-economic and environmental conditions of societies is examined in Chapter Two. Then, a comprehensive review of the expected role of ICTs, transportation, renewable energy, and utilities technologies in shaping the urban future is presented in Chapter Three.

Second, to provide the analytical basis of the research hypothesis, a detailed investigation of the relationship between technology and patterns of urban change is presented in Chapter Four. In this chapter, the thesis empirically examines the main differences in patterns and problems of urban change in countries of different technological statuses (developed, less, and least developing countries) (section 4.2). Finally, the thesis examines the main characteristics and factors affecting urban change patterns and problems in Africa, as a group sample of developing countries (section 4.3). Then, the thesis extensively examines urban change patterns and problems and the technological status of Egypt, as an example of the progressive developing countries (Chapter 5). It also examines the problems of urban primacy in Greater Cairo Region (section 5.3). Through this analysis, the thesis demonstrates two main points: (1) that developing countries are experiencing increasing technological capabilities in all areas of technologies concerned in this

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[1] Such assumption argues that social reality is a product of personal interpretation – not of independent existence.

[2] The epistemological assumption of anti-positivism stresses that knowledge of reality is based on personal experience and insight – not universally acquired and neutrally transmitted.

[3] Voluntarism assumption argues that man shapes and controls his environment with a free will–not being its product or mechanically responding to it.

research, (2) that these countries suffer some serious urban change problems, regarding the size and the spatial distribution of urban settlements. The thesis argues that these problems could be better managed through urban development approaches that could better address the future impacts of technological achievements.

Third; based on the theoretical underpinning of the future relationship between technology and urban change and on the analysis of ongoing urban change patterns and problems in Africa and in Egypt as an example of developing countries, the thesis proposes three urban development approaches for managing future urban change in developing countries: (1) urban decentralisation, (2) small-size settlements, and (3) incremental planning and development of urban settlements. In developing these approaches, the thesis theoretically investigates the main advantages and drawbacks of each of the proposed approaches and presents an appraisal of their application in Egypt's case and the role technology achievements in implementing them (Chapter 6).

Fourth, although the proposed approaches have been developed based on an extensive review of literature about technology and urban change and on a detailed examination of urban change patterns and problems in developing countries, the thesis tries to assess the effectiveness and applicability of these approaches in the light of the expected high rate of technological change. In doing so, the thesis employs the Delphi technique to survey the expectations of both technology specialists and urban development experts. The methodology adopted in performing this forecasting study is presented in the survey section in Chapter Seven. The statistical analysis and the discussion of the survey results are presented in Chapter Eight. Based on this analysis and discussion, the thesis presents in Chapter Nine an appraisal of the research hypothesis and the proposed approaches through formulating a synthetic evidence for the validity of each of them from the results of different questions in the three questionnaires of the forecasting survey. It also includes an analysis of the prospects of and constraints on applying the proposed approaches in Egypt.

Through its different stages, the thesis had faced several limitations that restricted data collection and analysis. As is the case for most forecasting studies, the low responses rate was the most serious problem. Also, the lack of dependable, systematically organized, and ready to use data in developing countries was another problem. However, this thesis attempted to use relatively extensive and reliable data.

AN INVESTIGATION OF THE RELATIONSHIP BETWEEN TECHNOLOGY AND URBAN CHANGE

Introduction:

In order to investigate the relationship between technology and urban change, this chapter starts by a theoretical examination of the technology-urban change process and how technology affects the characterising aspects of urbanisation. The thesis has identified three possible ways through which technology could affect urbanisation: (1) social change, (2) economic growth and (3) technological forces of direct impacts on the physical environment. In addition, and because of the increasing awareness about future impacts of globalisation, the thesis examines how technology affects globalisation and discusses its urban impacts, especially in developing countries.

2.1 TECHNOLOGY - URBAN CHANGE PROCESS

In investigative how technology affects urban change process, the thesis adopted two complementary approaches. First, is to define the characterising features of urbanisation that differentiate between urban and rural communities and then to examine how technology affects these features. Second, is to define the main factors affecting urbanisation process and then to discuss how technology affects each of these factors.

2.1.1 Technology and Urbanisation Definitions

In exploring the relationship between technology and urbanisation, it is important to investigate the impacts of technology on the defining characteristics of urbanisation such as the population size, the economic base, and the lifestyle characteristics of communities. Therefore, the thesis tries here to discuss the different views of how these characteristics are used to differentiate between urban and rural communities and how technology could interfere and change each of these characteristics.

Regarding population-size, although urban places are usually larger than rural ones the turning point at which the village becomes a town is still defined in different ways. Although the United Nations defines urban populations as "localities with 20,000 or more inhabitants", many countries have their own size-classification for urban settlements (Barba and Rabuco 1997). For several Scandinavian countries, including Denmark and Sweden, any settlement which has more 200 inhabitants is classed as urban in the national census, at least 1,000 inhabitants forms the required threshold in

Canada, but 2,500 is the minimum for the USA. Many countries impose much higher thresholds, such as Greece, with 10,000 and Japan with 30,000 (Herbert and Thomas 1997). In Egypt, although the administrative and economic functions are more important than the population size in defining the urban settlement, the size of smallest urban settlement is about 50,000 inhabitants. This diversity is initially confusing, but has some logic if considered with its societal context. Concerning the role of technology in defining settlement size, numerous studies proved that people usually concentrate in centres of better economic and employment opportunities. No doubt that technology is one the main driving forces for economic growth and job creation. The growth of industrial cities during Industrial Revolution era proves the effective role of technology in promoting urbanisation. On the other hand, technology - especially transportation and infrastructure technologies - has considerably facilitated the growth of large cities as it has highly facilitated the rural-urban migration and the emergence of suburbs (Hall 1993; Pacione 2001; Herbert and Thomas 1997; Hart 2001).

Regarding the functions and activities of communities, urban places have at least two kinds of activities that distinguish them from rural settlements. First, they are non-agricultural, and second, they are primarily concerned with the exchange rather than with the production of goods. Such criterion, combined with population-size, is employed in India, where a threshold of 75 percent of the adult male population is used (Herbert and Thomas 1997). In this regard, the nature and level of technology available to societies are decisive factors in determining the nature of functions and activities prevailing in different communities. The current classification of countries as developed and developing, which is usually parallel to being industrial or agricultural countries, demonstrates the important role of technology in determining the nature of the main activities prevailing in societies. Moreover, technology is currently introducing many new functions and activities such as. tele-working that is expected to change the current occupational structure of rural settlements. In addition, technological achievements in agriculture had reduced the amount of labour force needed, a matter expected to reduce the dominance of agriculture as a major employing sector in rural areas (Hall 1999, 173; Cane 1996; Chandrasekhar 2001).

Evidence of lifestyle differences between urban and rural places is therefore ambiguous and contrasts maybe more real at some stages of societal development than others. Urban-rural differences are blurred in many advanced western societies, as they are, for different reasons, in Third World societies which have experienced recent and large-scale rural-to-urban migration. There are many situations, however, in which urban places exhibit distinctive lifestyle characteristics. These are not necessarily urban-rural differences but are as likely to be inner city-suburban or small town-large city contrasts. These contrasts are products of social dimensions, such as class or race, rather than of place (Herbert and Thomas 1997). Taking the social dimensions and lifestyle patterns into consideration in differentiation between urban and rural communities, again technology had introduced substantial changes in these aspects. The role of technology in health, nutrition, and education during the last thirty years is undeniable. Moreover, the role of technology in media production and information dissemination through the radio, TV, satellite channels, and the Internet had significantly improved people's perception of local and global issues, increased their social and political participation, and reduced cultural and lifestyle differences not only between rural and urban communities but also between developed and developing countries (Fogel 1979; Marks 1983; UNDP 2001).

Potter (1985) defines urbanisation as the process that leads to increase the number of people living in large, dense and non-agricultural settlements. Some other definitions argue that the fundamental nature of urbanisation is the increasing concentration of both people, and secondary and tertiary economic activities in space (Yeates and Carner 1980). Although this is undoubtedly true as a description, it is not clear if process terms are taken into consideration and seem as circular an argument as stating that city is a city (Potter 1985). However, technology seems to be a necessary tool for meeting the requirements of the increasing number of people living in these large, dense and non-agricultural settlements.

This analysis clearly demonstrates that technology significantly affects the definition of urbanisation.

2.1.1 Technology and Factors Affecting Urbanisation Process

In exploring the relation between technology and urban change, it is useful to highlight first the main causes and factors affecting urbanisation and then to investigate the impact of technology on these factors.

Based on the previous analysis of how technology affects the defining characteristics of urbanisation, technology could affect urbanisation in three possible ways: (1) through changing the social behaviour and the nature of human needs and aspirations which in turn affect pattern of urban change (2) through improving the prevailing economic conditions which affect the human abilities to meet their needs and aspirations, which in turn affects the pace and scale of urban change, and (3) through introducing and improving many technological forces; mainly transportation, telecommunications, energy and urban utilities which yield direct physical urban changes (Figure 2.1). These three factors are highly interrelated and affect each other. This chapter presents the main arguments of how technology influences urban development through each of these three ways.

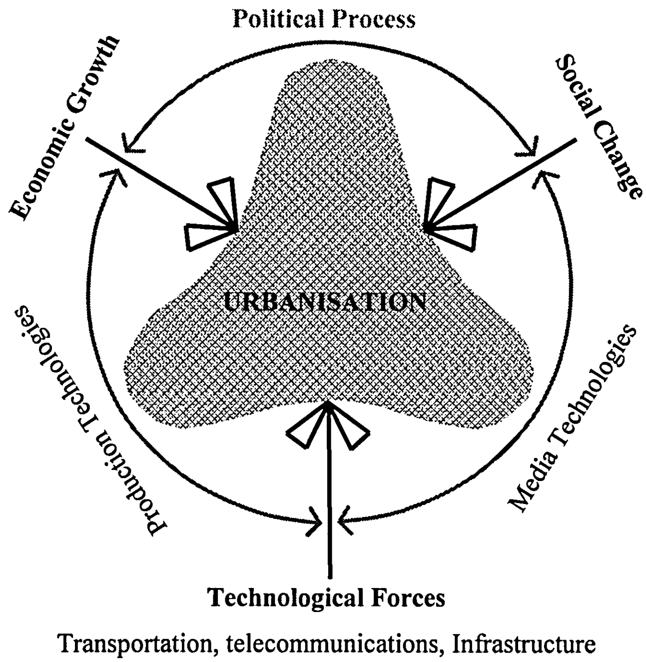


Figure 2.1: Ways in which technology affects urbanisation

Because of the increasing international economic, cultural and political interaction, many studies, such as UN-HABITAT and UK-DFID (2002), Friedmann (1986; 1995), Hall (1997), Sassen (1991, 1994a, 1994b; 2002; 2003; 2004), stress the role of globalisation in shaping the urban future in both the developed and developing countries. Therefore, and in addition to three factors mentioned earlier, the urban impacts of globalisation and the role of technology in this process will be discussed in details in this chapter.

2.2 TECHNOLOGY, SOCIAL CHANGE AND URBANISATION

In this section, the thesis tries to investigate the relationship between technology and social change and how social change affects urban change process.

2.2.1 Technology Impacts on Society through History

Although perception of technology differs from time to time according to the level of technology available and its impacts on the society, technology has always played a significant role in the transformation of the socio-economic and urban environments of all nations through history. The evolution of societies from agricultural to industrial to post-industrial or information societies was driven by the advancement of their technological capabilities. Clearly, from the discovery of fire, to the creation of gunpowder, to the invention of the computer--from the printing press to the computer, from the first use of penicillin to the widespread use of vaccines; each technological advance has pushed the limits of human capabilities and changed, to some extent, social patterns. Societies are now in the Information Age, where computers and communication technologies are again changing the way of thinking about the future (UNDP 2001).

The Agricultural Revolution - started in 8000 B.C. - had introduced cultivation as the main technological achievement of that era. Settling and the emergence of permanent human settlements were the most dramatic social changes brought about by the Agriculture Revolution. Agrarian societies, because they were based on large-scale agriculture, were far more efficient than earlier societies and typically had a huge food surplus. This supports a complex division of labour and the emergence of commercial exchange. Because of the profound impact of the Agricultural Revolution on society, many people call this era the "dawn of civilization" (Board of Curators. 1995).

The Industrial Revolution, which emerged during the 17th century, represents an important shift in the application of technology. It was a dramatic change in the nature of production in which machines replaced tools, steam and other energy sources replaced human or animal power, and skilled workers (artisan) were replaced with mostly unskilled workers. The Industrial Revolution shifted production from reliance on manual labour to mechanised, steam-engine-powered and automated fabrication processes. Through the mechanisation and standardisation, the Industrial Revolution introduced new materials, products, and commodities (Board of Curators. 1995).

The Post-Industrial or Information Revolution emerged by the start of the second half of the twentieth century and opened up a new era of the development and application of technology. Since then service jobs (ranging from high technology, highly skilled professions to low-skill jobs like short-order cook) are more common than jobs in manufacturing or agriculture. Post-Industrial societies are dominated by information, services, and high technology more than the production of goods. The product of skilled professionals is the information or knowledge they provide. The information revolution began with the invention of the integrated circuit or computer chip. These chips have revolutionized modern life, running appliances, providing calculators, computers, and other electronic devices to control our world. Table 2.1 summarises the main characteristics of the technology applied in each of these societies. Eventually, and due to the adoption of advanced technology, the three "societies" coexist simultaneously in any society (Board of Curators. 1995).

It is still too early to define precisely all the implications of the Information Revolution on future social life. But certainly changes such as the information superhighway permitting people to communicate using computers all around the globe, fax machines, satellite dishes, and cellular phones are changing how families spend their time, the kind of work, and many other aspects of social activities. The current, rather than the future, impacts of this new information society are not yet clear. In fact, even the phrase "Post-Industrial" belies the fact that it is not yet quite known what will follow industrial societies or the forms they will take. The thesis aims here to improve understanding about the future attitudes and the ramifications of this new technological era on the social and urban environments.

Indeed, as technical prowess grows uncertainty over its social assimilation persists. Technological advances do not occur in a vacuum but are shaped by social forces. For instance, industry recognizes that the acceptance of new technologies is driven by consumer awareness, needs, lifestyles, values, and a host of other market factors (John 1995, 57). Moreover, national research and development funding is often subject to the whim of politics. Because of all these confounding influences, the record of social forecasting is poor (Halal; Kull; and Leffmann 2001).

Table 2.1: Technological Characteristics of Agricultural, Industrial, and Information Societies

Characteristics	Agriculture	Industrial	Information
Beginning of Society	8000 B.C.	17th Century	1950s
Country of Origin	Egypt	England	U.S.A.
Basic Technology	Manual labour	Steam Engine	Semiconductors
Tech. Achievement	Agricultural Tools	Energy	Information
Role of Technology	Extraction	Fabrication	Process
Technological Focus	Farming & Irrigation	Mechanisation & Standardisation	Processing
Main Product	Food	Commodities	Knowledge
Main Labour Force	Farmers	Factory Workers	Information Workers
Social Institution	Farm	Steel Mills–Auto Factories	R&D Centres-Universities

Source: Based on: Fathy 1991.

Digital and communication technologies may mold social paradigms and influence social stratification in the coming twenty years. Chareonwongsak, (2002) argues that because of the rapid diffusion of information technology new social patterns are emerging. Tele-commuting and virtual relationships, e-commerce, and changes to home, work, and education environments are the most important of these emerging patterns expected to have significant urban impacts. In section 3.2.3, the thesis presents a detailed analysis about the causes and impacts of these emerging patterns.

2.2.2 Technology and Social Change Theories

The crucial role of science and technology in transforming the socio-economic structures in industrial societies has been emphasised in studies of several European social scientists, such as Radovan Richta (1967), Serge Mallet (1963), and Andre Gorz (1968). Also, the influential role of technology in socio-economic transformations has been expressed in many recent studies such as Mowery and Rosenberg (2000) Brynnjolfsson and Hitt (2000, 23), and Smith (2001).

The technology impacts on socio-economic conditions of societies have been conceptualised by three competing schools of thought. These are the subjective preference theory of value, the cost-of-production theory of value, and the abstract labour theory of value. Each of these schools is concerned with technology's impact on socio-economic activities as a way of understanding the valuation of human activity (Cole *et al* 1983; Fathy 1991; Patterson 2002).

The *subjective preference theory of value* -- developed by Pareto and Fisher in the first half of the twentieth century and then elaborated by Friedman (1953), Brittan (1975), and Arrow (1963) -- views technology as an autonomous development in a self-contained political and economic system. It proposes that the individual is endowed with tastes and talents and calculates actions to maximize his or her benefits in a free market (Cole *et al* 1983). In that context tastes define preferences among alternative consumption patterns, and talents determine the ability to fulfil these desires through productive activities. For this school, technology reduces prices for higher consumption through mass production and substituting machines for labour, and allows individuals to apply talents in the production process. Due to the apparent separation between the individual as consumer and the individual as producer, society is the aggregate of various individuals engaged in both production and consumption activities (Fathy 1991).

The *cost-of-production theory of value* -- originated in the works of Veblen (1932) and Marshall (1947), and elaborated by Keynes (1936) Chamberlin (1933), Robinson (1933) and Galbraith (1958) -- argues that value is determined mainly by decisions to produce, rather than decisions to consume. The prevailing technology dictates the nature and method of production, and therefore determines the technical division of labour, which in turn necessitates exchange of products at exchange rates (prices) based on each good's cost of production including distribution of social product between wages and profits. According to this theory, technology plays a deterministic role in production process. Therefore, the temporal equilibrium of political-economic forces of ever-changing interest groups is threatened by technological change. Hence, there is a possibility of sectional opposition to the introduction of new techniques. Technology, it is suggested, must be tamed, if the accelerative thrust is to be brought under control (Winner, L. 1977).

The third school, *labour theory of value,* emerged from the Marxist philosophy where material environment is transformed through production process to goods that individuals wish to use. According to Marxist philosophy, the industrial mode of production (economic structure of society) is defined as the "techniques of production and technical knowledge concerned with the development and use of resources". In addition, the mode of production (the base structure in his terms) is seen to affect social institutions and social relations. Its influence on superstructure (ideology, state, and social institutions) is the basic line of causation in history (Marx 1970). Technology (human productive forces) initiates a change in relation of production, and therefore, it has a determining role in human history (Elliott 1985). Therefore, and for this theory the type of technology employed, as in cost-of-production theory, determines the technical division of labour; but it depends upon a relationship of power over the means of production. The entire structure of production, distribution, and consumption reflects social relations of production (Sweezy 1939, 1968; Fine, B. 1975). Table 2.2 presents a comparison of the main characteristics of these schools.

It can be concluded that these three schools of thought share the idea that the economic growth process is essentially a profit-investment-technology model and that the growth rate in potential output depends on resources (capital, land, and labour) and technology. Moreover, technology is seen as capital investment. By increasing labour productivity and decreasing costs, technological improvements raise the potential output and profit for further investment. Thus, the profitability of investment depends on consumption as well as technology. In comparison, employment, the sources of wage income, and consumption depend on the relation between the flow of investment and technology (Elliott 1985). Moreover, these studies, despite their differences, clearly confirm that technology has introduced a series of rapid socio-economic transformations in both the developed and developing countries.

Table 2.2: Dominant Theories of Socio-Economic Impacts of Technology

	Subjective Preference	Cost-of-Production	Labour
Determination of Value	Individual Utility: in consumption	Technology Distribution: in production	Social Relations: Historic
Political Conflict	No conflict in Free Exchange	Conflict over distribution	Conflict Fundamental to Society
Political Institutions	Representative	Pluralist	Class Power
Theory of Social Change	Gradual: Development of New Ideas	Evolutionary: Technology Development	Revolutionary: Class Struggle
Role of Technology	Autonomous	Determinist	Structure to Superstructure
Emerging Ideas	Determinism + Essentialism + Reductionism		
New Conditions	Emergence of Information Society		

Source: Based on: Fathy 1991; Cole, K., Cameron, J. and Edward, C.1983.

2.2.2.1 Theories about Technology's Role in Social Change

The central controversy among scholars who study the history of technology is how far technology does or does not condition social change. Each of them emphasizes different factors in technological change. No neat explanation is reached and rigorous proof is difficult, if not impossible, to obtain or demonstrate (Chandler, 1995). Although the previous theories of industrialism have successfully analysed the technology impacts during the Industrial Revolution era, they failed to explain the role of technology in the new socio-economic conditions of the modern information society. They limited technology to three fundamental ideas: technological determinism, essentialism, and reductionism (Sabel, C.1982; Fathy 1991).

- TECHNOLOGICAL DETERMINISM:

Technological determinism is a very persuasive stance still the most popular and influential theory in understanding the relationship between technology and society. However, it has been increasingly subject to critical review by scholars in recent times. In approaching this theory, it should noted that the term 'deterministic' tends to be a negative one for many social scientists, and modern sociologists in particular often use the word as a term of abuse (Chandler 1995). Technological determinism usually seeks to explain social and historical phenomena in terms of one principal or determining factor. It is a doctrine of historical or causal primacy. The term 'technological determinism' was apparently coined by the American sociologist and economist Thorstein Veblen (1857-1929) (Ellul 1964; Jones 1990). Since then, various theorists such as Sigfried Giedion, Leslie White, Lynn White Jr, Harold Innis and Marshall McLuhan have adopted the stance of technological determinism (Chandler 1995).

Technological determinism depends mainly on three main hypotheses: first that technology is an autonomous, independent, and self-expanding force; second that technological changes are the single most important source of change in society (Winner, L. 1977), and third that it is unstoppable and their 'progress' is inevitable, unavoidable and irreversible, known as *'Technological Imperative'* (Chandler 1995).

For technological autonomy, technology is seen as an independent, self-controlling, self-generating, self-propelling, self-perpetuating and self-expanding force, rather than as a product of society and an integral part of it. Ellul (1964, 138), the most proponent of technological autonomy, declared that 'there can be no human autonomy in the face of technical autonomy. He stressed that technological autonomy reduces the human being to 'a slug inserted into a slot machine' (p. 135). Critics of the notion of technological autonomy argue that technology itself is shaped by society and is subject to human control.

For the significance of technology's role in the society, and as *technology-led* theory, technological determinism views technology as 'the prime mover' in history. In its most extreme form, it views the entire form of society as being determined by technology. New technologies are seen to transform society at every level, including institutions, social interaction and individuals. For example, the British biologist Sir Peter Medawar has argued that *technological evolution has contributed more to our biological success than our biological evolution* and suggests that in developing technologies, we shape ourselves (Pursell 1994, 33). In its modest form, a wide range of social and cultural phenomena is seen as shaped by technology. Within this *technology-led* theory, 'Human factors' and social arrangements are seen as secondary. In economics, this is known as a 'technology-push' theory rather than a 'demand-pull' theory (Chandler 1995).

Concerning 'Technological Imperative' stance, its advocates argue that technological developments, once under way, are unstoppable. Their 'progress' is inevitable, unavoidable and irreversible. In favour of the inevitability of technological developments (and against the mysticism of inspired genius) many theorists cite simultaneous invention widely dispersed geographically. The essence of the technological imperative is that as technology makes doing something technically possible, the action to do it is either *ought* to (as a moral imperative), *must* (as an operational requirement) or inevitably *will* (in time) be taken (Ozbekhan 1968). In that sense, technological imperative is commonly taken to be 'the lure of always pushing toward the greatest feat of technical performance or complexity which is currently available' (Pacey 1983, 79). With some alarm, the mathematician John von Neumann wrote that 'technological possibilities are irresistible to man.' (Mumford 1971, 186). Similarly, Jacques Soustelle declared of the atomic bomb that 'Since it was possible, it was necessary' (Ellul 1964, 99). Chandler (1995) argues that fatalists might add that as we can now destroy the planet, in future we will. The technological imperative is a common assumption amongst commentators on 'new technologies'. They tell us, for instance, that the 'information technology revolution' is inevitably on its way and our task as users is to learn to cope with it. Critics of technological imperative argue that there are countless examples of 'useless' inventions that no one wants and which are not developed but fade away, and stressing that societies decide what technology to develop as although the Chinese had discovered gunpowder they chose not to develop the gun (Shallis 1984, 64-5).

Generally, the main objection to technological determinism is that the performance standards of any technological system can be met in several ways. The fit between what needs to be done and how it can be done is rarely as tight as the determinists imagine. Factories using comparable technologies can divide the necessary work in various ways while it is possible to produce the same goods via different technologies. Ford Motor Company, for example, is one of many firms that owns and operates factories in different regions of the world. Despite the similarities among these factories, in terms of ample access to technological knowledge, capital, engineers, production facilities, and products manufactured, the technology in use is different. The relative cost of labour versus machinery is one of the main factors responsible for such variation in technology applied in different locations (Melman, S., *et al* 1972; Fathy, 1991; Chandler, D. 1995). Therefore, the great weakness of technological determinism is its inability to accept events that are exogenous to the single closed decision system, which is its main constituent (Ozbekhan, H. 1968). Dabinett (2002, 232) argues that the predilection of many policies and planning initiatives towards technological determinism means that many of these suffer from ambiguity and inconsistency.

However, Chandler (1995) recommends that it is not very helpful to retreat to the extreme position that 'everything causes everything' and that it is a great mistake to jump from the conclusion that the relationship between technology and society is not simple to the conclusion that the use of a particular technology in a specific context has no consequences at all. He also argues that any technological change, which is great enough, is likely to produce *some* social change, and that some of these changes may be widespread and major. In addition, Ruth Finnegan, who is strongly critical of technological determinism, feels able to accept that 'writing... can be seen as having vast consequences for society' (1975, 87).

Therefore, and although the thesis acknowledges the increasing impact of technology on the society, it rejects the technological determinism stances of "*technological Autonomy*" and "*Technological Imperative*". And rather, the thesis adopts the "*Technological Neutrality*" stance that views technology as 'neutral' or 'value-free' (neither good or bad in itself), and that what counts is not the technology but the way in which we choose to use it (Chandler 1995). In this research, technology is viewed only as a tool for human development that enables people to increase their incomes, improve their living standards, participate more in their communities and lead more creative lives (UNDP 2001). Also, technological advance and human development are viewed as mutually reinforcing, dependent, and creating a virtuous circle.

- TECHNOLOGICAL ESSENTIALISM:

Technological Essentialism is an offspring of determinism. It claims that what is true for society as a whole is true for its parts. For technological essentialism, the more advanced an industrial society, the more clearly modern forms of organization predominate in each of its parts. Consequently, differences between industrial societies are expected to disappear, each becoming more internally homogeneous. During the last fifty years, it has been clear that the mode of production does not unify societies. Cultural differences have not disappeared, and the same forces of production exist within a variety of different systems of social relations (Fathy 1991; Bell 1973).

The objection to essentialism is that radically different forms of organization are often interdependent. Advances in some industries create preconditions for the survival of outdated forms of industrial organization. The existence of the "backward" small firms is sometimes essential for the survival of large industrial organizations to meet flexible demand for maintenance and repair (Fathy 1991).

- TECHNOLOGICAL REDUCTIONISM:

Technological reductionism also belongs to determinism. It is the doctrine that focuses on causality - cause and effect relationships and that "experience determines thought", a focus usually associated with 'scientific' explanation. Any exploration of communications technology has to recognize the difficulty of isolating 'causes' and 'effects', or even in distinguishing causes from effects. As an explanation of change, technological determinism is 'monistic' or *mono-causal* (rather than 'multi-causal'): it offers a single cause or 'independent variable' (Chandler 1995).

Reductionism represents a simple 'billiard ball model' of change that contrasts with 'holism', which is broadly concerned with the whole phenomenon and with complex interactions within it rather than with the study of isolated parts 'atomism'. In holistic interpretations there are no single independent causes. Holistic interpretation proceeds from the whole and relationships are presented as non-directional or non-linear. It is holistic to affirm that the whole is more than the sum of its parts, a proposition with which it is difficult to disagree when you think of a working motor compared with the stacked parts (Chandler 1995; Melman, S., *et al* 1972).

In that sense, reductionism holds the view that everyday experience in modern societies determines the aspirations and desires of those societies' members. Reductionists argue that human wants are not fixed, but rather change over time, stimulated by society's capacity to satisfy them. The development of technology, for example, produces new goods that awaken new needs and desires, spurring further technological advances, and so on the cycle continues (Sabel 1982). Thus, industrialization means the end of ideology. If industrialization produces a uniform experience of life, and if the experience produces agreement that technology should be efficiently used to satisfy wants, ideologies have lost their significance (Bell 1967).

The objection to reductionism is that technological development is usually shaped by social choices imposed through the political and economic structures of the society. For example, changing oil prices and environmental concerns have forced changes in automobile and household appliances design (Sabel 1982).

2.2.2.2 Perceptions about the Future Role of Technology in Human Development

Again, and in confirmation with the previous discussion about the social impacts of technology, the United Nations Development Program (UNDP) views technological achievements as crucial for human development progress achieved during the twentieth century. Technological advances from the printing press to the computer, from the first use of penicillin to the widespread use of vaccines, were effective tools for improving health, raising productivity and facilitating learning and communication (UNDP 2001; Garson and Hershey 2000).

The UNDP (2001) argues that technological innovation is of considerable importance for the future of human development for two reasons. First, it can directly enhance human capabilities. Many technological products such as farming, breeding and irrigation technologies, vaccines, clean energy sources, Internet access for information and communications directly improve people's health, nutrition, knowledge and living standards. A matter which increased people's ability to participate more actively in the social, economic and political life of a community. Second, technological innovation is a means to human development because of its impact on economic growth through the productivity gains it generates. It raises the crop yields of farmers, the output of factory workers and the efficiency of service providers and small businesses. Moreover, it creates new activities and industries—such as the information and communications technology sector—contributing to economic growth and employment creation (Díaz Martínez 2000, 669).

On the other hand, human development is also an important means to technology development. Technological innovation is an expression of human potential. Higher levels of education and training make especially powerful contributions to technology creation and diffusion. More scientists can undertake research and development, and better-educated farmers and factory workers can learn, master and use new techniques with greater ease and effectiveness. In addition, social and political freedom, participation and access to material resources create conditions that encourage people's creativity (Szántó, B. 2001, 673; UNDP 2001). Therefore, technological advance and human development are in fact mutually reinforcing, dependent, and creating a virtuous circle. Technological breakthroughs in agriculture, medicine, energy, manufacturing and communications have been important—though not the only—factors behind the gains in human development and poverty eradication. These innovations have effectively broken the high-cost and bureaucracy barriers to progress and have made more rapid gains possible (UNDP 2001, Garson and Hershey 2000). Figure 2.2 summarises the role of technology in human development.

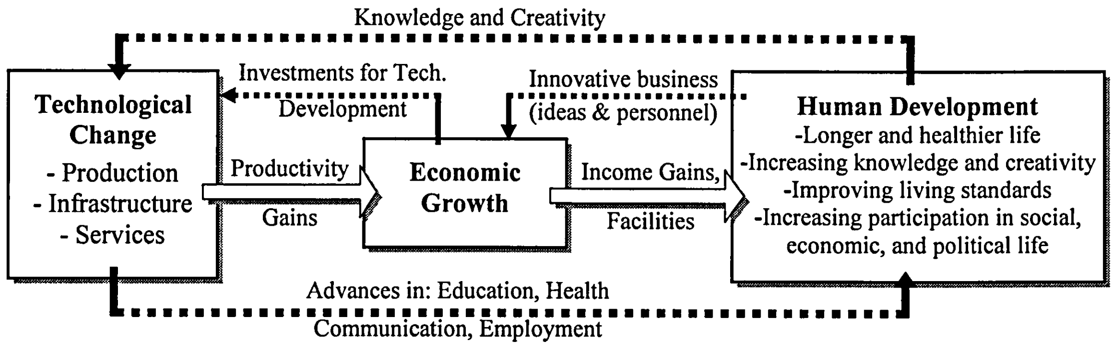


Figure 2.2: Mutual relationships between technology and human development

Sometimes, technology is seen as a reward of development, making it inevitable that the digital divide follows the income divide. It is true that as incomes rise people gain access to the benefits of more technological advances. But many technologies are tools of human development that enable people to increase their incomes, improve their living standards, participate more in their communities and lead more creative lives. Throughout history, people have devised tools to meet the challenges of existence, from war to health care to crop production. In addition, technology is like education—it enables people to lift themselves out of poverty. Thus technology is a tool for, not just a reward of, growth and development (UNDP 2001).

On the other hand, it should be noted that every technological advance brings potential benefits and risks, some of which are not easy to predict. Technology is not inherently good or bad—the outcome mainly depends on how it is used. But certainly people can create and use technology to improve human lives, especially to reduce poverty. The benefits of technologies can be far greater than what their creators foresaw. But, the hidden costs of technologies can also be devastating. Nuclear power, Chlorofluorocarbons (CFCs), and the bovine spongiform encephalitis - *mad cow disease* - are examples of the devastating impacts of the misuse of advanced technologies. Societies respond to these uncertainties by seeking to maximize the benefits and minimize the risks of technological change. Doing so is not easy: managing such change can be complex and politically controversial (UNDP 2001).

- TECHNOLOGY AND HEALTH

Medical breakthroughs of the 20th century, such as immunizations and antibiotics, have helped developing countries in Latin America and East Asia to achieve health development faster than what Europe had achieved through better nutrition and sanitation in the 19th century. From the 1930s onwards, human health and survival in both regions began to improve dramatically (Chen, L. 1983). By the 1970s, life expectancy at birth had jumped to more than 60 years, achieving in four decades an increase that took Europe 15 decades starting in the early 1800s (UNDP 2001).

During the 1980s, the use of two new medical breakthroughs —oral rehydration therapy and vaccines had better adapted to the conditions of developing countries. These technologies had been diffused through a major global campaign and resulted in major reductions in child mortality. Deaths from major childhood diseases and from diarrhoea-related illnesses in developing countries were cut by about 3 million in a span of ten years only, 1980-1990. More important is that such impressive achievement came during that "lost decade" of economic growth, when income growth was stagnant or negative (WHO. 1998; UNESCO. 2000) Under-five mortality rates were cut by nearly half between 1970 and 1999, from 170 to 90 per 1,000 (UNDP 2001). Also, a recent World Bank study revealed that technical progress accounted for 40–50 percent of mortality reductions between 1960 and 1990 (WHO. 1997; Wang, J. et. al 1999).

- FOOD PRODUCTION AND NUTRITION

Technological progress has played a similar role in accelerating food production. It took nearly 1,000 years for wheat yields in England to increase from 0.5 tonnes per hectare to 2, but only 40 years to go from 2 tonnes per hectare to 6 (Hazell, 2000; World Bank. 2001-a) The green revolution of plant breeding, fertilizer use, better seeds and water control, that started in 1960, significantly improved land and labour productivity around the world. This increased food production, reduced food prices and eliminated much of the under-nutrition and chronic famine in many of the developing countries. Because the poorest families rely on agriculture for their livelihood and spend half their incomes on food, this also contributed to huge declines in income poverty (UNDP 2001).

- PARTICIPATION

The increasing communication facilities of the twentieth century, such as the telephone, radio, television, fax, and the Internet, had effectively reduced people isolation and enabled them to be better informed and to participate in decisions that affect their lives. Tied to these technologies is the free media, a pillar of all functioning democracies. The advent of the fax machine in the 1980s enabled much more rapid popular mobilization both nationally and globally.

- EMPLOYMENT AND ECONOMIC GROWTH:

During the 1970s, the acquisition and adaptation of manufacturing technology brought rapid gains in employment and incomes to the Republic of Korea, Malaysia and Singapore. The industrial revolution was triggered by technological change, and economists argue that technological progress plays a pivotal role in sustained long-term economic growth (Lee, J. 2001; Romer, 1986, 1003; 1990, 67; Aghion, P. and Howitt, P. 1992, p.323). Cross-country studies suggest that technological change accounts for a large portion of differences in growth rates (Lee, J. 2001).

2.2.3 Social Change and Urbanisation:

Throughout history, social factors were the driving force for the emergence and the growth of cities. Human needs for protection and socialising were the driving force for the emergence of cities, while the continuous change in the nature of social needs and preferences was the main factor behind the continuous change in city structure, function and image. In the twentieth century many urban sociology studies analysed the social forces affecting urbanisation. The most important of these studies are those developed by the 'Chicago School' from the 1920s to the 1940s. The main two concepts developed at that school are: (1) the 'ecological approach' in urban analysis developed by Robert Park, and (2) the characterisation of 'urbanism as a way of life' developed by Louis Wirth (Giddens, 2001).

The *urban ecology* approach stresses the social dimension of cities and views them as 'human communities' and 'human ecology' centres. According to this approach, the sitting of major urban settlements and the distribution of different types of neighbourhoods within them is perceived in similar principles of plant and animal organisms that tend to be distributed over the terrain resulting in a balance or equilibrium between different species. In addition; patterns of location, movement and relocation in cities is seen to have a similar form. Different neighbourhoods develop through the adjustments made by inhabitants as they struggle to gain their livelihoods. According to this approach, a city can be pictured as a map of areas of distinct and contrasting social characteristics (Park, 1952).

Wirth's thesis of *urbanism as a way of life* stresses more the social dimension of urbanisation process. Such thesis is concerned less with the internal differentiations of cities than with what urbanism is as a form of social existence. Wirth argues that:

> *"the degree to which the contemporary world may be said to be 'urban' is not fully or accurately measured by the proportions of the total population living in cities. The influences which cities exert on the social life of man are*

greater than the ratio of the urban population could indicate, for the city is not only increasingly the dwelling-place and the workshop of modern man, but it is the initiating and controlling centre of economic, political and cultural life that has drawn the most remote communities of the world into its orbit and woven diverse areas, peoples and activities into a cosmos. (Wirth, 1938, 342)

In addition, Wirth (1964) argues that because the city is the product of growth rather than of instantaneous creation, it is to be expected that the influences which it exerts upon the modes of life should not be able to wipe out completely the previously dominant modes of human association. Therefore, our social life bares the imprint of an earlier folk society, the characteristic modes of settlement of which were the farm, the manor, and the village. This historic influence is reinforced by the circumstances that the population of the city itself is in large measure recruited from the countryside, where a mode of life reminiscent of this earlier form of existence persists. Hence we should not expect to find abrupt and discontinuous variation between urban and rural types of personality.

In addition to the urban sociology concepts developed at the 'Chicago School', there are some recent theories that stress the social factors in urbanisation process. Most of these theories, especially those of David Harvey and Manuel Castells, stress that urbanism is not an autonomous process and has to be analysed in relation to major patterns of social, political, and economic change (Harvey 1973, Castells 1977, 1983).

Harvey argues that urbanism is just one aspect of the created environment brought about by the spread of industrial capitalism. He argues that while modes of social life in urban and rural areas were clearly different in traditional societies, industry in modern societies greatly blurs such difference. In similar vein, Castells in his analysis of *'urbanism and social movements'* argues that the spatial form of a society is closely linked to the overall mechanisms of its development. To understand cities, he argues that the processes whereby spatial forms are created and transformed should be closely investigated. In addition, he argues that the lay-out and architectural features of cities reflect struggles and conflicts between different groups in the society. In other words, urban environments should be viewed as symbolic and spatial manifestations of broader social forces (Giddens, 2001).

Through this analysis it has been clear that technology is of considerable social impacts on societies. Also, this analysis shows that these social impacts considerably affect urban change process. In addition, it clearly shows that technology is of considerable importance for the future of human development.

2.3 TECHNOLOGY, ECONOMIC GROWTH AND URBAN CHANGE

As mentioned at the start of this chapter, economic growth is one of the main factors that affect urbanisation. Therefore, the thesis tries in this section to investigate the relationship between technology, economic growth and urbanisation. Although the economic impacts of technology are quite clear, the thesis highlights these impacts and investigates how they affect urban change process.

2.3.1 Technology and Economic Growth

Technological change and industrialisation was one of the driving forces for economic development during the last three centuries, especially in technology-advanced societies (Pacione 2001, 6). This explains the continuous shift in human economic activities from hunting to agriculture to industrialisation and to information in modern societies. In addition, the historical review of urbanisation reveals the fact that urbanisation moves with such inventions; from Mesopotamia and Egypt where agriculture is invented to England and Europe where industrial revolution took place to USA where information revolution is overwhelming.

Michael Pacione (2001) argues that these technology systems shaped not only the evolving national economies but also the pace and character of urbanisation. Each technological stage has been followed by a corresponding economic and city-building cycle; known as Kondratiev cycle (Pacione 2001, 6). Each cycle has been marked by a progressive acceleration in the arte of price increases for about 20 years, followed by a rapid inflationary spiral. After the peak, prices collapse, eventually reaching a trough some 50 to 55 years after the start of the cycle. This periodicity, that seems to be linked in a cause-and-effect manner with technology systems, has provided the political economy of capitalism with a remarkable rhythm that has reverberated widely to influence social and institutional structures, politics, demographics, and even culture. Cities have been in the middle of these reverberations, echoing changes while simultaneously transforming themselves (Berry 1991, 33; Dassbach 1995).

Simon Kuznets identified 25-year cycles of economic growth, each characterised by an acceleration phase of 11-15 years, followed by a deceleration phase of similar duration. These cycles have affected many aspects of economic development, including the rhythm of investment in transport infrastructure and in city building (Knox 1994, 11). It should be stressed here that these cycles represent only investments in infrastructure and city building not urbanisation as population movement to urban centres were progressively increasing during the last 100 years. Table 2.3 depicts the main features of technological change and corresponding economic and city building cycles.

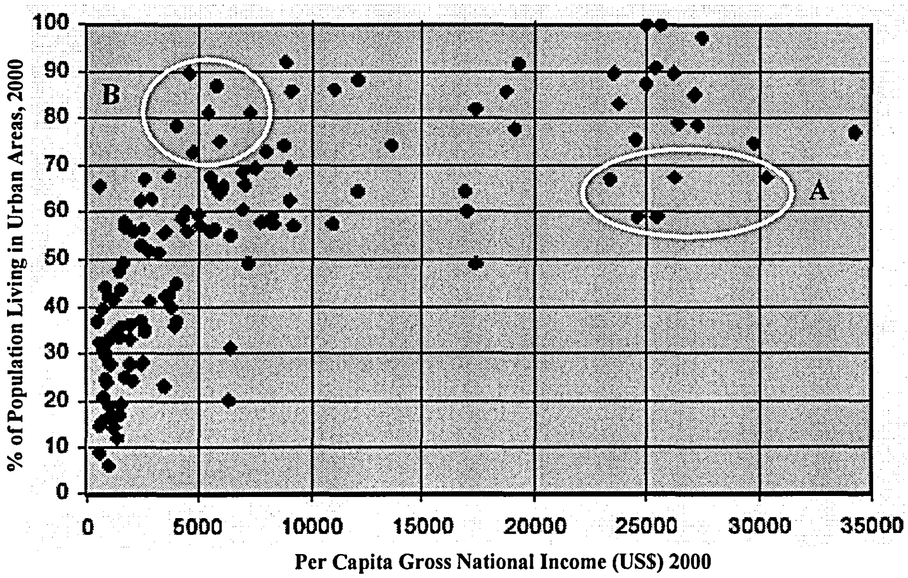
Table 2.3: Summary of major technological stages and corresponding economical and urban development cycles during 1800-2000

<table>
<tr><th>Long-wave Turning Points</th><th>1815</th><th colspan="2">1865</th><th colspan="2">1920</th><th colspan="2">1980</th></tr>
<tr><td>Technology Systems</td><td>Waterpower, Steam Engines, Cotton Textiles, Iron Works</td><td colspan="2">Coal-Powered Steam Engine, Steel, Railroads, Machine Tools, World Shipping</td><td colspan="2">Internal Combustion Engine, Oil & Plastics, Electrical Engineering, Automobiles, Aircraft, Radio & Telecommunications</td><td colspan="2">Microelectronics, Digital Telecommunications, Robotics, Biotechnology, Information Systems</td></tr>
<tr><td>Labour Processes</td><td>Manufacture</td><td colspan="2">Machinofacture</td><td colspan="2">Fordism/Taylorism</td><td colspan="2">Flexible Production Systems</td></tr>
<tr><td>Phases of Capitalism</td><td colspan="3">Competitive</td><td colspan="2">Organised
Industrial capitalism</td><td colspan="2">Disorganised
Advanced Capitalism</td></tr>
<tr><td>Economic Waves
"Kondratiev Cycles"</td><td colspan="7">Industrial Revolution "Gilded Age" "Roaring Twenties" "1980's Boom"
Industrial Revolution, Hungry Forties, Victorian Boom, Depression of 1890, Great Depression, Swinging Sixties</td></tr>
<tr><td>"City Building & Technology"
Kuznets Cycles in real estate and infrastructure construction</td><td colspan="7">Canal Building, First Railway Boom, Second Railway Boom, Streetcar Boom, First Automobile Boom, Second Automobile Boom</td></tr>
<tr><td>Epochs of Urban Systems Development</td><td>Mercantile</td><td>Expansion & Realignment</td><td>Organisati-on of Industry</td><td>Automo-bile Era</td><td>Spatial Decen-tralisation</td><td>Economic Crisis & Restruct-uring</td><td>Emergence of 'Informational' Cities</td></tr>
<tr><td>Evolution of Urban Form</td><td>Commercial City</td><td>Transitional City</td><td>Industrial City</td><td>Suburban Infill</td><td>Freeways and Sprawl</td><td colspan="2">Post-Suburban Development</td></tr>
</table>

Source: Adapted from: Knox, P.L. 1994, 9.

2.3.2 Economic Growth and Urban Change

Many studies, such as those of Pacione, M. (2001, 3) and Carter, H. (1995, 19), emphasize that economic development and urbanisation are intimately associated and that economic development process necessarily involves urban increase. Also, David Satterthwaite (2002) argues that the more urbanized a nation, the stronger and more productive its economy. He also stresses the strong association between nations' average per capita incomes and their level of urbanization in the light of the fact that all the world's wealthier nations have high proportions of their population living in urban areas (see Figure 2.4). Moreover, he argues that the concentration of the world's large cities in its largest economies clearly confirms the link between economic strength and urbanization level. In 2000, the world's five largest economies (USA, China, Japan, India and Germany) had nine of the world's 16 largest cities (the so called 'mega-cities' each with 10 million or more inhabitants) and nearly half of all the cities with one million or more inhabitants. By 2000, all but two of the world's 16 mega-cities and more than two thirds of its million-cities were in the 20 largest economies. Similarly, within each of the world's regions, most of the largest cities are concentrated in the largest economies – for instance, Egypt and South Africa in Africa; Brazil and Mexico in Latin America and China, India, Indonesia and the Republic of Korea in Asia (Satterthwaite, D. 2002).



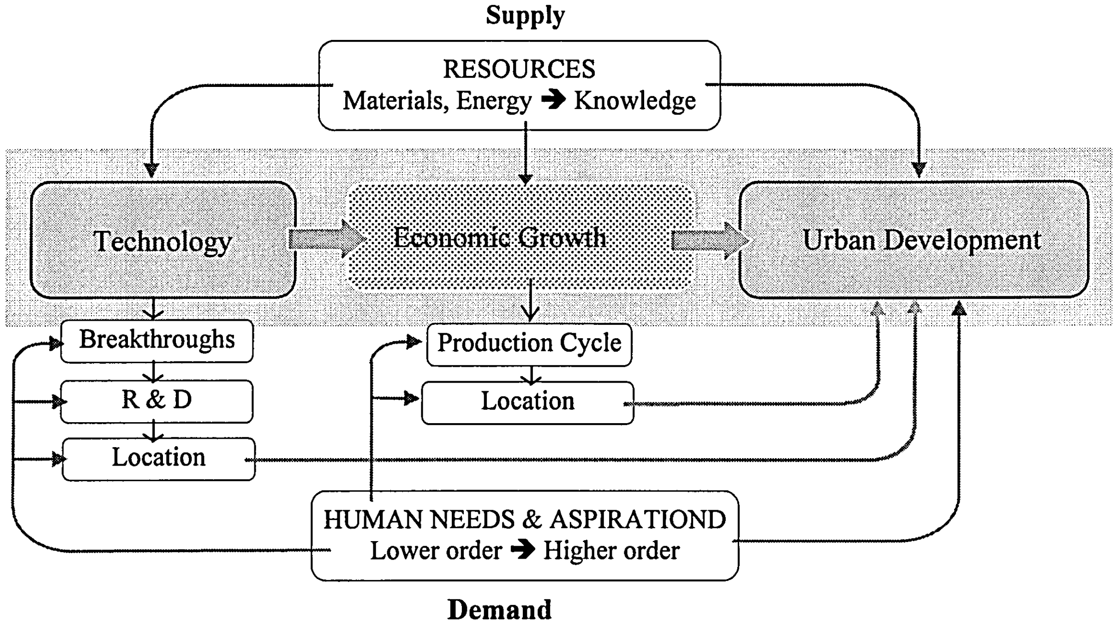
Source: Satterthwaite, D. 2002.

Figure 2.4: The association between nations' per capita incomes and their levels of urbanization

Although such argument seems sound and although Figure 2.4 shows some degree of correlation between economic growth and urbanisation level, it does not explain why some countries such as those in group (A) on Figure 2.4 are less urbanized than those in group (B) although they are of much higher per capita gross national income. Moreover, and in counteracting such argument, Africa is often singled out as an example of a region where particularly rapid urban growth is taking place without economic growth. Certainly, and despite the fact that many African nations have had very little economic growth in recent decades, Africa has some of the world's fastest growing cities over the last fifty years and that the rates of natural increase in these cities are high despite the spread of AIDS (Simon, 1997). The World Bank and various other researchers have suggested that sub-Saharan Africa is unusual because it has been urbanising rapidly without economic growth (World Bank, 1999, p. 130). There are two main explanations for such phenomenon: (1) because it began from such a small base (Potts, 1995); and (2) the achievement of political independence and the removal colonial restrictions on the rights of national populations to live and work in urban centres (Satterthwaite, 2002). A more detailed analysis of such phenomenon is presented in section 4.3.2.1 that discusses economic growth and urbanisation level in Africa. In support of the economic-urban growth association argument, David Simon (1997) argues that African urbanisation rates were highest during the immediate post-colonial period, coinciding with the economic boom years of the 1960s and early 1970s.

Nijkamp and Schubert (1985, 79) stressed the role of social change associated to the economic impacts of technology in urbanisation process. They argue that to understand the process through which technology could affect urban change, it is necessary first to examine the motivational forces behind the use of technology. Two main motivational forces have been identified: on the supply side; maintaining economic growth and profit-for-private-sector industry; on the demand side, meeting human needs and aspirations. Supply-demand change and innovation have been an integral part of all economic systems. Technological change and economic growth are interlinked through the ability of new technology to lower costs, to improve the quality of products and to increase output and profitability. Demand-induced change is a function of the appetite and lifestyle among the population of an increasing array of 'needs'. Concerning supply-induced changes, resources are shifting from material and energy to information and knowledge. Technological breakthroughs require research and development and then production, and locational decisions are required at each stage. Technological change leads to changes in the resource inputs used in production. This is resulting in less inputs of materials, energy and labour and greater input of knowledge. The main consequences of this shift include the reduction in demand for materials and energy, and job loss in production. Job loss thereby accrues to cities unevenly as location decisions also change. On the demand side, emerging higher order human needs and aspirations are seen to play an increasing role in this process, and will, in turn, involve locational decisions associated with residential development and infrastructure provision (Brochie *et al* 1985, 8). Figure 2.5 depicts process in which the economic impact of technology affects urban change.

Many economists agree that at each stage of economic development, the dominant technology that available to the society (coal, steam power, electricity or micro-electronics) determines its prevailing pattern of production across the main sectors of the economy (such as agriculture, industry and commerce). Production requirements and the technology capabilities determine the scale, concentration, and location of economic activities, which in turn influence the pattern of human settlement and the flows of trade. Consequently, technology is considered to influence where people live and work, the nature of the work they undertake as producers and the means by which they are able to travel. The totality of these influences is a crucial determinant of the pattern of urbanisation at each stage of economic development (Hay 1990).



Source: adapted from: Brochie *et al* 1985.

Figure 2.5 Structural-Model of Technological on Urban Change Process

Peter Hall (1985, 23) argued that technology had influenced urbanisation in Europe in two ways. First, the capital substitution in manufacturing and goods handling activities has played a major role in the contraction of these industries in congested inner-city locations and in older-industrialised regions. Second, the rapid technological development in transportation and telecommunications sector in almost all countries of Europe, during the period 1950-80, have introduced considerable urban impacts on both the inter-regional and intra-regional levels.

Knox (1994, 11) argues that the economy, as one of the driving forces for urban change, has been carried along by a succession of technology systems that have been fundamental to the changing economic conditions. The most important of these technologies are the clusters of energy sources, transportation technologies, and key industries that characterised each of technology systems emerged since the seventeenth century. In addition, he argues that technological advances in farm productivity had fuelled urbanisation in two ways. First, it provided the extra food necessary to support the increased numbers of townspeople. Second, it released farmers and agricultural workers who then moved to towns and cities to swell the numbers of producers and consumers. Improved agricultural productivity came about through the application of improved tools, machinery and techniques (Knox 1994, 11).

This analysis clearly reveals that technology, economic growth and urbanisation are highly interrelated.

2.4 TECHNOLOGICAL FORCES AFFECTING URBAN CHANGE

In addition to the economic role of technology in urbanisation process, technology had significantly facilitated this process and in many cases it had been developed to respond to some urban problems. Technology achievements in the area of transportation, such as the railways and automobile, have facilitated the process of rural- urban migration. Significant urban growth was noticeable after the introduction of both the railways and the automobile. In addition, technology has provided technical solution for the problems of gathering large number of people in towns and cities. This is mainly in areas of transportation, telecommunications, and infrastructure systems. In the next chapter, the thesis presents a detailed examination of the urban impacts of each of these forces.

2.5 TECHNOLOGY, GLOBALISATION AND URBAN CHANGE

Because of its mounting impacts, there is a growing consensus that globalisation is much more than the worldwide production and consumption of products. It is not just an economic or cultural trend but a movement of ideas, lifestyles, and developments that could affect our families, our employment, and the future of the world (Chareonwongsak, 2002). This is mainly because the forces by which it was decreed promise to make its mandate even more enforceable in the foreseeable future (Gomory and Baumol, 2004).

During the last two decades, the causes and impacts of globalisation were the subject of fierce debates. However, globalisation is still not an easy concept to pin down. Nor is it easy to specify the ways in which the process of economic, political, and social globalisation is affected by, and affecting, the production, distribution, and transfer of technology (Rycroft, 2003). Therefore, the thesis tries in this section to investigate how technology affects globalisation and the possible impacts of globalisation on the urban future in developing countries. It also sheds light on globalisation and technology transfer to developing countries.

2.5.1 Technology and Globalisation

Today, it is widely accepted that technology achievements, especially in areas of transportation and telecommunications technologies, are important catalysts for globalisation (Graham, 2004; James, 2002; Ohmae, 2001; Kaplinsky and Fitter, 2004). By collapsing time and distance, they enable countries, cities, organizations, and individuals to develop networks of interest that transcend national boundaries. These technologies significantly increase the integration of production systems and markets, the speed of communications, and the velocity of capital flows with corresponding increases in complexity and volatility. In addition, by reducing the cost of search, the cost of knowledge, and transaction costs they contribute to a more "frictionless" global capitalist system which favours the swift, the well-educated, and the well-connected, while contributing to growing disparities. In the twenty-first century, it is expected that information infrastructures will differentiate the political and economic influence of countries, the performance of corporations, and the well-being of individuals across diverse cultural contexts (Agnew, 2001).

Chareonwongsak, (2002) argues globalisation and technology are integrally connected and share a causal relationship, each gaining from and building on the other. He views information technology as the "bones and sinews" of globalisation that has taken our lives out of the temporal and into the imaginary and unseen. Reality is no longer defined in terms of things we can see, feel, and measure; but rather by ideas and by the ability of people to generate and communicate them.

2.5.2 Globalisation and Urban Change

During the last two decades there has been an extensive literature about the possible impacts of globalisation on the future of cities and urbanisation. This literature extensively affirms the influential role of globalisation in the emergence of global functions for some cities and regions all over the world. In the 1980s, Friedmann (1986) presented his fundamental thesis – *the world city hypothesis-* arguing that around thirty "world cities" are the main centres of the global economy and have certain characteristics in common (Friedmann, 1995). In a similar vein, Saskia Sassen (1991, 1994a, 1994b) asserted a triad of 'global cities' (i.e. London, New York, and Tokyo) and thoroughly analysed the ongoing development of the economic structure in global cities (1996; 1998). In 1997, Peter Hall stressed the increasing impacts of globalisation in shaping the urban future arguing that:

> A new kind of city is emerging: globalised (connected to other cities in global networks); *tertiarized* and even *quaternarized* (dependent almost entirely for its economic existence on advanced services); 'informationalised' (using information as a raw material); and *polycentric* (dispersing residences and decentralising employment into multiple centres or 'edge cities') (Hall, 1997).

Sassen, S. (2002; 2003; 2004) stresses the role of globalisation in the emergence of the global networks of cities and argues that the urban future in the 21st century, especially in developing countries is highly affected by the phenomenon of globalisation, which has already brought dramatic changes. Wilheim (1999) argues that globalisation gives shape to the "global village", predicted by the Canadian Marshall McLuhan, and accentuates a "new urban geography" in both the developed and developing countries.

Fu-chen and Yeung (1998) argue that there will be growing interaction between urbanization and globalisation. They view globalisation as a multifaceted process of drawing countries, cities and people ever closer together through increasing flows of goods, services, capital, technology and ideas. The world cities have come to the fore because they perform special functions in the new global economy. In a globalising world, countries and cities are increasingly linked in interdependent and interlocking relationships. In the next century, cities will be centres of economic production, social organization and knowledge generation. World cities will be especially influential in shaping the development of the global economy. Technological advances and easy access to information will enable cities to evolve more efficient ways of production, capitalizing on the cheapest sources of materials (Fu-chen and Yeung 1998).

Next, in this section, the thesis will discuss the main hypotheses about the urban impacts of globalisation: Friedmann's "world city" hypothesis and Sassan's triad of "world cities". Also, the thesis will examine the urban impacts of economic, cultural and political globalisation. Then, it will highlight the urban impacts of globalisation in developing countries. And finally, the thesis will examine the role globalisation in technology transfer to developing countries.

- FRIEDMANN'S "WORLD CITY" HYPOTHESES

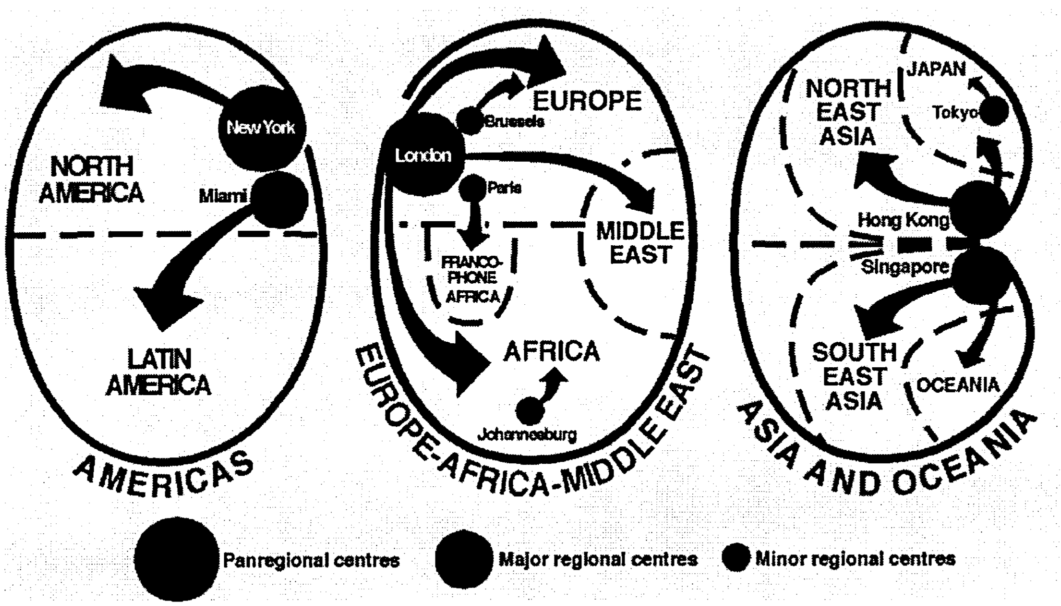
Friedmann's (1986) 'hypotheses' argue that the 'new international division of labour' is organized through 'world cities'. These cities are unique because they act as nodal points and control centres for the interdependent skein of material, financial, and cultural flows which, together, support and sustain globalisation (Hall, 1996; Short and Kim, 1999). Moreover, they provide an interface between the global and the local, containing economic, socio-cultural and institutional settings that facilitate the articulation of regional and metropolitan resources and impulses into globalising processes while, conversely, mediating the impulses of globalisation to local political economies (Knox, 2002).

In addition, Friedmann (1986) asserts that the internationalization of capital has led to the emergence of a hierarchy of cities with particular roles in the capitalist economic system (Rakodi, 1997). At the apex of that hierarchy are the so called "world or global cities," which are sites for the control and management of transnational corporations (TNCs) operations, specialized business services, and nodes in the world banking and commercial system (Friedmann and Wolff, 1982; Sassen, 1985; 1994; Thrift, 1987). Second to these global cities are the regional or continental cities, which perform similar functions within the world capitalist system to global cities, but within a more restricted geographical region (Sit, 1993, Yeung and Lo, 1996). The third level in that hierarchy is national cities, which are foci for national accumulation but also provide a location for transnational offices and operations, banks, and corporate services, and are thus linked into the world economic system (Sit, 1993; Simon, 1992, 1993, 1995).

In confirmation with Friedmann's argument, the University of Loughborough's Globalisation and World Cities (GaWC) Research Group analysed the key 'world city' functions (international accountancy, advertising, banking, and legal services) in 122 cities and confirmed that there is a three-fold hierarchy (Knox, 2002). At the top of the hierarchy are ten 'alpha' world cities, each of global significance in all four service areas. Not surprisingly, the cities with the highest scores are London, Paris, New York, and Tokyo; followed closely by Chicago, Frankfurt, Hong Kong, Los Angeles, Milan and Singapore. A second tier of ten 'beta' world cities, headed by San

Francisco, Sydney, Toronto, and Zürich, is of global significance in three of the four key world-city functions. Cities of Brussels, Madrid, Mexico City, Sao Paolo, Moscow and Seoul came after in the same group. Beneath these in the hierarchy are 35 'gamma' world cities, each of global significance in two of the four key world-city functions; these include Amsterdam, Boston, Caracas, Dallas, Dusseldorf, Geneva, Houston, Jakarta, Johannesburg, Melbourne, Osaka, Prague, Santiago, Taipei, and in an irony of alphabetical order – Washington (Knox, 2002; Fossaert, 2001).

The linkages between world cities, along with their relationships to processes of globalisation, have been subject to rather less attention. World-system theory tends to portray world cities as the "cotter pins" that hold together the global hierarchy of core, semi-periphery, and periphery. Knox (2002) argues that there are three main circuits of traffic (the Americas, Europe/Middle East, and Asia/Oceania) that dominate the "space of flows" of the informational economy between leading 'world cities' (Figure 2.4).



Source: Knox, P.L. (2002)

Figure 2.4 Main Circuits of Information Economy Flow Among Regional 'World Cities'

- SASSEN'S TRIAD OF WORLD CITIES

Sassen's (1991, 1994a, 1996) work is particularly important for her careful specification of the nature of global cities. Although she identifies changes in international banking and finance as vital in the emergence of her triad, she contends that world cities are more than just financial centres. For Sassen (1991) finance is just one of a series of advanced producer services which serve to define global cities as post-industrial production sites. This contrasts with Friedmann's (1986) original idea of world cities as general 'command centres' because a concentration of corporate headquarters is not identified by Sassen as an essential component of a city if it is to be classified as a world city. The crucial difference is that for Sassen a world city is the loci for the critical servicing of global capital not just its specific management.

This analysis of both Friedmann's and Sassan's views about world cities clearly reveals that today's world cities are both cause and effect of economic, political and cultural globalisation. Therefore, the thesis tries in the following sections to investigate the urban impacts of economic, political and cultural globalisation.

2.5.2.1 Economic Globalisation and Urban Change

Economic globalisation - or the progressive integration of various parts of the world into a global economy and global finance system - has attracted considerable debate over the past decade (Dieleman and Hamnett, 1994). Although the relationship between economic globalisation and urban development is complex, and quite difficult to trace and to validate empirically (Shachar, 1997, p. 22), the thesis tries this section to highlight the main economic impacts of globalisation and their associated urban effects.

- GLOBALISATION AND THE DEMISE OF URBAN FORMAL ECONOMIES

There is a growing consensus among economists that, in the current phase of globalisation, "a new structure of global competition has arisen" as a result of the appearance of "global" markets and "global" production complexes (Thrift, 1994; Rogerson, 1997; Castells, 1992; 1996). Rogerson (1997) argues that although many factors contribute to the making of this new structure of competition, particular importance is attached to new innovations in technology, such as micro-electronics, telecommunications, or materials science, which exert a profound impact on refashioning world production systems. The growth of transnational production and the increasing openness of and interdependence among national economies are the key elements in economic globalisation. Alongside new globalised production strategies there has been a parallel integration of financial markets which, together with a vastly improved global telecommunications and transportation infrastructure, has increased global economic integration in general (Doohan, 1994, p. 26).

Such changes have profound impacts at the level of both national and urban economies and for individual enterprises. At the level of national and urban economies, the major impact has been an intensification of international and local competition for markets and investments. Increasingly, rates of growth of GDP and of employment hinge on an economy's ability to compete successfully within the new system of globalised production. At the level of the enterprise, the effects have been to stress the importance of adopting new process technologies, of new flexible systems of work organization, and of shifting towards flexible rather than Fordist mass production systems. This process is widely expected to result in the demise of formal economies at both national and urban levels (Rogerson, 1997).

For developing countries, especially Africa and its cities, the impacts of recent economic globalisation trends and the associated changes are disturbing. However, many economists argue that it is better for national and urban economies in these countries to be affected by these trends than to be left out. Despite all its negative side-effects, exposure to "the new competition" seems to be increasingly essential for augmented growth, efficiency, and sustained job creation (Storper, 1992; Doohan, 1994; Rogerson, 1997).

- GLOBALISATION AND THE NEW REGIONALISM: GLOBAL CITY REGIONS

Contrary to many recent predictions that globalisation will lead to the end of geography (e.g. O'Brien, 1992), many recent studies (e.g. Hall, 1966; Castells, 1996; Friedman and Wolff, 1982; Sassan, 2004) assert the increasing importance of geography in the era of globalisation. They argue that globalisation enhances the possibilities of heightened geographic differentiation and locational specialization. In addition, as globalisation proceeds, an extended archipelago or mosaic of large city-regions is evidently coming into being, and these peculiar agglomerations are now beginning to function as the spatial foundations of the new world system that has been taking shape since the end of the 1970s (Scott, 1998, 2001). The internal and external relations of these city-regions and their complex growth dynamics present a number of extraordinarily perplexing challenges to researchers and policy makers alike as we enter the 21st century.

Most of the extensive literature available on "world cities" and "global cities" focuses on a concept of the cosmopolitan metropolis as a command post for the operations of multinational corporations, as a centre of advanced services and information-processing activities, and as a deeply segmented social space marked by extremes of poverty and wealth. Most of these studies assert the emergence of wider metropolitan regions, or 'global city-region', that act as political-economic units with increasing autonomy of action on the national and world stages (Scott, 2001).

Analysts such as Hall (1966), Castells (1996), Friedmann and Wolff (1982), Sassen (1991), Knox (1995) and Scott (2001) define 'global city-regions' as dense megalopolitan spaces that are bound up in intricate ways in intensifying and far-flung extra-national relationships. As such, 'global city-regions' represent an outgrowth of large metropolitan areas - or contiguous sets of metropolitan areas -- together with surrounding hinterlands of variable extent which may themselves be sites of scattered urban settlements. In parallel with these developments, 'global city-regions' consolidate into definite political entities as contiguous local government areas unite together to form spatial coalitions in search of effective bases from which to deal with both the threats and the opportunities of globalisation. So far from being dissolved away as definite geographic entities by processes of globalisation, city-regions are by and large actually thriving at the present time, and they are, if anything, becoming increasingly central to the conduct and coordination of modern life (Scott, 2001; Taylor, 2000; Knox, 1995; Porter, 2001).

2.5.2.2 Cultural Globalisation and Urban Change

As global cities embody and articulate the various processes and outcomes of globalisation, and taking into account that a great deal of attention has been devoted to economic globalisation and the city, it is important to highlight the main impacts of cultural globalisation on the city. Short (2002) argues that cultural globalisation has two main impacts on the city. The first is the increasing heterogeneity of global cities as they are the home to a variety of ethnic diversities. The global city is the heterogeneous city and a growing indicator of provincialism is homogeneity. Global cities are sites of both reterritorialisation and deterritorialisation. An important feature is the extent to which certain ethnicities are tied to certain niches in the socio-economic hierarchy as well as to certain urban social spaces. Transnational communities of both rich and poor of very different national and ethnic groups have been recognized. The second is the extent to which these communities are both the bearers and transmission lines of economic globalisation. Much of the literature has equated economic globalisation with the penetration of local markets by large multinational companies. Short (2002) argues that this gigantist view of economic globalisation ignores the extent to which economic globalisation occurs in and through transnational communities in cities around the world. Transnational communities are the sites between the intersection of local and family ties and global flows of people, money, capital, goods and services (Appadurai, 1996; Short, 2002).

Therefore, cultural globalisation is expected to have considerable impacts on large cites in developing countries, especially primate cities such as Cairo, Lagos, and Johannesburg. These cities start experiencing increasing levels of ethnic diversity and social heterogeneity.

2.5.2.3 Political Globalisation and Urban Change

In recent years, there have been some predictions that globalisation will lead to the death of the nation state. However, many analysts such as Clarke and Gaile (1997), Short (2002) and Sassen (1999) assert that with globalisation the state becomes more important as a mechanism for mediation between global forces and national social formations. They argue that because of globalisation, interconnections between city, regional and national governments have become more complex. A post Keynesian, post federal state with marked inequality in the national space economy, has replaced the Keynesian state committed to a large range of free public services nationally available. In states with a non-primate urban distribution and a federal structure, city-states can be identified in which the regional and city governments have become much more important as vehicles for globalising cities. In other countries, those with a larger degree of central governmental power and a primate urban hierarchy, the national government along with regional and local governments can also play a part in ensuring the global competitiveness of primate cities. Short, (2002) argues that the *grande ensembles* of Paris or the heavy UK government investment in London are two examples of national governments ensuring global city competitiveness.

However, the relationship between global cities and the state is complex. In some cases the city region may be separating of from the fortunes of the rest of the national space economy; in others the fortunes of nation state and global city are inextricably linked. Also, the different levels of the state are involved in such relationship in different ways (Short, 2002).

For developing countries, political globalisation highly influences the capital cities of many of these countries. Because of their political and economic role on the international level, these cities became more dominant and primate in their national urban systems. Moreover, governments and elite groups have pushed for the development of these cities as primate political, economic and service provision centres. This attitude has resulted in many socio-economic and urban problems at both the local and national levels. Cairo, Egypt, is one of the best examples in this regard.

2.5.2.4 Globalisation and Urbanisation in Developing Countries

Many researchers argue that globalisation has not been a boon to all cities. While it has brought new opportunities and wealth to some cities, it has marginalized others, especially those in developing countries and particularly in Africa (Fu-chen and Yeung 1998). In addition, the changes associated with globalisation are disturbing for almost all developing countries. However, Rakodi (1997), Storper (1992), and Doohan

(1994) argue that it is better for national and urban economies in developing countries to be affected by them than to be left out. Despite all the side-effects of globalisation, exposure to "the new competition" seems to be increasingly essential for augmented growth, efficiency, and sustained job creation. Many of these countries realised this fact and try to maximise their benefits from globalisation and strive to avoid, or minimise, its negative impacts.

Regarding the possible impacts of globalisation on urbanisation in developing countries, it should be noted that the relationship between the two has its old and recent dimensions. For the old dimensions of such relationship, most of the developing countries were formerly colonies and the foundations for their incorporation into the world economic and political system were established during the colonial period. Colonial urbanisation was marked by a reorientation of urban patterns to serve the needs of trade and administration. In meeting these needs, some existing settlements prospered, while others stagnated or decayed, and a series of new centres was established (Gugler and Flanagan, 1978; Mehretu, 1983; Coquery-Vidrovitch, 1991). In addition, although political independence did bring some degree of autonomy for these countries, this was largely eroded by superpowers interests and continued economic dependence. Many of the developing countries were overwhelmed by a wide range of domestic political difficulties, resulting in political instability and administrative weakness (Chazan et al., 1988). These two problems largely influenced patterns of urbanization and adversely affected the capacity of local governments to manage urban growth in many developing countries of these countries.

The early phase of post-colonial urbanization in many of the developing countries, especially those in Africa, was predominantly geared to the expansion of colonial physical and social space to incorporate new indigenous interests and needs and thereby spreading the "fruits of independence". But there were real limits to physical and social incorporation in the context of finite resources, particularly in a situation of rapid population growth. As a result, existing urban problems of poverty and inequality, unemployment, pressure on resources, deterioration of services and infrastructure, and the weakening of social and spatial order and control were exacerbated in many of the developing countries (Aina, 1997). In Chapter Four, the thesis tries to investigate globalisation impacts on urban change patterns in Africa (section 4.3.3) and tries to define the position of African large cities in the global urban system (section 4.3.4).

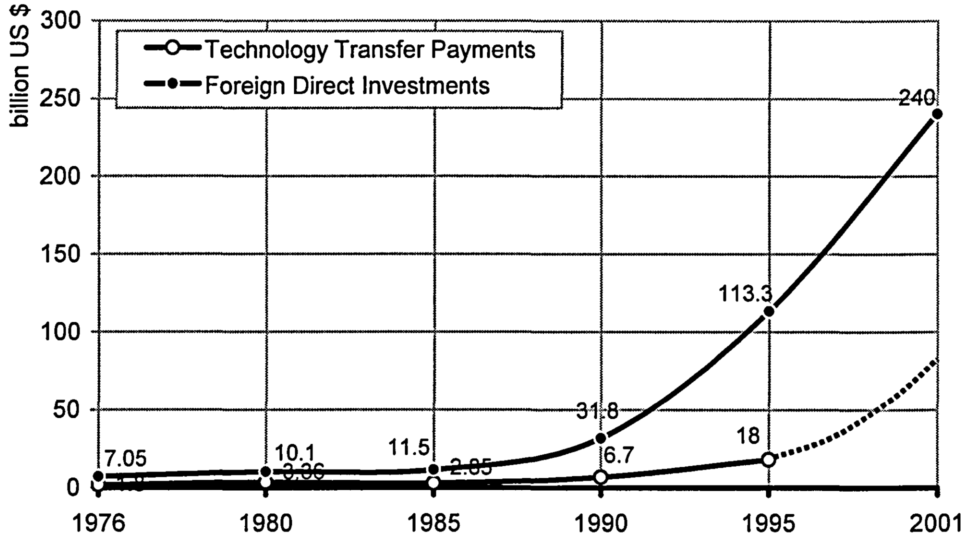
In recent years, the rate of urban growth in all developing countries has significantly increased due to expansion of public sector employment, industrialisation, development of transportation systems, an increased rate of natural increase, and relative neglect of rural areas Rakodi, 1997). Indeed, globalisation has its impacts on each of these factors.

2.5.3 Globalisation and Technology Transfer to Developing Countries

Many studies stress the role of globalisation in facilitating technology transfer to developing countries (UNCTAD, 2001-a; Kumar, 1997; Fu-chen and Yeung 1998). The last twenty years have witnessed an increasing trend of technology transfer to developing countries. Both the developed and developing countries have supported this trend. For developing countries, technology transfer is at the core of development debate and political agenda. Transformation of developing countries from a stage of low technological development to a more developed stage would not be possible except through transfer of technology. For developed countries, technology transfer to developing countries has its economic benefits. It provides an access to the markets of developing countries. Moreover, technology transfer enables developed countries to utilise the available natural resources and the cheap labour force.

In measuring technology transfer, the global flow of Foreign Direct Investments (FDI) and the Technology Transfer Payments (TTP) are the most practical indicators. According to the *World Investment Report 2001* published by the United Nations Conference on Trade and Development (UNCTAD), the FDI is reaching many more countries than in the past. The number of countries receiving an annual average of more than $1 billion rose from 17 (six of which were developing countries) in the mid-1980s to 51 (23 of them developing countries) at the end of the 1990s. In the case of outflows, 33 countries (11 of them developing countries) invested more than $1 billion at the end of the 1990s, compared to 13 countries (only one of them a developing country) in the mid-1980s (UNCTAD, 2001-a).

For developing countries, FDI inflows have registered an explosive growth over the past 25 years, especially since the mid- 1980s. The annual technology transfer payments by developing countries rose from $ 1.8 billions in 1976 to $ 18 billions in 1995. Similarly, the annual FDI inflows to developing countries rose from $ 6.3 billions in 1975 (Kumar, N. 1997) to $113.3 billion in 1995 to 240 billions in 2001 (UNCTAD, 2001-a). Figure 2.2 presents the developing countries technology transfer payments and foreign direct investment inflows during 1975 to2001.



Source: Prepared by the researcher; data from: Kumar, N. 1997; UNCTAD, 2001-b

Figure 2.2: Growth of technology transfer payments and foreign direct investments inflows to developing countries during 1976-1995

Concerning technology transfer to Egypt, the country is receiving an increasing amount of Foreign Direct Investments. Although FDI inflows into Africa had declined from \$10.5 billion in 1999 to \$9.1 billion in 2000, after an increase of \$2 billion during the previous year, and while Inflows to major recipients such as Angola, Morocco and South Africa halved, Egypt remained the most important recipient of FDI flows in North Africa, with increasing inflows of about 20% (\$1.2 billion compared to \$1 billion in 1999). Since the early 1980s, multinational joint ventures have increased investments in Egypt. FDI stocks in Egypt tripled during 1985-2000 (UNCTAD 2001-b). A more detailed analysis of the increasing technological capabilities of Egypt is presented in section 5.1.3.

This increasing trend of technology transfer to developing countries suggests that technology will have considerable impacts on the socioeconomic and urban structures of these countries. Although the research acknowledges the difference between the use of technology (as products) and its invention, it views the use of technology, especially in areas of transportation, telecommunications and infrastructure, as an effective factor in shaping the urban future in developing countries.

Conclusion:

Through this chapter, the thesis has thoroughly investigated the relationship between technology and urban change. In doing so, the thesis has identified and analysed the four main ways through which technology affects urbanisation: social change, economic growth, technological forces, and globalisation.

For the relationship between technology and social change and how social change affects urban change process, numerous studies have emphasised the crucial role of science and technology in transforming the socio-economic structures of societies. In addition, the analysis of the main theories about technology and social change reveals that, despite their different views on how technology introduces social change, all these theories agree that technology affects the social structures of all societies. Also, the analysis of technology's role in the improvement of health, food and nutrition, and economic growth, affirms that technology is of considerable importance for the future of human development. In addition, the analysis of the main urban sociology concepts, especially the 'ecological approach' in urban analysis developed by Robert Park, and the characterisation of 'urbanism as a way of life' developed by Louis Wirth, reveals that social factors are of considerable impacts on urban change process.

For the relationship between technology and economic growth and how economic growth affects urban change process, there is an extensive literature that stresses the role of technological change and industrialisation in economic development. Many economists argue that each technological stage has been followed by a corresponding economic cycle; such as Kondarative and Kuznets cycles, and a city development cycle. This analysis reveals that economic growth is one of the driving forces for urban change.

For globalisation and how it is affected by technology and how it affects urbanisation, there is an extensive literature that views technology achievements, especially in areas of transportation and telecommunications technologies, as important catalysts for globalisation. Many studies argue that these technologies significantly increase the integration of production systems and markets, the speed of communications, and the velocity of capital flows. For the urban impacts of globalisation, many analysts stress the influential role of globalisation in the emergence of global functions for some cities and regions all over the world. The seminal work of John Friedmann, Peter Hall, and Saskia Sassen about 'world cities', 'global cities' and 'global city regions' emphasise the influential role of globalisation in shaping the urban future in both developed and developing countries.

For the technological forces that yield direct physical impacts on cities and urban systems, the thesis argue that transportation, telecommunications, and infrastructure technologies are the most influential of these forces. In the next chapter, the thesis presents a detailed examination of the urban impacts of each of these forces.

Chapter Three

AN ASSESSMENT OF THE URBAN IMPACTS OF THE MAIN TECHNOLOGICAL FORCES

Introduction:

In this chapter, the thesis tries to explore the urban impacts of the main technology forces and their role in shaping the urban future. In doing so, the thesis looks at how these technologies affected urban change in the past and tries to analyse the possible ways in which each of these technologies could affect the urban future. Because of focusing on developing countries, the thesis focuses on two main aspects of technology: the communications and infrastructure technologies, as they are the most influential technologies in shaping the urban future in these countries. In this regard, communications has two main facets: transportation and telecommunications. Transportation is seen as the physical aspect of communication, responsible for the physical movement of people and goods. While telecommunications, especially information technologies, is seen as the virtual aspect of communications responsible for the movement of data and information. Infrastructure technologies, especially in the areas of energy production and the increasing use of renewable energies, and in the area of urban utilities technologies, mainly water treatment and sanitary systems, are of considerable importance in shaping the urban future in developing countries. In this chapter, the socio-economic and urban impacts of each of these technologies will be thoroughly reviewed.

Many urban studies view the application of technology as an integral force in the development of towns and cities, in the past, in the present and in the future. In his book 'Victorian Cities', Asa Briggs (2000, 16) viewed Victorian cities as:

> *.... Cities of the railway and tramway age, of the age of steam and of gas, of a society sometimes restless... Perhaps their outstanding feature was hidden from public view – their hidden network of pipes and drains and sewers, one of the biggest technical and social achievements of the age, a sanitary 'system' more comprehensive than the transport system.*

Angus McIntosh (1997, 43) argues that as technology develops, it has an accelerating impact on urban development. Such impact has not been anticipated by physical town planners. Unless we begin to measure and understand its significance, technology will continue to rule urban areas, rather than be harnessed to benefit cities and towns. McIntosh also defined technologies that mainly affect urban development as: construction material technology; farm technology, water & steam technologies, urban railway, automobile, air transport technology, electric technology, and computer & information technology.

3.1 TRANSPORTATION TECHNOLOGIES

In examining the urban impacts of transportation technologies, the thesis will start by discussing the increasing mobility, increasing diffusion and falling costs of transportation, and space-time convergence. Then, it discusses the urban impacts of successive transport technologies shedding light on the future advancements of transport technologies. Finally, the research analytically reviews the key debates about the future urban impacts of transportation.

3.1.1 Transportation as a Tool for Increasing Mobility and Improving Accessibility

Mobility is an essential human need and people usually seek to increase their mobility in order to improve accessibility — "the ease by which desired social and economic activities can be reached from a specific point in space" (US DOT, BTS 1997; p. 136). People desire mobility both for its own sake and because it enables them to overcome the distance. Businesses also need mobility because it helps them overcome distance — the distance that separates them from their sources of raw materials, from their markets, and from their employees (WBCSD. 2001, 11). In that sense, transportation is a necessary tool for overcoming space which characterizes a variety of human and physical constraints such as distance, time, administrative divisions and topography. Such constraints confer a friction to any movement, commonly known as the friction of space. The cost of overcoming these constraints and the friction they create varies greatly according to factors such as the distance involved and the nature of what is being transported. The goal of transportation is thus to transform the geographical attributes of freight, people or information, from an origin to a destination, conferring them an added value in the process (Rodrigue, Jean-Paul 2002a).

Throughout most of human history, people and goods were moving at speeds that were limited to the strength of people and the animals they domesticated. By the nineteenth century, the image has substantially changed when humans harnessed steam energy and used it to transport their goods and themselves at significantly faster speeds. The invention of the petroleum-fuelled motor vehicle at the end of the nineteenth century and the aeroplane at the beginning of the twentieth century opened up new opportunities for greatly increased speed and greater travel flexibility. Roads could go where railways could not, and aeroplanes only needed runways on which to arrive and depart. As a result of these transport innovations, the twentieth century was the "golden age" of mobility and improved accessibility (WBCSD. 2001, 11).

3.1.2 Transportation: Increasing Diffusion and Falling Costs

During the last half-century, the broad patterns of travel behaviour - known for increasing trip frequency, trip distance, and travel expenditure as incomes rise - have become evident in the statistics of passenger transportation all over the world. Between 1950 and 1997, the total number of kilometres travelled each year by each person increased more than threefold. The total transportation system, accommodating both that per capita increase and population increase, provided over eight times more passenger-kilometres in 1997 than in 1950. Also, the average world growth rate of kilometres travelled annually has been rising at an impressive rate of 4.6% per year. Surprisingly, the growth rate in some developing regions is even higher. China is the premier example, growing at 9.4% per year, although from an admittedly low base (Table 3.1) (MIT and CRAI. 2001, p.36).

On the other side, there have been major shifts among means of transport. It is argued that as people earn more and travel more, they use faster and more convenient vehicles, automobiles in particular. Worldwide, the greatest loser is therefore travel by rail. Since 1950, rail travel has decreased dramatically as a share of the total travel, especially in developing regions where it was the dominant form of motorized travel (MIT and CRAI. 2001, p.37).

Table 3.1. Growth in passenger-kilometres travelled

	1950		1997		AAGR*, %/yr	
	Per Capita	Total (billions)	Per Capita	Total (billions)	Per Capita	Total (billions)
Industrialized Regions	4,479	2,628	16,645	14,951	2.8	4.8
Other Regions	373	717	2,627	12,998	4.2	6.4
World	1,334	3,345	4,781	27,949	2.8	4.6
Specific Segments						
United States	11,205	1,706	24,373	6,530	1.7	2.9
Western Europe	1,668	542	12,631	5,658	4.4	5.1
Former Soviet Union	705	127	4,152	1,250	4.8	5.0
China	NA	NA	1,313	1,634	NA	NA
India	348	125	1,457	1,392	4.1	5.3

Source: MIT and CRAI. 2001, p.37

Since the 1950s, the number of automobiles has considerably increased in both the developed and developing countries. This process of motorization involved a significant reduction in the number of people per automobile, from 48.2 in 1950 to 11.5 in 1999. In 1999, the global automobile fleet was estimated to be around 520 million vehicles, with an annual car production of around 35-40 million cars. Along with the number of vehicles, the distance travelled per vehicle is also increasing (Table 3.1). More important, transport costs have considerably declined during the 20th century, notably through the application of economies of scale. In 1960, maritime transport costs were a third of their 1920 level. Air transportation costs have followed a similar trend, but over a much shorter time span. Air transportation boomed after World War Two with the application of significant technological improvements (such as the jet engine) (Rodrigue, Jean-Paul 2002a).

3.1.3 Transportation and Space-Time Convergence

Transportation significantly and continually changes the relationship between time and space. The development of transportation technologies resulted in so called 'space-time convergence' because the amount of time needed to move between two points decreases significantly. The development of stagecoach services in the 18th and early 19th centuries has substantially declined travel times. The development of rail networks initiated a new phase of space-time convergence and by the early 20th century travel times were significantly decreasing. The development of highways and then air transportation systems from the mid 20th century reduced travel times more than anytime before. For example, the travel time from London to Edinburgh (520 km apart) reduced from 20000 minutes in year 1650 to only 100 minutes in 2000, and the New York and Boston (310 km apart) reduced from about 2700 minutes in year 1800 to only 70 minutes in year 2000 (Janelle 1968; Rodrigue, Jean-Paul. 2002b).

3.1.4 Transportation and Urban Change: Key Debates

In all city-planning theories, transportation was a key factor in defining a city's size, form, structure, and function within the regional settings. In *Garden Cities of Tomorrow (1902),* Ebenezer Howard envisaged a garden city depending on comprehensive railway systems of internal communications. Also, Le Corbusier's linear-city ideas in 1920s were founded mainly on a sound transport strategy, including public transportation. In addition, the linear city model, developed by Don Arturo Soria Y Mata in 1892, was based mainly on railways. In England, the suburbs that grew between 1850-1920 owe their existence mainly to the railways, and their development during this period. Railway development has significantly facilitated the population redistribution away from the crowded city centres and within easy walking distance of railway stations (McIntosh 1997, 45).

Urban growth has historically been strongly related to transport technology. The reach of development has traditionally been constrained by the available vehicles, rights-of-way, landforms, and the costs of dealing with each. Automobiles and trucks have dominated the transport technology of the last half of the 20th century. The technologies of these vehicles are continually improving and the development of a system of high speed express rights-of-way has significantly reduced travel times and costs. Even terrain obstacles (rivers, deserts, mountains, etc.) have been conquered and landform has almost faded away as a barrier through advances in engineering. In short, all of the constraining variables have been continually loosening. Vehicles are becoming faster, more flexible, and less expensive (if externalities are ignored). Transport technology has also become highly individualized enabling individuals to travel according to their own schedule and needs (Bolan *et al* 1997).

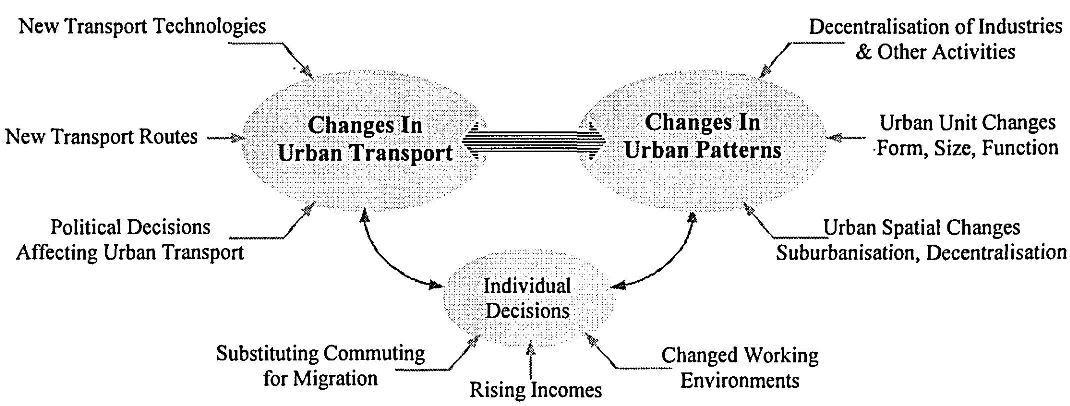
Transportation capabilities are argued to determine how large cities could grow. The average city in ancient Greece is said to have had a population of only about 10,000; this was the most that could be supported by the transportation systems that connected these cities and their immediate hinterlands. However, the population of ancient Rome managed to grow to about 1,000,000 because the Romans were able to transport large quantities of grain from Egypt using high-capacity (for that time) ships. Moreover, the inexpensive, reliable freight transport technologies has transformed otherwise worthless substances - such as remotely located deposits of low-grade iron ore - into valuable resources. Indeed, the improvement of personal and goods mobility has made the present globalised economy possible (WBCSD. 2001, p. 16).

Van der Berg *et al* (1982, 26) argue that the spatial form of a town is determined to a great extent by the prevailing transport facilities and traffic provisions. The stage of the economic development and income level force those who work in the town to settle there, their choice of residence is limited by the available transport facilities. They argue that as transport technologies develop, the spatial shape of the town evolves. During the early days of the Industrial Revolution, workers had to walk to work, so that houses had to be built near to factories. With the advent of the railways and tramways, longer distances could be bridged and towns expanded along the tracks and around the stations. As public transport in town is the main mode of conveyance, residents' mobility is restricted to the town where they live, which consequently is characterised by a high residential density.

Peter Hall (1970) asserted that there is a close interrelationship between the available forms of urban transport and the form of urban growth. In addition, he argues that at any point in a city's history, its form had affected the available choices of transportation, which afterwards affected the subsequent urban growth and the city form. In the pre-public-transport city, there was a very dense concentration of people and activities within walking distances of the centre. In the early public transport city, horse bus and horse tram and steam railway were the main transportation modes and urban growth was along the main radial arteries. The later public transport city was dependent on the finer-grained accessibility of the electric train and motor bus, a matter that allowed the overall spread of medium density housing while employment still concentrated at the centre or in well-defined factory or warehouse areas (Hall 1970, 131).

Simmons (1973) argues that transportation technologies significantly affect urban development through increasing population mobility. The links between transport technology, individual mobility, urban form, and spatial dimensions of urbanisation process are an important but elusive aspect of urban research. Many studies, especially those about nineteenth-century cities, have primarily focused on the impact of railways on urban growth (Simmons 1973, 277; Hume 1983, 179), or on the role of omnibuses and trams in the process of suburbanisation (Dickinson 1959, 214; Dennis 1984, p.110).

Pooley and Turnbull (2000, 360) identified several factors that influence the relationship between transport technologies and urbanisation patterns. Although the nature and direction of links between the key factors of this process are uncertain, it is possible to summarise these factors and their inter-links as shown in Figure 3.1. It is likely that all these factors operated in some places and time periods, and that cause and effect relationships will be difficult to disentangle. However, it is possible to identify a series of significant trends that may be identified. First, new transport technologies of the twentieth century had definitely increased mobility for many, though they were not necessarily available to all (Freeman 1986, 80; Thrift 1990, 453). Second, changes in urban form, with the decentralization of homes and workplaces, created increasingly complex commuting patterns inside and between urban settlements during the second half of the twentieth century. Third, the rise in real incomes and the improvement of working arrangements increased choices for urban residents in terms of where to live and work. Fourth, and based on these points, many people increasingly chose longer journeys to work over migration. Whereas in the nineteenth century a change of work would have necessitated a residential move, in the twentieth century it could be accommodated by a longer and more complex journey to work (Pooley and Turnbull 2000, 360; Green *et al* 1999, 49; Pooley and Turnbull 1999, 127).



Source: Adapted from: Pooley and Turnbull 2000, 360.

Figure 3.1: Urban transport and changes in urban patterns

In his investigation of the relationship between transportation technologies and urbanisation patterns, Pacione (2001, 248) identified four stages of transportation technologies and four corresponding patterns of urbanisation (Table 3.2). In the pre-industrial stage, when most people had to walk to engage in necessary daily activities, cities were necessarily compact and citizens lived at or close to their workplaces. Consequently, high-density living environments in small, functionally integrated cities were the prevailing patterns. Only during the Industrial Revolution, vehicles of relatively high capacity and speed allowed greater distances to be travelled and larger quantities of goods to be exchanged. This situation relaxed restrictions of city size and established the interdependence between transport technology and urbanisation. The development of railways and trams during the nineteenth century was crucial in separating home and workplace, encouraging functional specialisation of land uses in the city, and in promoting the expansion on the surrounding countryside along the more accessible transport corridors (Pacione 2001, p.248). This proves that technological changes have introduced parallel changes in urban patterns.

Again, as it has been said earlier, the automobile has substantially transformed the urban environment as it encouraged the development of areas that are not along railway lines, which results in returning to the circular shape of the city that was prevailing before the industrial age. In addition, it encouraged the emergence of the suburbs at city edges that usually were not along railway lines. Moreover, the automobile was a major force in the development of cities that are not connected to railway lines.

The urban impacts of transport technology at the regional level were profound. In the pre-industrial era, cities were in a balanced relationship with each other and with the rural surroundings. This situation explains why these cities were of similar size. Only during the Industrial Revolution and since the introduction of new transportation modes that affect the regional setting, especially the railways and the automobile, the previous balanced relationship had changed significantly. Rural to urban migration was the most significant phenomenon during this period and resulted in a sharp size-difference between cities. This era witnessed the emergence of multimillion settlements, the primate cities, and what are called the metropolitan regions. Table 3.2 presents a summary of the relationships between transport technologies and urbanisation changes at local and regional levels.

Table 3.2: Transport technology and urbanisation changes on the local and regional levels

	Urban Unit Level			Urban Regional Level	
	Transport Technology	Urban Functions	Urban Form	Transport Technology	**Urban System**
Stage 1 **Pre-industrial**	Pedestrian, horse-drawn vehicles	Multi-functional, Defence, marketing, political-symbolic, craft industry	Compact, small, concentric, low-rise settlements	Draught animal (Camel caravans)	Dispersed, independent & of similar size units, short distances between adjacent settlements
Stage 2 **Early Industrial**	Electric tram, streetcar, public transportation	Emergence of specialisation - Basic industries, secondary, manufacturing	Large & eccentric-growth along tram lines, suburbanisation, satellite form	Railways, public transport	Differential growth of cities – emergence of large cities – interdependence among cities
Stage 3 **Industrial**	Motor bus, underground systems Public transport, private cars	Specialised function- industry or service centres – tertiary activities	Population concentration-Large cities- polycentric- high-rise, suburbanisation, industrial decentralisation	Railways, Public transport, free ways, private cars, public air transport	Emergence of primate cities & urban regions-new towns
Stage 4 **Post Industrial** (HYPOTHETICAL)	*High-speed rail travel, moving pavements, smart car & bikes, personal rapid transit, horizontal elevators..?!!*	*Specialised functions: IT, education, health, service centres – provision of daily service activities Or Combination of related activities*	Population deconcentration, *Post-suburbanisation - Edge city – dependent-dispersed & small settlements*	*High-speed national & international railways, Automated & intelligent highways, more advanced cars, public & private air transport*	*Urban decentralisation & diffusion of settlements - new small settlement around and away of existing cities- new role of rural settlements*

Source: prepared by the research; data partially from: Hall 1993, Pacione 2001, Herbert and Thomas 1997, Hart 2001,

For the future impacts of transport technologies, Peter Hall (1993, 883) expects that new technologies of high-speed ground transport, automated transit and 'smart streets' (intelligent Vehicle-Highway Systems) will be of high influence in shaping the future of urban development in Europe. In addition, the emerging new transport technologies such as the moving pavements, smart cars and bikes, and personal rapid transit are expected to make life in both the existing and new cities more enjoyable (Richard 2001, 101). Developments in information technology are expected to be highly effective in shaping the role of transport in the city of tomorrow. Electronic transmission of information could replace the movement of hard copy. Telecommuting is starting to replace traditional physical movement of people to work. The question is how these new technologies will be used. In particular, this depends both on the extent to which telecommunications act as a complement or a substitute for the physical movement of goods and people, and, where it is a substitute, what new pattern of activities develops (Gwilliam 1996).

3.2 TELECOMMUNICATIONS TECHNOLOGIES

Since the 1990s, telecommunications systems are increasingly viewed as the virtual form of transportation systems and as a substitute for the physical movement of people and services. The growing use of telecommunications systems is not only affecting where people work and live, but also changing the character of activities that occur in the home, workplace, and automobile. Information and telecommunications technologies are changing the everyday urban life and transforming the home into an extension of the office, shopping mall, and classroom; allowing the automobile and aeroplane to become workplaces; and converting the office building into a hub for social interaction and interpersonal contact.

The main purpose here is to give an idea about the growing diffusion of telecommunications technologies and to define the main socio-economic changes introduced by telecommunications technology. Then, the research discusses the main debates regarding the urban impacts of these changes.

3.2.1 Diffusion of Telecommunication Technologies

Since the late 1970s, telecommunications technologies have been in continuous and progressive development. In less than three decades, the telecommunications industry has grown to become the world's fastest growing industry and it is on the verge of becoming the world's largest one (Graham and Marvin 1996, 11). Because of these technological advances, the previously separated areas of telecommunications, computing, and media technologies, are now converging in a core group known as *Telematics*.

The diffusion of mobile telecommunications is impressive all over the world. In 2001, the International Telecommunications Union (ITU) reported that mobile cellular phones constitute almost one-third of all telephone connections in the world and growing at twice the rate of fixed telephony. It seems likely that the number of mobile cellular subscribers will surpass conventional fixed lines during the early part of this decade (ITU 2001-B;TIW 2002). In Europe, mobile telecommunications was gaining an annual revenue growth rate of more than 30% during 1995-1998, reaching a market size of 21 billion ECU. In 1997, the number of new subscribers increased by 57% at a penetration rate of 14% for total Europe and reached 50% in Finland (Gruber and Verboven 1998, 2). On the international level, and by the end of 2000, there were an estimated 700 million mobile cellular subscribers across the globe - up from 300 million in 1998. The number of mobile subscribers worldwide has been doubling every 20 months since the early 1990s. The expected growth in mobile voice and data revenues is projected to push the total market for mobile services to over US$700 billion in revenues by 2005. In fact, revenues from fixed-line telephone service have been in decline globally since 1996. At current trends, the value of mobile revenue will overtake total fixed-line revenue worldwide in 2004. In the developing world, mobile cellular is often the most convenient and cost-effective solution to fixed-line shortages (TIW 2002).

3.2.2 Growing Reach and Falling Costs

Information and telecommunications innovations in microelectronics, computing (hardware and software), telecommunications and opto-electronics (microprocessors, semiconductors, fibre optics, etc..) enabled the processing and storage of enormous amounts of information, along with rapid distribution of information through communication networks. Moore's Law predicts the doubling of computing power every 18–24 months because of the rapid evolution of microprocessor technology. Gilder's Law predicts the doubling of communications power every six months—a bandwidth explosion—due to advances in fibre-optic network technologies (Gilder 2000). Both are accompanied by huge reductions in costs and massive increases in speed and quantity (UNDP 2001, 30).

The growth in information transmission has been very rapid. The UNDP's Human Development Report (UNDP 2001) stated that in 2001 more information could be sent over a single cable in a second than that was sent over the entire Internet in a month in 1997, only four years before the Report (UNDP 2001, 30; Gilder 2000). In 1990, an international phone call was on average at 1 to 5% of its 1940 cost. With fibre optic cables and decreased costs for satellite use, telecommunications are accessible throughout the world. The current mass diffusion of cellular phones is likely to further decrease costs. Another significant wave of innovation involves information technologies, as indicated by the excessively rapid decrease of computer costs since their initial introduction (mainframes) in the 1960s (Rodrigue, Jean-Paul 2002a). The cost of transmitting a trillion bits of information from Boston to Los Angeles has fallen drastically from $150,000 in 1970 to 12 cents today, and the cost of a three-minute phone call from New York to London that in 1930 cost more than $300 (in 2001 prices) costs less than 20 cents today (Hall 1999, 173; Cane 1996; Chandrasekhar 2001). E-mailing a 40-page document from Chile to Kenya costs less than 10 cents while faxing it costs about $10 and sending it by courier costs about $50 (UNDP 2001, 30). Such achievement radically improves the access to information and the structure of communication for both business and home activities and extends the networked reach to all corners of the world. Stressing the future urban impacts of telecommunications, Moss and Townsend (2000, 33) wrote:

> *.... the deployment of new telecommunications systems is altering the activities that occur in the key elements of urban society – the home, the office, the automobile, and even the hotel room and public parks and streets. Telecommunications systems are blurring the separation between the home and the workplace, radically changing office design and function, transforming the automobile into an extension of the workplace, and moving street crime into the shadows of cyberspace.*

3.2.3 Socio-economic Impacts of Telecommunications

In order to understand the possible urban impacts of telecommunications, the research tries first to examine the main socio-economic impacts of telecommunications which are of considerable importance in shaping the urban future.

3.2.3.1 Emergence and Growth of Telecommuting Activities:

Technological advances of the last two decades in computers and network communications have changed the ways in which people practice their activities. Information and telecommunications technologies introduced many new, but widely used, prefixes especially *Tele…* and *Distance…* (telework, telecommute, telemedicine, distance work, distance education, …etc). The increasing number of terms causes some confusion in identifying each of them. The most confusing terms are *telecommuting* and *teleworking* (widely used in Europe) or *distance working* (widely used in USA) as they sometimes are used interchangeably. While *teleworking* can be defined as the way in which employees could work from home and commute to their offices through the use of telecommunications technologies such as telephones, computers, modems, fax machines, and electronic mail, telecommuting seems to be more comprehensive and includes other types of teleactivities especially distance education (Wilczynski 1996; Niles 2002).

Telecommuting for both work and education has many social and economical advantages. From the social point of view, telecommuting allows more families to be united and stable and allows people to work or educate while enjoying the family environment. From the economical point of view, telecommuting significantly reduces the costs for both the employee (or the student) and the employer (or school or university administration). In addition, telecommuting increases flexibility that is considered as one of the main benefits for students and employees because it helps achieve the desired balance between ones workload and ones private life (Glory 1994, p.32). Also, telecommuting reduces energy consumption and air pollution as a result of decreased automobile traffic (Mokhtarian; Handy; Salomon 1995; Sharman 1994). Finally, telecommuting offers good work and education opportunities for mobility-impaired individuals (Wilczynski 1996; Pacific Bell. 1996). All these advantages make teleworking a growing activity all over the world.

For developed countries and during the last half of the twentieth century, distance education was one of the most clearly valuable applications of ICTs. It also has proven to be a particularly successful model for developing countries where affordability and geography are the real barriers to access. The six largest distance-learning universities in the world are located in developing countries: Turkey, Indonesia, China, India, Thailand and Korea (InfoDev, World Bank Group. 2000).

3.2.3.2 Telecommuting and Travel: Main Arguments

Many studies argue that wireless telephony and other telecommunications technologies have transformed transportation and travel across the world, converting the automobile, the train, the hotel room, and even the airport into an information-intensive infrastructure. In addition, it is expect that telecommunications will make the automobile commute into a productive part of the workday, as it had been possible to send and receive e-mails, faxes, and telephone calls from any street or highway. It is argued that telecommunications technologies will make traffic jams and congestion more tolerated, as there will be more chances to catch up with telephone messages and e-mails (Moss and Townsend 2000, 38).

Many other studies suggest that telecommunications encourages telecommuting, which in turn yields travel savings, and therefore it could offer clean and dematerialised substitutions for the material ills of transportation (Bly *et al* 1993; Davenport 1993; Egido 1988; Hadden and O'Connor 1993). SPECTRE (2002) argues that in many cases telecommunications serve as a substitute for physical contact, which in earlier times necessitated travel or transportation. Moreover, it argues that there is a direct link between transportation infrastructure and telecommunications infrastructure as the advent of new transport modes; i.e. postal coach, railways, automobile, aeroplane, was accompanied by the introduction of new communication technologies and infrastructures (SPECTRE 2002, 13).

On the contrary, Niles (1994) suggests that telecommunications not only yields some travel savings through telecommuting and other travel substitution effects, but also it sets up a countervailing mechanism of travel stimulation that needs to be more widely recognized and better understood. Graham (1997, 25) argues that in reality transport and telecommunications tend to grow together and to be mutually reinforcing in three ways. First, telecommunication can actually generate or induce many new demands for physical movement. As telecommunications increase the number of participants in business or recreation networks, this creates a demand for physical co-presence leading to new forms of physical travel that might not be possible without the telecommunications linkage. Second, as telecommunications saves the travel-to-work time for telecommuters, it increases the leisure time available to them. Therefore, telecommuters may travel further total distances than before, not to work but for social and shopping trips during the working day and holidays. Third, telecommunications have played a significant role in increasing the efficiency, safety, and attractiveness of all transport modes. Consequently, the travel costs reduced and the travel attractiveness increased significantly (Graham 1997, 26). Niles (1994) stressed that a number of distinct travel stimulation effects can be identified. For example, the increasing millions watching soccer on TV provide a growing pool of people who begin to consider going to the stadium occasionally. Similarly, intensive telephone, video, and fax interchanges between people who barely know each other create desire for follow-up face-to-face meetings. It should be noted here that such an effect could be valid for occasional and temporary events and not for business activities that require continuous and regular contacts (Niles 1994).

In confirmation with the all the previous arguments, and despite the increasing impact of telecommunications in the British society, the annual travelled miles per person has increased during the last twenty-five years. But, it should be noted that the rate of growth in the last ten years was very low. The growth in annual travelled miles per person during the last ten years (1989/91 to 1997/99) was only 332 miles; which is only 28% of the corresponding growth during the proceeding five years (1985/86 to 1989/91) that was 1157 miles. So, telecommunications may have had an effect in lowering the growth rate of annual travelled miles per person during the last ten years as this period had witnessed an unprecedented growth in the use of telecommunications facilities, especially the Internet and the cell phone, that have commercially emerged during that period.

Therefore, telecommunications may have an effective role in reducing business travel. To make it clearer, one must think of an answer for the following question: what will be the travel volume if the current business in the country is to run at the same level of efficiency in absence of telecommunications facilities; Internet, telephony, faxing, etc., taking into account the implications of stopping all forms of telework? In the meantime, transportation is expected to continue being an integral part in business activities for the physical movement of raw material and finished products.

3.2.3.3 Tele-shopping and E-Commerce:

The convergence of computer and telecommunications technologies has revolutionized the way companies acquire, store, retrieve, and share information and has created what is widely known as the *information economy*. Commercial transactions on the Internet, whether retail business-to-customer or business-to-business, are commonly called e-commerce. In 1995, it was estimated that about 1 to 2 million people in the Untied States used the Internet for some form of commercial transaction. By the next year, Internet traffic, including e-commerce, was doubling every 100 days. One 1998 industry estimate projected that U.S. retail transactions would reach $7 billion by 2000—a figure now widely accepted as having been reached in the year that the report came out. It also estimated that, by 2003, business-to-business transactions would have reached $1.5 trillion, up from $131 billion in 1999 (McLoughlin 2000, 196).

For the UK, the proportion of businesses with access to the Internet reached 94% in 2001 (up from 90% in 2000) – and comes just behind Sweden (98%), Germany (97%) and Canada (95%), and equal with the USA. The proportion of employees accessing the Internet increased during 2000. In 2001, the UK had the third highest proportion (35%) of employees who work in businesses that have Internet access making daily use of e-mail for external communication. In addition, the proportion of businesses with a website continues to grow rapidly; reached 80% in 2001 (up from 66% in 2000) (DTI, UK. 2001).

For developing countries, although e-commerce is not highly practiced, the future is promising due to the very high rate of Internet use. Although the Western industrialized nations dominate Internet development and use, by 2003 it is expected that more than half of the material posted on the Internet will be in languages other than English. This has large ramifications for e-commerce and ease of transactions, security, and privacy issues (McLoughlin 2000, 197). E-commerce is expected to increase the ability of developing countries to be more involved in international markets. On the local level, it may minimize the role of large cities as a commercial centre and increase the competitiveness of small cities in this regard. Also, small cities could be more efficient in attracting new commercial enterprises as they could offer cheaper land prices and better employment opportunities. These aspects could have considerable impacts on urban structure on both the regional and local levels.

3.2.3.4 Changes to Workplace:

The emergence of telematics has profoundly altered the physical design of office buildings and the type of activities that occur within them. New office buildings increasingly feature advanced telecommunications infrastructure built into their walls and floors. In large cities such as London many older office buildings are unable to meet today's technological requirements, generating a demand for new buildings that can meet today's spatial and technological requirements. Thus, Canary Wharf in the London Dockyards has attracted leading financial institutions to areas that are not contiguous to the city's traditional financial district (Moss and Townsend 2000, 36).

More important, office work is generally becoming more mobile, more complex, and more diverse. And yet there is often the need for some concentrated, individual work in the same place. This has resulted in one of the eternal conflicts in office design: the need to accommodate communication and interaction as well as individual work (Duffy 1998). Corporations such as IBM have reduced the size of individual offices and rely on flexible office arrangements such as "hot-desking," but there is simultaneous a greater emphasis on the use of conference rooms and centres for mobilizing workers, encouraging interaction, and bringing experts together to work in team efforts (Moss and Townsend 2000, 36).

3.2.3.5 Changes to Home Environment

Because of the increasing application of telecommunications technologies, the home is undergoing a fundamental change in its function and design. Throughout history, the home has functioned primarily as a site for social-emotional functions of the family, explicitly designed as a refuge from the workplace. This separation of home and work is disappearing as new information technologies are becoming widely available.

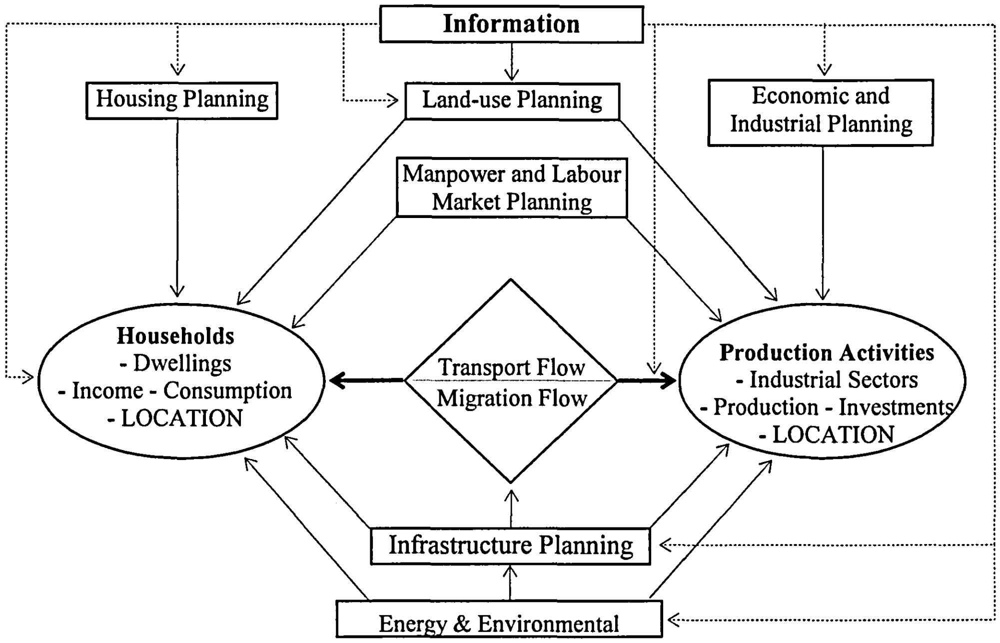
Currently, there is a rapid diffusion of new information-based services in the home – for security, climate control, and entertainment. Moreover, many of public services that were usually provided within designated public buildings such as schools, libraries, or prisons are now being provided in the home. It is quite obvious that telecommunications technologies, especially the Internet, have facilitated the emergence and development of "home-schooling" and “distance education”(Moss and Townsend 2000, 39).

During the twenty-first century, it is expected that home's attractiveness will be judged by the speed of its dial-up connections and extent of its intelligent infrastructure, rather than conventional measures such as the number of bedrooms or bathrooms. Moreover, it is believed that "everything" in the home will be connected to the Internet – not just electronic devices (Beiser 1999). Definitely, the movement of information into the home will expand its social and economic functions, allowing all members of a household to participate in a wide array of different economic and social activities and making the home far more than a site for housing family members (Moss and Townsend 2000, 39).

3.2.4 Telecommunications and Urban Change: Main Debates

The diffusion of information technologies is expected to drastically increase the complexity of cities through increasing the numbers and types of interactions among individuals, firms, technical systems, and the external environment. Information systems are opening new opportunities for new combinations of people, equipment, and places. Therefore, a dramatic change in the spatial organization of activities within cities and large metropolitan regions is highly expected. Old ideas and assumptions about the development, planning and management of the modern, industrial city seem less and less useful (Graham and Marvin 1996). Dabinett (2002, 232) stressed that ICTs will have consequences on how places are used, on future patterns of spatial development, and on the context that strategic planning operates within. Moreover, the fundamental elements of urban life – housing, transportation, work, and leisure – are expected to become far more complex logistically, spatially, and temporally (Moss and Townsend 2000, 31). In a similar vein, Nijkamp (1985, 209) argued that information technology would affect all components of urban systems. This argument is based on the suggestion that innovation technology will affect land-use planning, economic and industrial planning, infrastructure planning, energy and environmental planning, and housing planning. Figure 3.2 presents a summary of this argument.

Although cities are centres for activities that rely on both face-to-face and electronic communication and despite the popular expectations that new technologies will alter the urban space, remarkably little research has been done to understand ways in which communications technologies affect the function of cities in an information-based economy. Local governments are more concerned about the effects of new technologies on economic development in rural and urban areas (Miller and Stone 1996; Moss 1999). Stephen Graham and Simon Marvin (1996, 6) confirmed that telecommunications remain far from being a central focus in urban studies or urban policy-making. Moss (1999) considered the subject of telecommunications and cities as being remarkably neglected and extremely immature field of policy and research.



Source: Nijkamp 1985, 210.

Figure 3.2 Impacts of Information Technology on Urban System Components

The academic literature on new information technologies reflects a growing belief that electronic communications will lead to the economic decline of cities as they make it possible to replace the face-to-face activities that occur in central locations (Moss and Townsend 2000, 32). More than thirty years ago, Ronald Abler (1970), a pioneer in the study of communications and urban space, suggested that advances in information transmission would quickly permit the dispersal of information-gathering and decision-making activities away from metropolitan centres. Moreover, he expected that electronic communications media would make all kinds of information equally abundant everywhere in the world (Ronald 1970).

On the other hand, geographers such as John Goddard, Jean Gottman, and Allen Scott have a different argument. Gottmann argues that communications technologies work in two directions: by making it possible to concentrate and disperse economic activities. He argues that the telephone has had a "dual impact" on office location. First, it has freed the office from the previous necessity of locating next to the operations it directed; second, it has helped to gather offices in large concentrations in special areas (Gottmann 1977, 310).

In his study; *Telecommunications and the Future of Cities: Debunking the Myths*; Stephen Graham (1997, 21) criticised the over-simplification of the relationship between telecommunications and cities. He viewed these studies as being based on poorly-informed technological forecasts and aimed mainly at attracting media attention or generating sales for technological equipments.

3.2.4.1 Cities and Telecommunications Determinism

It is more often in the mainstream of social research on technology and cities to view new telecommunications technologies to directly cause urban change. Most of these scenarios view the forces that stem from new telecommunications technologies as having some autonomy from social and political processes. Moreover, they often assume that current or future urban changes are to be determined by technological change in a simple, linear cause-and-effect manner. In addition, they suggest that technological development is somehow separated from society, rather than being designed, applied and shaped within specific social, economic, and political contexts. Graham (1997, 22) viewed the effect of telecommunications as much more complex than the simple vision of these scenarios for two reasons: (1) the biased nature of the design and production of telecommunications in favour of large, trans-national corporations while people in disadvantaged areas are lucky to access a pay phone; (2) the political and social influences can redirect telecommunications application as they can redirect the shaping of the built environment. Therefore, Graham (1997, 22) argues that the relationship between telecommunications and cities is complex and indeterminate and that there can be very different effects in different places and times. In a similar vein, Dabinett (2002, 233) views technology as only playing a part in enabling the many processes and relationships that characterise regional patterns of uneven spatial development.

In fact such arguments could be valid for all aspects of technology and seem to be more concerned with conceptualising and theorising the relationship between technology and urban change. Also, they could be viewed as a call for not exaggerating the role of technology in shaping urbanisation, and they appear similar to the arguments raised at the start of Industrial Revolution calling for not exaggerating the impact of industrialisation. Although the cause-and-effect approach in understanding the technology-urbanisation relationship is over simplistic, the unprecedented changes in the built environment following the Industrial Revolution are undeniable and prove that there is some relation between technology and urbanisation.

On the other hand, these arguments prove that considering technology as the prime cause for urban change underestimates the social and political factors in this process. Technology should be viewed no more than a tool for meeting social needs and desires. For example, the decision to move to a new location depends on three main factors: the disadvantages of the old location, the advantages of the new one, and how to make this possible - and this is the area where technology takes place. The decision to move will not be taken just because it is technically possible, but mainly because there are socio-economic and environmental needs and desires to move to an advantaged location (Figure 3.3). Therefore, technology should be regarded just as a tool or a facilitator to overcome social problems and to fulfil social desires.

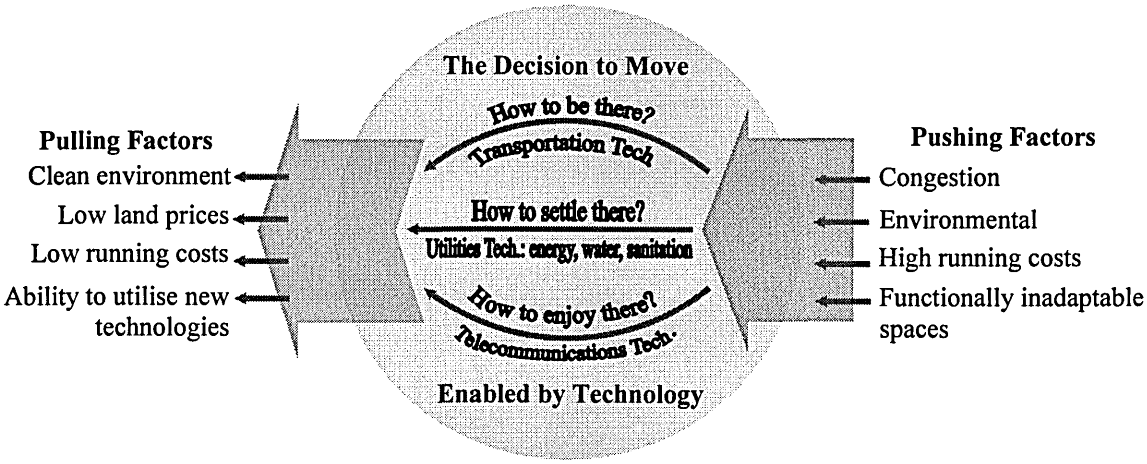


Figure 3.3: Technology as an Enabler for Social Decisions- i.e. the decision to move.

3.2.4.2 Telecommunications: 'Death of Distance' and 'Death of Cities'

In 1960, Constantinos Doxiadis was the first to write about the death of cities. His argument stressed the role of the machine, among other factors of population growth and political socialisation, on cities and how it deteriorated the conditions of human settlements. Also, he argued that architects, planners and administrators are unable to deal with this triple growing of urban units, unless they proceed to remodelling and demolition. In 1997 and 2000, Frances Cairncross wrote two books about the "death of distance" stressing that distance would no longer determine the cost of communicating electronically. This means that the traditional distance-deterrence effects, embodied in all locational models, will diminish to zero and that the entire world will become a frictionless plain on which it is perfectly easy to locate any activity anywhere. According to this vision, companies will tend to locate screen-based activities wherever they find the best bargain of skills and productivity (Cairncross 1997, 238). George Gilder and Peter, T. (1995) elaborated more on this argument when they anticipated the "death of cities" because of "death of distance" due to the continued growth of personal computing and distributed organizations advances. They viewed cities as the leftover baggage of the industrial era. According to this vision, cities are no longer needed to access a wide range of cultural activities and information sources, because telecommunications can bring the library, concert hall, or business meeting into any home or office (Moss and Townsend 2000, 32).

Peter Gordon and Harry W. Richardson (1997, 95) argue that the rapid advances in communications technologies will facilitate the movement out of cities that the automobile had initiated. For them today's cities will continue to become less compact and the city of the future will be anything but compact. Many other studies argue that technology will eliminate the need for cities as centres of interaction (Moss and Townsend 2000, 32; UNCHS-Habitat 1995; Cairncross 1997, 18). Nicholas Negroponte (1996, 165) and Wheeler *et al* (2000, 3) argue that the post-information age will remove the limitations of geography. Digital living will be less and less dependent upon being in a specific place at a specific time, and the transmission of place itself will start to become possible. Even the concept of the "edge city," a label that Joel Garreau (1991) applied to clusters of suburban office parks linked by freeways, is an indication of how both transportation and communication technologies are considered as forces that have fostered the out-migration of work and housing from the central city (Moss and Townsend 2000, 32).

Admittedly, researchers such as Jean Gottman (1983), Allen Scott (1995), and James Wheeler, Yuko Aoyama, and Barney Warf (2000) have carefully examined the ways in which telecommunications could both centralize and decentralize urban activities. Gottmann (1983, 411) argues that communications technologies could help both to concentrate and to disperse economic activities. He views telecommunication technologies as of "dual impact" on office location. First, they have freed the office from the previous necessity of locating next to the operations it directed. Second, they have helped to gather offices in large concentrations in special areas. Moss and Townsend (1996, 1997, 1998) have agreed to this spatial imperative and emphasized the role of technology in reinforcing the position of major cities in the United States.

Nigel Thrift (1996, 1487) stressed the need for face-to-face contact in an era of high-speed communications by claiming that telecommunications networks generate a demand for instant information in the financial services sector that is best achieved in a face-to-face environment. Thrift argued that the principal function of major financial centres is interpreting in real time the massive amounts of information that are generated each day: "*Since the international financial system generates such a massive load of information, power goes to those who are able to offer the most convincing interpretations of the moment.*" Interpreting information depends as much on face-to-face interaction as on advanced technologies, an activity that is necessarily and increasingly centralized in the leading world financial centres (Moss and Townsend 2000, 33).

SPECTRE (2002), a study about telecommunications impacts on urban Europe, argues that although electronic communication could surmount distance not only through 'shrinking of space' but also through 'extension of people' into a position in which they can bridge distances, distance has not lost its relevance. In this regard, the study argues that both the huge concentration of activities in urban centres, where space is at the premium, and the flows of commuters, moving in and out of cities and becoming stuck in traffic jams prove that distance has not lost its significance yet. In addition, it suggests that logistical matters and the transportation of goods are becoming increasingly disentangled and that the mobile telecommunication revolution will help overcome the spatial barriers to communication. But, the study affirms that people will not stop face-to-face contact (SPECTRE 2002, 13).

In the same vein, Jed Kolko (1998, 4) argued that telecommunications have led to the "death of distance" but not to the "death of cities." He also found that "city size is positively related to domain density, and significantly so" (Kolko 1998, 17). In addition, Peter Hall (1999) considered the argument that the 'death of distance' will lead to the 'death of cities' as exaggerating simply because it ignores the significance of face-to-face contact and the continuing significance of agglomeration. He argues that although telecommunications cost is falling sharply, it never falls to zero and it will always cost more to call far away areas, and that the informational economy agglomeration still does very much matter as many information businesses still favour agglomerated locations (Hall 1999, 176). Despite the fact that these points stress the need for the city in the information age, they evoke more questions about the locational-preference. For example: would the diminishing difference of telecommunications-cost between near and far locations be a determining factor in choosing location? And for how long could it be? Moreover, the increasing number of businesses moving out of large urban centres and teleworkers pose another question about the appropriate size of the agglomerations in the information age.

Also, and against the prophets of urban dissolution, Graham (1997, 23) argues that globalisation and advances in telematics actually tend to compound the many existing advantages of urban agglomerations as they facilitate both tele-mediated and face-to-face communications. In addition, he stresses the urban dominance of telecommunications investments as, for example, Paris, which houses only 15 percent of French population, receives 80 percent of telecommunications investment; and Tokyo has 30 percent of Japanese computers and more telephones than in the whole of sub-Saharan Africa. He also suggests that the concentration of telecommunications and computer networks will facilitate two things for the city: (a) telematics will help cities to weave together into fast-moving and integrated transactional systems; (b) telematics supports the dominance of cities as service centres for more distant hinterlands. He also argues that telematics will allow 'action at a distance' and remote control from cities, enabling cities to extend their dominance over more distant places, i.e. smaller towns and rural areas. Moreover, he stresses the need to avoid the dangerously simplistic concepts which continue to feed the myth of urban dissolution (Graham 1997, 24).

Although it is true that urban agglomerations receive the highest share in telecommunications investments, the most appropriate indicator is the rate of growth not the absolute growth. If the growth rate is taken into account, it becomes clear that investments in smaller cities and rural regions are growing faster. Also, the argument that telematics will help cities to be integrated into a larger transactional system and to be more effective on the regional level is also valid for smaller cities, rural settlements, and remote areas. In fact, telecommunications have added new advantages to these unprivileged areas as they become more physically and virtually accessible. Moreover, small cities and rural settlements may have many other advantages that are not available in large urban agglomerations (cleaner environment and lower land prices). Therefore, although it is true that the idea of "death of cities" is over simplistic and seems to be unrealistic in the foreseeable future, such an idea should not be completely rejected as many cities throughout history have disappeared as a result of serious changes in prevailing social, economic, and technological conditions. In addition, it is unclear whether the idea of 'death of cities' is concerned with existing cities or future cities. If it is concerned with existing cities, it is undeniable that existing cities will face radical transformations regarding their function, size, and structure.

In relation to the argument that death of distance will lead to the death of cities, it seems that there is some confusion between the meaning of 'distance' and 'location'. While telecommunications will significantly shrink the space and consequently reduce the effect of distance as a deterrent factor, site location will continue to be influential. For example, although the distance has not become the determining factor in choice between two locations, location advantages (i.e. regional settings, natural resources, environmental advantages) became more and more important in this regard. Therefore, the decision to settle or to build a new settlement in any location will not be mainly governed by the matter of distance but rather by the advantages of such location. This will increase the possibility of developing rural, remote and under-developed regions and incorporating them in the national development plans.

3.3 RENEWABLE ENERGY TECHNOLOGIES

Energy is another important technological force for urban change. It is the backbone of all modern technologies, which are usually known as energy intensive technologies. Without energy the whole fabric of modern societies would crumble; the effect of a 24-hour cut in electricity supplies to a city shows how totally dependent we are on that particularly useful form of energy. In such a situation, computers, lifts, and metros would cease to function, hospitals would sink to a care and maintenance level and the lights would go out. Due to the rapidly growing population, the need for more and more energy is exacerbated. Enhanced lifestyle and energy demand rise together and the wealthy industrialized economies which contain 25% of the world's population consume 75% of the world's energy supply (Dincer, I. 2000, 157).

Through globalisation and international trade rules, high-energy converters are transferring into the developing world. The energy crisis of the 1970s placed the spotlight on energy conversion and renewable sources of energy. Consequently, new large infrastructure investments in non-renewable resources worldwide are made and their use moved on to a rapidly rising curve (Kapur, J.C. 1999, 1246).

3.3.1 Advantages of Renewable Energy:

Renewable energy is seen as the main effective alternative for the depleting fossil energies. Most contemporary fuel sources are due to expire well within this century as widely available and relatively peacefully contested sources, and much of this reality will become globally pervasive within the next thirty to fifty years. Even conservative industry, national and international governmental sources estimate that oil will expire by 2050 — the depletion of the more easily accessible supply sources is likely to take place already in the 2020-2030 time frame (Scheer, H. 1999). Given rising use rate scenarios natural gas is likely to run out by 2040 (Droege, P. 2001).

The main advantages of renewable energy are that it is abundant, with well-established technology and that its main ingredients are completely free. Sunlight reaching the land surface of the earth can produce the equivalence of 1,600 times the total energy consumption of the world. That is, the amount of solar energy derived from the sun's radiation on just one square kilometre is about 4,000 megawatts, enough to light a small town (Irfan, H. 2001).

These advantages are of considerable importance if the fact that only eight countries have 81% of all world crude oil reserves, six countries have 70% of all natural gas reserves and eight countries have 89% of all coal reserves is taken into account. More than half of Asia, Africa and Latin America import over half of all their commercial energy. This problem is worsened by the fact that power generation is continuously increasing in these oil-importing countries. Moreover, the world population keeps increasing at 1.2±2% per year, and is projected to double every 60 years. And consequently, world energy demand has increased from 70 millions oil barrels/day in 1940 to 350 millions oil barrels/day in 2000 (Sayigh, A. 1999, 15).

From the environmental point of view, problems with energy supply and use are related not only to global warming, but also to such environmental concerns as air pollution, acid precipitation, ozone depletion, forest destruction, and emission of radioactive substances. These issues must be taken into consideration simultaneously if humanity is to achieve a bright energy future with minimal environmental impacts. Fossil fuels are seen to have caused many environmental problems. It is well established that global warming is happening and that the temperature rise during the last 70 years is estimated between 1.3 to 2.3 °c. The increase of CO_2 since 1760 is 20%, while methane increased by 7%. These situations led to global warming with a temperature rise of 1+0.5 °C. During the last 100 years, rain has increased by 15% and the sea level has risen by 10.5 cm. It is projected that if the temperature rises by 0.3°C every 10 years, this will result in a 4 cm rise in sea level per decade. In addition, CO_2 emissions are steadily increasing worldwide (Sayigh, A. 1999, 16).

Sayigh (1999, 17) affirmed that the cost of power generation from renewable sources has dropped significantly over the past decade and several technologies are now cost effective not only for off-grid applications but for grid-connected power as well. This is despite the fact that there are some barriers that still stand in the way of pressing ahead with the use of renewable energy; mainly the unequal access to investment capital, distorted energy market and inadequate institutional capacity to commercialise immature technologies.

For developing countries, photovoltaic (PV) technology offers a unique opportunity for supplying electricity to remote and scattered rural and desert settlements without the need for the extremely expensive networks. The World Energy Council reports that single-family homes in much of Egypt's rural territories, which are more than half a kilometre from existing electric-lines, are more cost-effectively served by solar energy than by extending the electric-grid. Even diesel is more expensive than solar energy in these instances. A diesel-generator of equivalent capacity has a lifecycle cost almost twice that of a (PV) system. Thus, there exists an opportunity for Egypt to provide cost-effective PV electrical generating capacity to those living beyond a reasonably priced electrical grid (Taylor, R. and Abulfotuh, F. 1997).

Renewable energy sources (RES) represent the most promising option for the considerable energy needs of desalination processes. Especially in remote and arid regions where there is acute shortage of potable water, RES-powered desalination plants may be an attractive alternative. In most cases fresh water scarcity co-exists with abundant RES potential. Stand-alone RES-powered desalination schemes are selected mainly for remote areas where a grid connection is impossible or very expensive (Voivontas, D. *et al* 2001, 176).

Dincer (2000) argues that the overall benefits of renewable energy technologies are often not well understood and consequently they are often evaluated to be not as cost effective as traditional technologies. In order to assess comprehensively renewable energy technologies, however, some of their benefits that are often not considered must be accounted for. Renewable energy technologies are sometimes seen as direct substitutes for existing technologies so that their benefits and costs are conceived in terms of assessment methods developed for the existing technologies. For example, solar and other renewable energy technologies can provide small incremental capacity additions to the existing energy systems with short lead times. Such power generation units usually provide more flexibility in incremental supply than large, long lead-time units such as nuclear power stations (Dincer, I. 2000, 167).

Despite having such difficulties and challenges, the research and development on renewable energy resources and technologies has been expanded during the past two decades because of the facts listed above. Nowadays, significant progress is made in improving the collection and conversion efficiencies, lowering the initial and maintenance costs, and increasing the reliability and applicability.

In 1995 Shell Petroleum Group predicted that by the year 2050, solar power would be main source of electricity on earth. Several projects have been slowly developing along this timeline. According to Shell Solar, a part of Shell Renewables of Shell Petroleum Group, the costs of providing solar energy have fallen by more than 50% over the last 10 years. Shell Solar is currently building one of the world's largest roof-mounted PV plant on the roof of the new Munich Trade Fair Centre. 7,560 solar modules from Shell Solar are being installed on an area of 63,000 m^2, providing a nominal peak output of 1.058 megawatt (MW) (Shell Solar, 2002-a). At the same time Shell Solar optimises manufacturing to reduce production costs and overheads to be more competitive in world market that is growing at over 30 percent per year with global production capacity increased significantly from 400MWp in 2001 to 760MWp in 2002, nearly doubled in a single year (Shell Solar, 2002-b).

British Petroleum (BP) is currently collaborating with the Philippine government to develop the largest rural infrastructure solar energy project ever. This project aims to bring electricity for the first time to over 400 isolated, small villages, benefiting approximately 700,000 people. The company stresses that in the world's poorest areas, solar energy is often the most cost-effective way to supply basic needs such as lighting, water pumping, and irrigation (BP, 2002).

Since 1996, The World Solar Program coordinated many efforts such as the Arab Solar Energy Programs of Morocco and Oman, the Clean Energy Fund, and promoted the role of private banks in financing renewable energy sources (Irfan, H. 2001).

The real success of renewable energy is its falling costs and increasing efficiency. The cost of electricity produced from wind power has in some European countries fallen as low as 0.3 Euro/kWh, which is cheaper than from gas (Sayigh, A. 2002, 19). Since 1954 photovoltaic technology has progressed very rapidly. The improved efficiency, declining cost and high reliability have contributed to the expansion of PV worldwide. The world accumulated photovoltaic production increased substantially from less than 5000 MW in 1994 to more than 15000 in 2000 and expected to reach 70000 in 2010. More important, the price of photovoltaic power production declined sharply from \$100/w in 1970 to less than \$2/w in 2000 (Sayigh, A. 1999, 27).

PV installations are increasing substantially all over the world and projected to reach one million roofs by the year 2010 in the USA. In Japan, PV installations is planned to provide electricity at a cost of \$0.27 per Kwh which is very close to the electricity from the Japanese utility (Sayigh, A. 1999, 27).

Many of the developing countries have progressively started production and installation the PV units. India shipment was about 6.0 (MW), China was 1.5 (MW), and Singapore and Taiwan shipments were 2.5 (MW). Since 1988, Indonesia has led the way among the developing countries in the use of PV. The country has thousands of villages scattered throughout the thousands of islands with no electricity service. In 1992, 8000 PV systems were installed to serve more than 100,000 people in remote areas. The Energy produced is used mainly for street lighting, public television, radio, telecommunications, security lighting, waterway lighting and individual home lighting. In 1993, Indonesia increased PV usage nationwide to 60 MW, installing about one million PV systems in 27 provinces (Sayigh, A. 1999, 28).

Since 1996, The World Solar Program has coordinated several efforts such as the Arab Solar Energy Programs of Morocco and Oman, the Clean Energy Fund, and has promoted the role of private banks in financing renewable energy sources. Although passive heating of water by solar energy for domestic purposes has provided only 2% of total energy use in Jordan, the savings incurred in the initial phases of its use has already allowed Jordan to pay back its investment costs in the project. Four projects by Friends of the Earth in the Middle East are seeking to provide solar power facilities to communities that lack power and water resources such as the New Basis Village in Egypt and other projects in the area. Some of these systems will include desalination plants and generators to power reverse osmosis water with a peak power of 250kwp. Being able to pump water from rural springs will allow the population of about 5,000 to have solar electricity supply and desalinated water for domestic and communal use (Irfan, H. 2001). Even oil-exporting countries have started to utilise renewable energy technologies. In 1970, Saudi Arabia initiated a solar energy program called the "Solar Village". The project depends on the direct conversion of solar energy into electric power with a capacity of 1000 KW. Such a project supplies electricity to a community of 3500 residents near the capital city Riyadh (Al-Amoudi, A.O. 2002).

3.3.3 Renewable Energy and Urban Future

Droege, P. (2001) argues that the form of the built environment, as cultural, economical and technological system, is deeply affected by the nature of its basic fuel supply. Since the beginning of the 20th century, fossil energy introduced many changes in the general urban structure. These changes were highlighted by the leaders of the great modern design movements: *Futurism* in Italy, *Constructivism* in the Soviet Union, *De Stijl* in the Netherlands, *Das Bauhaus* in Germany, and the declarations of *the International Modern Architecture Congresses*. These movements, and the broader societal changes they express, were supported by the dawn of the fossil machine age. This new age, an outgrowth of earlier stages of the Industrial Revolution when hydro-power was a main driver of textile mill operations, was boosted by the discovery of coals' potential and the discovery of electricity, giving rise to ideas about the mechanization of manufacturing and later the increasingly urban and automated global production-consumption systems of the advanced industrial age, boosting global power consumption at an exponential rate Droege, P. (2001).

Droege, P. (2001) argues that although some local urban systems theoretically are relatively safe of fossil fuel depletion through their reliance on hydro-electric, nuclear or bio-energetic power, no currently utilized alternative energy source alone can help the vast majority of cities world-wide. Therefore, he argues that the only viable option to secure the continuity of urban civilization in this century is a system-wide turn to a broad portfolio of renewable energy sources.

Renewable energy opens up new opportunities not only for urban development but also for the comprehensive development process at both regional and national levels. Renewable energies provide distributed, ubiquitous and redundant renewable power supply systems that are highly needed for the vast undeveloped deserts in many developing countries. Abdel-Aal and Al-Naafa (1998) argue that solar energy will open new opportunities for desert development in countries such as Egypt and Saudi Arabia. They argue that it provides a relatively cheap and ubiquitous source of energy that is necessary for water pumping or water desalinisation and other agricultural, industrial, and residential purposes. Selecting a location will be more dependent on the availability of natural resources and site qualities rather than being close to the national grid. Consequently, it is expected that renewable energies will increase dispersing development activities out of congested over-exploited regions to desert regions.

For urban development, there is no doubt that these technologies will minimise the role of energy supply sources as determining factors in selecting the location and size of future urban settlements. It clearly adds more freedom in locating urban development projects and not to be strictly located near electricity grids. As each house will be self-sufficient, there will be a less need to group residential projects and other urban activities around a power station or near an electricity grid. Therefore, urban settlements are expected to be smaller and more dispersed to more environmentally advantaged locations.

3.4 URBAN UTILITIES

Utilities, especially water purification and distribution and sanitation, are of considerable importance in shaping cities and patterns of urbanisation. And in many cases they were the direct motivation for population concentration around water purification stations. For the economic functioning of water and sanitation units, large-scale stations were usually used, a matter that somehow facilitated the rapid growth of many cities.

To overcome the acute shortage of water supply and sanitation facilities in rural areas and because of the high cost of water and sanitation networks, many private, international development and research agencies have been involved in developing new effective technologies for sustainable water and sanitation systems. The most important of these is the World Bank "Water and Sanitation Program" which is concerned with water and sanitation services for the poor. This program has supported some technologies for provision of water and sanitation in rural communities. Concerning water supply, the program has supported many technologies for utilization of ground water, surface water, and rainwater. Concerning sanitation, the program has supported many technologies, mainly the ecological sanitation and many of the small sanitation units' techniques.

3.4.1 Water Supply Technologies

Water shortage is an increasing problem, especially for developing countries. Many of the Third World cities will face extreme water shortages by the year 2010, threatening the life and health of the inhabitants. Globally, some 80 countries with 40% of the world's population are already suffering from water shortages at some time during the year (UNCHS-Habitat, 1996).

These problems have forced many countries to increase their water supply through developing new technologies for the use of groundwater, surface water, and rain harvest. In addition many technologies have been developed for well-digging, solar and wind powered pumps, water treatment, and storage tanks. These technologies will be of considerable benefit to both rural and small urban communities.

For the use of ground water, many new types of wells have been developed. The most important of these are the solar- and wind-powered pumps. Solar pumps are primarily designed to run directly from the solar panels, but most can also be run from battery systems. The advantages of solar water pumping are many. Solar pumping systems are reliable stand-alone systems that require no fuel and very little attention. Generally, water is needed most when the sun shines the brightest. Solar panels generate maximum power in full sun conditions when larger quantities of water are typically needed. Because of this natural matching effect, solar water pumping is an obvious and economical choice over windmills and engine-driven generators for most locations away from utility power (Sun Pumps, 2002). Solar pumping systems are very suitable for delivering water for farms, ranches, remote homes, cabins campgrounds, third world villages and off-grid industrial and government sites.

Because of the rapid developments and the increased competitiveness, the prices of solar pumps are decreasing sharply. According to ClearSkies company, the current price of the SunPump System 2000 is now starting at $1,500.00 (ClearSkies, 2002). Similarly, the wind-powered water pumps are widely available and maybe more than solar pumps. The most prominent example for the success of wind pumps in developing countries is the 10 kW Bergey wind-electric pumping systems installed at Ain Tolba and Dar el Hamra in Morocco. The system includes a 50 m^3 storage tank to ensure the stable and economical supply of water to 4 villages of 3500 inhabitants (Bergey Windpower, 2002).

Another important water supply technology, which is currently in market, is the Solar RO Unit. The Unit is an innovative solar powered system, which uses reverse osmosis to desalinate salty borehole water. This system is mainly designed for applications in areas with low or limited access to electrical power. The Solar RO Unit is simple to use and once set up it will start automatically when the sun starts to shine. It can provide up to 1600 litres of purified water per day and is easy to use and maintain and is fully portable (SABS, 2002). Also, the AquaTech and AgraTech solar pumping systems for domestic and agricultural purposes are currently available in the market. These two systems can pump from as deep as 2000 feet (ERA Tech. 2002, 33).

Regarding water treatment, many new chemical and biological water treatment systems have been developed to suit rural and small urban communities. Micro-filtration is one of the most effective water-treatment systems and offers an attractive means to remove particulate contaminants such as clay, algae, bacteria and cryptosporidia from drinking water to meet the increasingly stringent regulatory requirements (Meier-Haack, J. *et al* 2003, 585). As many developing countries cannot afford conventional means of water treatment, solar disinfection is a revolutionary system for water-treatment in these countries. Solar disinfection is thought to be a viable water treatment option because of the minimal investment cost and the simple disinfection procedure. This process produces pathogen-free water by exposing water bottles to sunlight. To ensure adequate microbial inactivation, 3–5 hours of solar radiation above 500W/m2 should be available, a matter that is widely available in many developing countries, especially Egypt (Oates, P.M. *et al* 2003, 47).

Another water treatment technology is the Aquanow Portable Water Purification System that produces sterile drinking water from even the most unhygienic and dirty water source. A series of filtration systems form the heart of the unit with U.V. lamps and OZONE employed in the sterilisation process. An output of between 3000 and 4000 litres per hour can be achieved, depending on water quality, using a push button control system (SABS, 2002).

Regarding water-storage tanks; a wide variety of new forms and sizes of different materials are currently available. Many of these types are resistant to both rust and corrosion and are suitable for placing above- or underground. Moreover, they are environmental friendly and of high durability (CorrTech 2002; AGASA 2002; Sydney Water 2002).

3.4.2 Sanitation Technologies

Adequate sanitation is a major problem for many rural and urban communities in developing countries. Today, nearly 3 billion people lack adequate sanitation (WSSCC-WHO. 2000). Most cities, and almost all rural communities, in the Third World cannot afford the necessary resources, in terms of water, money and institutional capacity, to provide a flush-and-discharge sanitation system. Flush-and-discharge approaches can work well and achieve an acceptable level of pathogen destruction. However, in the Third World, sewage is nearly always discharged into the environment at large without treatment (SIDA 1998, 1).

During the last two decades, many international development and research agencies were involved in developing effective and affordable sanitation systems that suit the socio-economic conditions of developing countries. The World Bank, through its water and sanitation program, has developed and applied many sanitation systems that suit the socio-economic conditions in Asia, Africa, and Latin America. Almost all of these efforts focus on developing and promote a sustainable sanitation system, known as “Ecological Sanitation” or “Eco-San” for short.

Ecological sanitation is an approach to sanitation that respects ecological integrity, conserves and protects fresh water resources, promotes dignified and healthy living, and recycles nutrients from human excreta for use in agriculture. It is a cycle - a sustainable, closed-loop system, and applies a new understanding of sanitation as a holistic system based on healthy ecosystems. More important, residual material is recycled and reused as part of an eco-cycle process. External inputs into the system and "waste" that exits the system are reduced to a minimum or eliminated. Very little or no water is used. Excreta are processed and rendered safe close to the point of excretion, pollution is minimized, ground and surface water sources are protected, and nutrients and carbon are returned to the land and made productive. The holistic and ecological approach becomes safe and non-polluting. It can be gender and culturally acceptable, economically feasible, and environmentally sustainable (World Bank. 2002). In this approach, higher temperature degrees of the climate help to get rid of almost all pathogens. In hot climates, almost all pathogens die in two to three weeks, while this may take years in cool, moist, shady environments. This makes ecological sanitation highly suitable for desert countries in Africa (SIDA 1998, 20).

3.4.3 New Urban Utilities and the Urban Future

The available new, affordable, small, simple, and environmental friendly systems for water and sanitation are expected to highly affect the location and the size of future urban settlements.

Regarding location, these systems are expected to decrease the effect of utilities availability as a deterrent factor for locating of housing activities out of congested and environmentally polluted cities. Many people in such cities are willing to move to more environmentally advantaged locations but utilities availability are the main deterring factor, especially in developing countries. Such water and sanitation systems will open up new opportunities and removes one of the main obstacles for inhabiting many desert and rural areas. Moreover, these systems will improve the infrastructure status of many rural communities that could later be upgraded to urban status.

Regarding the possible effects of these water and sanitation systems on the size of future urban settlements, two main expectations arise. First, the large size of population needed for the economic functioning of water and sanitation stations is no longer required. Many of the currently available water and sanitation systems are suitable for small urban or rural communities, and even for single houses. Second, such systems represent an economical alternative for utilities networks in remote rural locations, and sometimes in urban fringes. These advantages make the construction and functioning of small urban communities technically and economically possible.

Conclusion:

In this chapter, the thesis examined the possible urban impacts of transportation, telecommunications, renewable energy and urban utilities technologies. Through this analysis, the thesis came to some important conclusions.

First, advancements in transportation technology have resulted in increasing mobility, improving accessibility, increasing diffusion and falling costs of transportation facilities, and space-time convergence. These changes have significantly influenced city's size, form, structure, and function within the regional settings. The urban impacts of transport technology at the regional level were profound. In the pre-industrial era, cities were in a balanced relationship with each other and with the rural surroundings. This situation explains why these cities were of similar size. Only during the Industrial Revolution and since the introduction of new transportation modes that affect the regional setting, especially the railways and the automobile, such balance had significantly changed. New technologies of high-speed ground transport, automated transit and 'smart streets' (intelligent Vehicle-Highway Systems) are expected to be of high influence in shaping the future of urban development.

Second, the increasing diffusion of information technologies is not only affecting where people work and live, but also changing the character of activities that occur in the home, workplace, and automobile. Information and telecommunications technologies introduced many new, but widely used, prefixes especially *Tele…* and *Distance…* (telework, telecommute, telemedicine, tele-shopping, distance education, …etc). These technologies have also changed the home environment, function and design. Many of public services that were usually provided within designated public buildings such as schools, libraries, or prisons are now being provided in the home. The diffusion of information technologies is expected to drastically increase the complexity of cities through increasing the numbers and types of interactions among individuals, firms, technical systems, and the external environment. Information systems are opening new opportunities for new combinations of people, equipment, and places. Therefore, a dramatic change in the spatial organization of activities within cities and large metropolitan regions is highly expected.

Although there are some predictions that telecommunications will lead to "death of distance" and that "death of distance" will lead to "death of cities", many analysts assert that telecommunication could both centralize and decentralize urban activities. Peter Hall (1999) considered the argument that the 'death of distance' will lead to the 'death of cities' as exaggerating simply because it ignores the significance of face-to-face contact and the continuing significance of agglomeration. Moreover, while telecommunications will significantly shrink the space and consequently reduce the effect of distance as a deterrent factor, advantages of site location will continue to be influential. This will facilitate the development of rural, remote and under-developed regions and incorporating them in the national development plans.

Third, renewable energy is the main effective alternative for the depleting fossil energies because it is abundant, with well-established technology and that its main ingredients are completely free. The cost of power generation from renewable sources has dropped significantly over the past decade and several technologies are now cost effective not only for off-grid applications but for grid-connected power as well. Many of the developing countries, such as Indonesia, India, China, Egypt and Morocco, have progressively started production and installation the PV units. Renewable energy opens up new opportunities not only for urban development but also for the comprehensive development process at both regional and national levels. Renewable energies provide distributed, ubiquitous and redundant renewable power supply systems that are highly needed for the vast undeveloped deserts in many developing countries. For urban development, there is no doubt that these technologies will minimise the role of energy supply sources as determining factors in selecting the location and size of future urban settlements. It clearly adds more freedom in locating urban development projects and not to be strictly located near electricity grids.

Fourth, new utilities technologies are of considerable importance in shaping cities and patterns of urbanisation. Technology advancements in areas of water supply and the use of solar pumps are rapidly advancing. In the area of sanitation, the World Bank supports the ecological sanitation approach which is designed to suite the need on remote location. Such approach respects ecological integrity, conserves and protects fresh water resources, promotes dignified and healthy living, and recycles nutrients for use in agriculture. Because of the rapid developments and the increased competitiveness, the prices of many of these technologies are decreasing sharply. Advancements in urban utilities technologies are expected to affect the urban environment in two ways. First, the large size of population needed for the economic functioning of water and sanitation stations is no longer required. Many of the currently available water and sanitation systems are suitable for small urban or rural communities, and even for single houses. Second, such systems represent an economical alternative for utilities networks in remote rural locations, and sometimes in urban fringes. These advantages make the construction and the functioning of small urban communities technically and economically possible.

The analysis reveals that although new urban utilities technologies will have considerable impacts on existing settlements, they open up new opportunities for managing the urban future in many of the developing counties. Also, these technologies will facilitate the spread of development activities to remote and under-developed regions.

In the next chapter, the thesis starts by a theoretical examination of the relationship between technology and patterns of urban change. To investigate the relationship between the technology status of a society and patterns of urban change prevailing in that society, the thesis empirically examines the main differences in patterns of urban change in countries of different technological statuses (developed, less, and least developing countries). Then, the thesis examines urban change patterns in Africa, as a group sample of developing countries.

TECHNOLOGY AND PATTERNS URBAN CHANGE IN DEVELOPING COUNTRIES

Introduction:

During the last three centuries, urban development in both the developed and developing countries had faced many physical and socio-economical changes. The spatial distribution of urban settlements as well as the size of these settlements had changed significantly during this period. Such urban changes had been highly affected by the successive influential socio-economic changes that technology was one of the main driving forces behind them.

This chapter aims to investigate the relationship between technology and patterns of urban change and to identify the main differences in patterns of urban change in technology advanced countries and developing countries. It also aims at defining the main patterns and problems of urban change in developing countries. In doing so, it starts by discussing the main arguments about technology and patterns of urban change. In this regard, the thesis focuses on changes in the size of urban settlements and the concentration of urban population, as they are the most prominent features of urban change in developing countries. Then, and to investigate the relationship between the technology status of a society and patterns of urban change prevailing in that society, the thesis empirically examines the main differences in patterns of urban change in countries of different technological statuses (developed, less, and least developing countries). Finally, the thesis examines the main characteristics and factors affecting urban change patterns in Africa, as a group sample of developing countries.

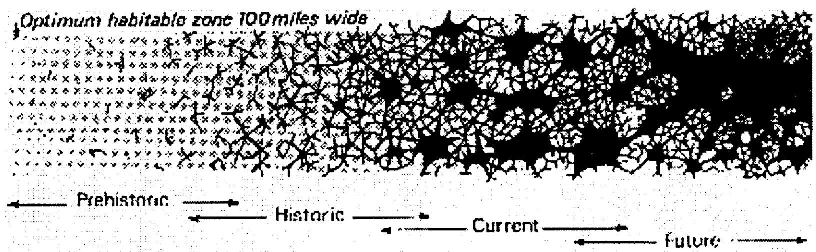
4.1 TECHNOLOGY AND PATTERNS OF URBAN CHANGE: THEORETICAL ANALYSIS

The twentieth century had been an age of urban transition. By the end of that century, more than half of the world's people were living in cities. Two hundred years ago (around 1800 A.D.) there was only one city in the world - London - with a population of one million. At the beginning of the twentieth century, almost a hundred years ago, there were three cities with a population of one million or more. By the end of it, there are 281 cities with a population of over 1 million (UNCHS-Habitat 2002).

During the last two hundred year, all characteristics and patterns of urbanisation, in both the developed and developing countries, had faced serious changes. These changes were profound on both the city and the system of cities. Therefore, the research will focus on changes in the size and the spatial distribution of urban settlements, as they were the most prominent features of urban change affected by technological change experienced during the last two centuries.

4.1.1 Changes in the Size of Urban Settlements

Throughout history, the size of urban settlements has undergone a series of change and was on of the striking features of urban change. Potter (1985, 26) and Kolars and Nystuen (1974) argue that during the prehistoric period, human settlements were first non-permanent and later small and isolated. But, for later historic and current eras, cities grow bigger and primate cities start to appear. Moreover, they argue that cities will continue to grow bigger and may join together forming large megalopolis (see Figure 4.1). In that sense, the shift from non-permanent to permanent settlements was a direct result to the shift to practicing agriculture, which represents the first wave of technological development.

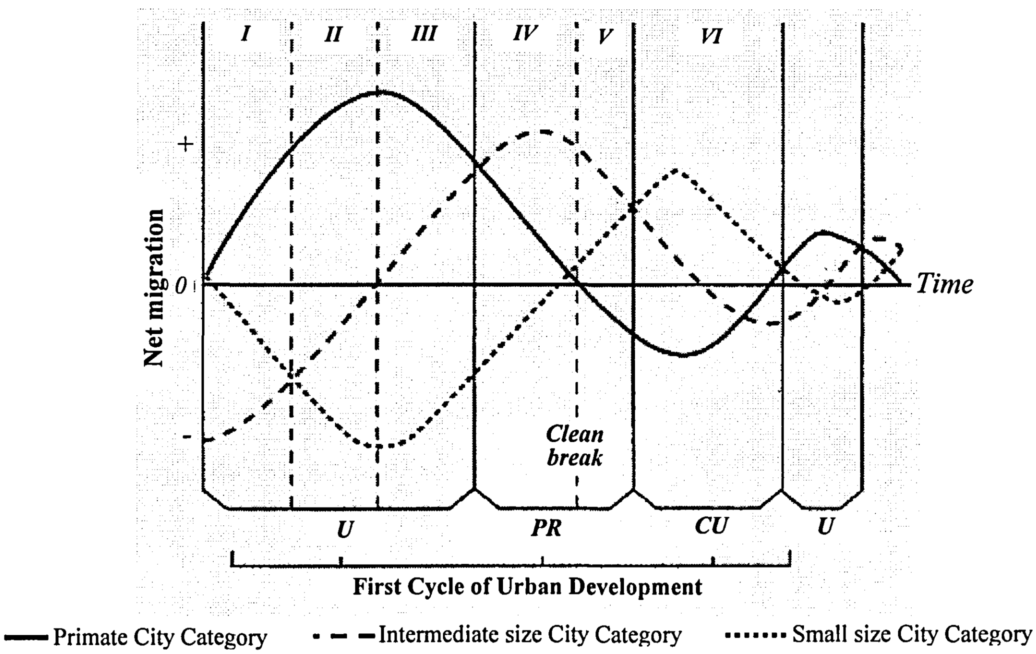


Source: Kolars, J.P. and Nystuen, J.D. 1974, cited in: Potter, R.B. (1985, 27)

Figure 4.1: Historical changes to the physical form of settlements

Based on the principles of central place theory (Christler 1966; Lösch 1954), the roles of market forces (Isard 1972), locational attributes (Richardson 1973; Ullman 1958), technological innovation diffusion (Berry 1972; Hägerstand 1965; Pred 1977; Stephens and Holly, 1980), development axes in the development of urban systems (Geyer 1987; Stewart, 1958; Berry 1972; Sheppard 1982), and agglomeration economies (Hirschman 1958; Myrdal 1957; Pred 1966); Geyer and Kontuly (1993, 158) have identified five stages in the development of urban systems. The classification of these stages is mainly based on the relative size of settlements in each stage and the corresponding spatial patterns of population movement – which depends, to large extent, on the nature and level of technology prevailing in each stage. Michael Pacione (2001, 75) grouped these five stages of change in settlement size into three general phases: the primate city phase, intermediate city phase, and small city phase. Each of these stages was mainly formulated according to successive waves of technological change.

Figure 4.2 presents a summary of the three main phases of urban growth and shows the net migration gains and losses for primate, intermediate-sized, small-sized cities over time. In addition, it helps to compare the positions of different developed and developing countries on the same graph at different points in time as they advance through consecutive cycles of urban development. Geyer and Kontuly (1993, 166) argue that these three phases represent only the first cycle of urban development and that the conclusion of the small city stage signifies the start of a new cycle. They argue that during this new cycle a second sequence of major metropolitan, intermediate-sized, and small city growth will occur.



I, Early Primate city stage; II, Intermediate primate city stage; III, Advanced primate city stage IV, Early Intermediate city stage; V, Advanced intermediate city stage; VI, Small city stage.
U = Urbanisation; PR = Polarisation Reversal; CU = Counter Urbanisation.
Source: Geyer, H. and Kontuly, T. 1993, 165; and Champion, T. 2001, 146.

Figure 4.2: Generalised Stages of Differential Urbanisation

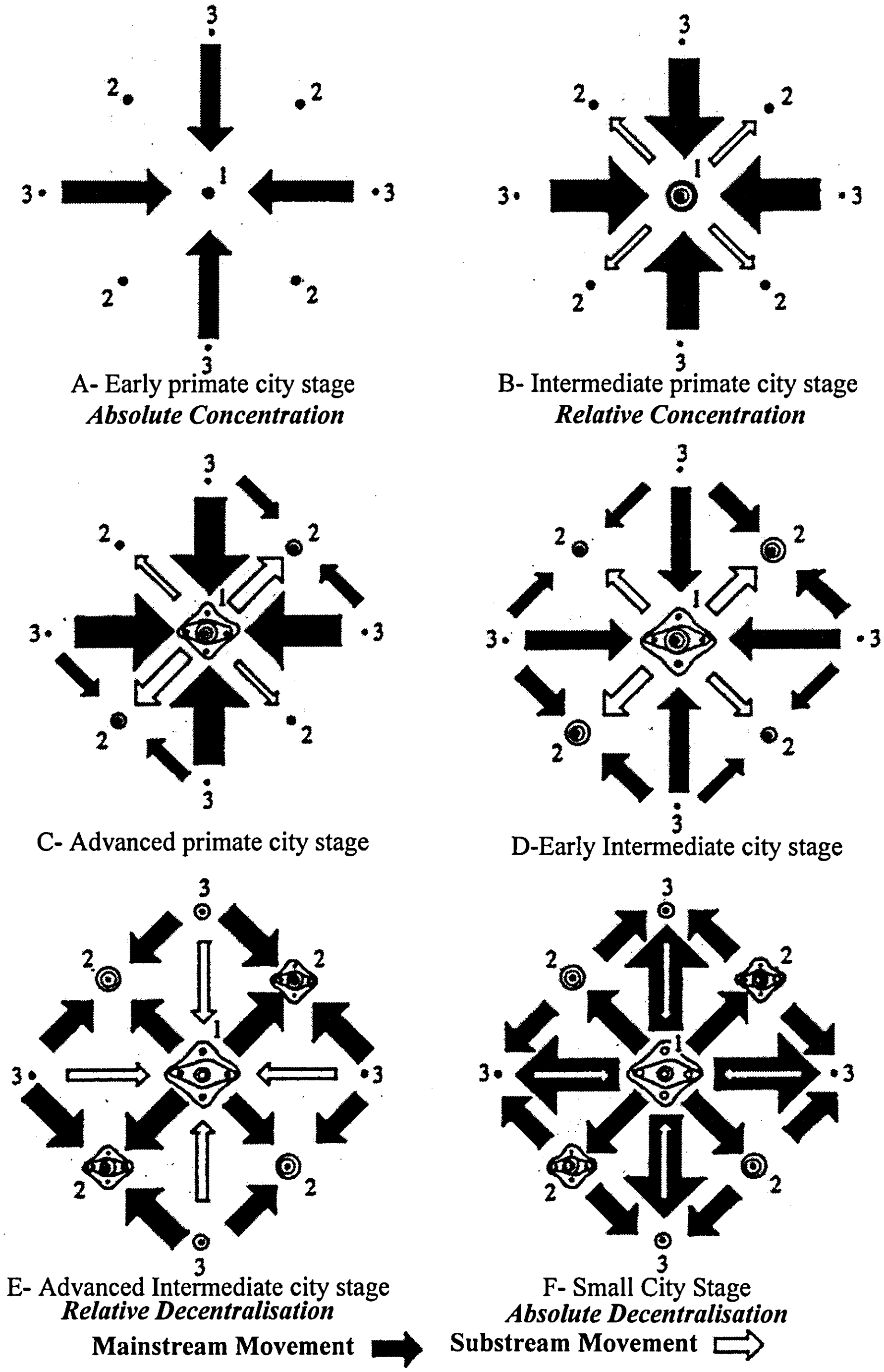
4.1.2 Spatial Changes in Urban systems

Urban systems spatially change through time in a variety of ways as the social, economic, technological and geographical conditions around them evolve. Developments in transport, railroads, the automobile and aircraft technologies, have considerably modified the locational advantages of existing urban centres, have created opportunities for new centres in previously less accessible areas, and have permitted different spatial patterns both within cities and the surrounding hinterlands. Advances in communications have similarly permitted greater flexibility in the location of productive facilities. Certain high-technology industries need no longer to be situated in cities or even in close proximity to them (Oakley and Cooper 1989, 347).

Peter Hall (1985, 24) stressed the spatial effects of technological development, especially in transportation and telecommunications, on migration flows on both the inter-regional and intra-regional levels. He argues that at urban inter-regional level, the effect has been to shrink effective distance through big reductions in the time and cost of communication. Transport achievements have brought provincial cities effectively closer to national capitals. Generally, the main effect has been to reduce the role of provincial cities to subsidiary centres, controlled from national capitals. At intra-regional level, he argues that the effects were more varied and complex as the level of investment in transportation and telecommunications varies considerably from country to country. But, he stressed that these achievements have facilitated the emergence of primate cities and new towns of national impact in many countries.

The differential urbanisation model of Geyer and Kontuly (1993), as well as most of urban development theories, acknowledge the role of the regional forces, mainly inter- and intra-regional migration patterns, in determining the size and the spatial diffusion patterns of urban settlements (Hall, P. 1985; Pacione, M. 2001; Elliot, J. 1997; Eke, E.F. 1982; Jefferson, M. 1939; Berry, B. 1976).

Emphasizing the role migration in urban change, Geyer and Kontuly (1993, 171) elaborated more on their model of differential urbanisation explaining the role of migration flow on the growth of cities and the development of urban systems. They argue that more affluent, better-educated people usually tend to deconcentrate in search for better living conditions (environmentalism), while less affluent people tend concentrate in search for better livelihood (productionism). If a small proportion of a country's population is wealthy while the majority is less well to do, then population majority will tend to concentrate while the minority will tend to deconcentrate. Figure 4.3 presents the expanded model with both mainstream and substream migration flows.



Source: Geyer, H. and Kontuly, T. 1993, 170.

Figure 4.3: Conceptual Phases of Urban Change Process

During the last decade, an estimated 16 million people migrate each year from rural to urban areas of developing countries, excluding China, accounting for about half of recent urban growth. In addition, about 2 to 4 million people migrate internationally each year. Another 18 million people—over five times the number 20 years ago—have fled their own countries, as refugees. Also, about 20 million people are internally displaced (Gardner and Blackburn 1996). Such massive population movements will certainly affect the future of urban development in developing countries.

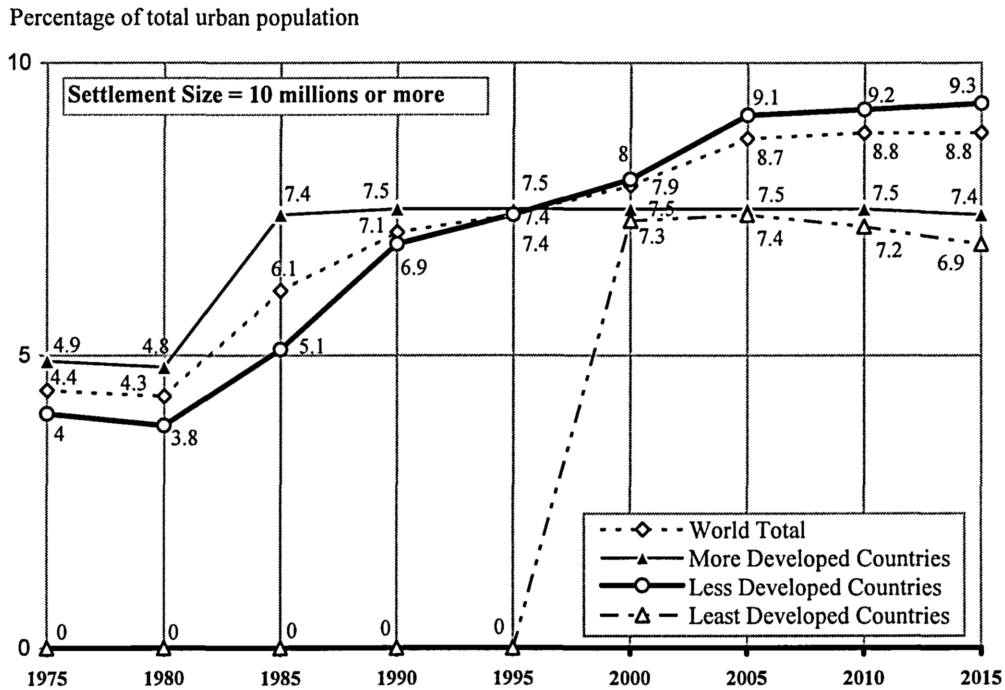
In investigating the role the role of population migration in altering urban systems, many studies have identified several phases or stages of urban development. The development-phasing approach is first devised by Peter Hall (1971), who suggested a four-stage model of metropolitan-area development, beginning with a period of centralisation whereby people become more concentrated in the core at the expense of the ring, continuing with periods of relative and then absolute decentralisation in which the core grows less rapidly than the ring and then experiences absolute loss of population to the ring, and ends up with a stage in which the metropolitan area as a whole moves into overall decline because the core's loss becomes greater than the ring's gain. Klaassen and Scimeni (1981, 18) added an additional feature to this approach, which is the idea of recurring cycle. According to this idea, after the phase which defined by Hall (1971, 118-19) as 'decentralisation in decline', there follows a process of reconcentration which leads on to a second cycle beginning with renewed growth overall and centralisation within the core (Champion 2001, 147). This cyclic model is further developed incorporating extra elements by Van der Berg, L. *et al* (1982). Later, Geyer and Kontuly (1993, 171) introduced the differential urbanisation model, arguing that urban systems have went through consecutive stages of urbanisation, suburbanisation, counterurbanisation, and reurbanisation. Each of these stages is characterised by different spatial patterns which is shaped by different socio-economic and technological forces.

4.2 TECHNOLOGY LEVEL AND PATTERNS OF URBAN CHANGE: INTERNATIONAL DIFFERENCES

In order to investigate whether technology level prevailing in a society could influence the urban pattern in that society, the thesis tries in this section to examine the main differences in urban patterns in both the developed and developing countries. The thesis focuses on urban settlements' size and urban population concentration, as they are the main patterns of urban change in developing countries. This analysis also aims to give a clear idea about the main patterns and problems of urban change in developing countries. In this analysis the thesis adopts the UN development classification of countries as more, less, and least developed. Although such classification is set according to the development status in general, it reflects the technological status of countries and usually matches with other classifications such as industrial and non-industrial. Moreover, such classification of more, less, and least developed countries presents different levels of technological status, a matter that is useful in drawing a general guideline about the relation between technology level and patterns of urban change.

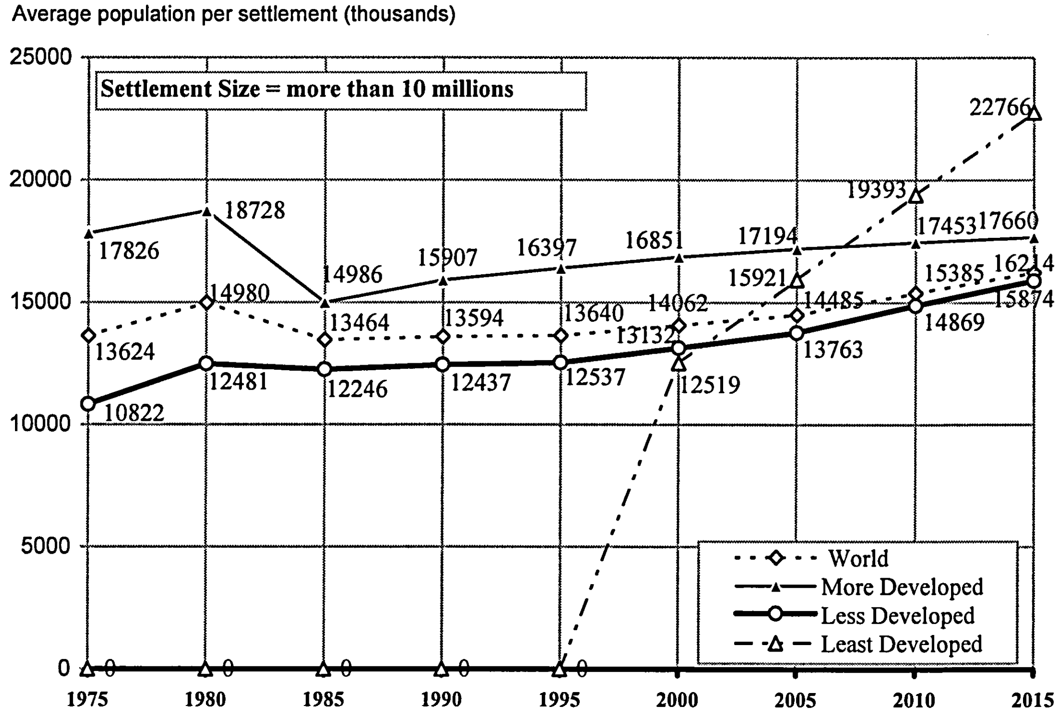
The thesis extensive analysis of urban change patterns in all world regions reveals two main important facts. First, is that developed and developing countries present different trends regarding the shares of different sizes of settlements of their national urban populations. In more developed, and more technically advanced countries, the share of large urban settlements is considerably decreasing and the share of smaller ones is increasing. This is while almost all developing regions present a different pattern of increasing share of large settlements and sharply declining share of smaller ones. Second, is that the developed and developing countries present contrasting trends regarding the average size of settlements. While the average size of large urban settlements experiences a declining rate of growth in more developed countries, it experiences a mounting growth rate in developing countries. This situation explicitly indicates the increasing rate of urban concentration in developing countries.

For large urban settlements of more than 10 million inhabitants, their share of the total urban population was increasing sharply in both less and least developing countries while it was declining in more developed countries during 1985-2000 period. According to UN population statistics, this trend is expected to continue during 2000-2015 period (Figure 4.4). Moreover, the average size of these settlements is growing at a rapid rate in the least and less developed countries while it is growing at very low rate in more developed countries (Figure 4.5). This is despite the fact that the number of these settlements in more developed countries had remained constant at four settlements since 1985 and expected to remain constant till 2015, while in less developed countries the number of these settlements (of more than 10 million inhabitants) has grown from 5 in 1985 to 12 in 2000 and expected to reach 17 in 2015. This situation demonstrates the clear difference in the role of these settlements between the more developed and less and least developed countries. It also proves the increasing primacy of large urban settlements, and consequently urban concentration in large metropolitan areas in less and least developing countries.



Source: Prepared by the researcher; Data compiled from: UNPD, 2002. World Urbanization Prospects: The 2001 Revision, 173.

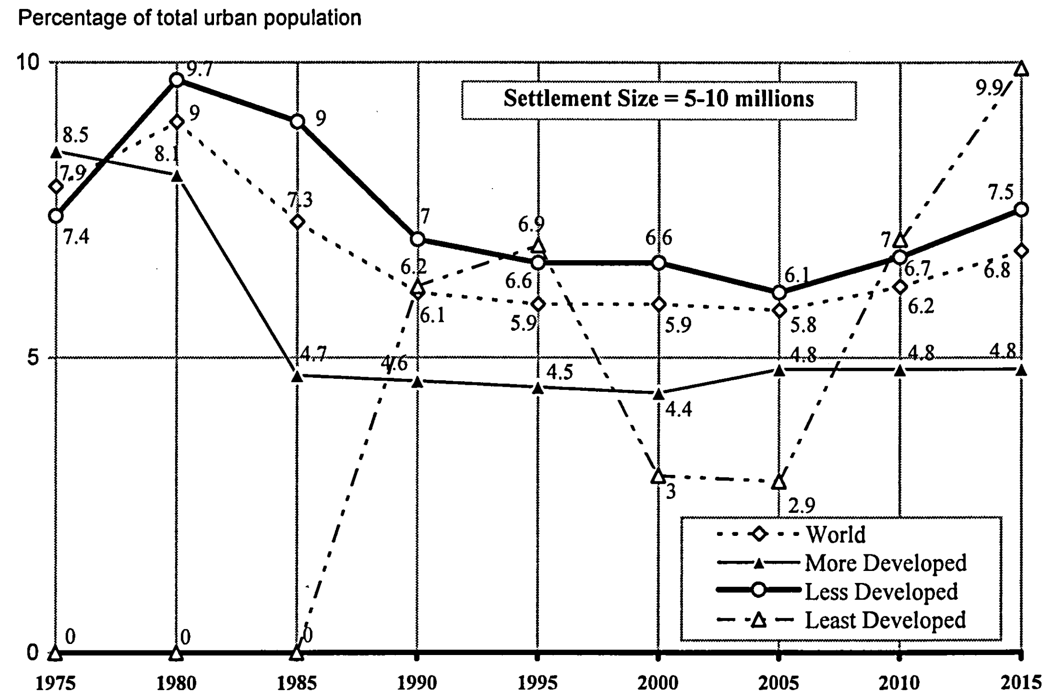
Figure 4.4: Urban population shares of urban settlements of more than 10 million inhabitants



Source: Prepared by the researcher; Data compiled from: UNPD, 2002. World Urbanization Prospects: The 2001 Revision, 173.

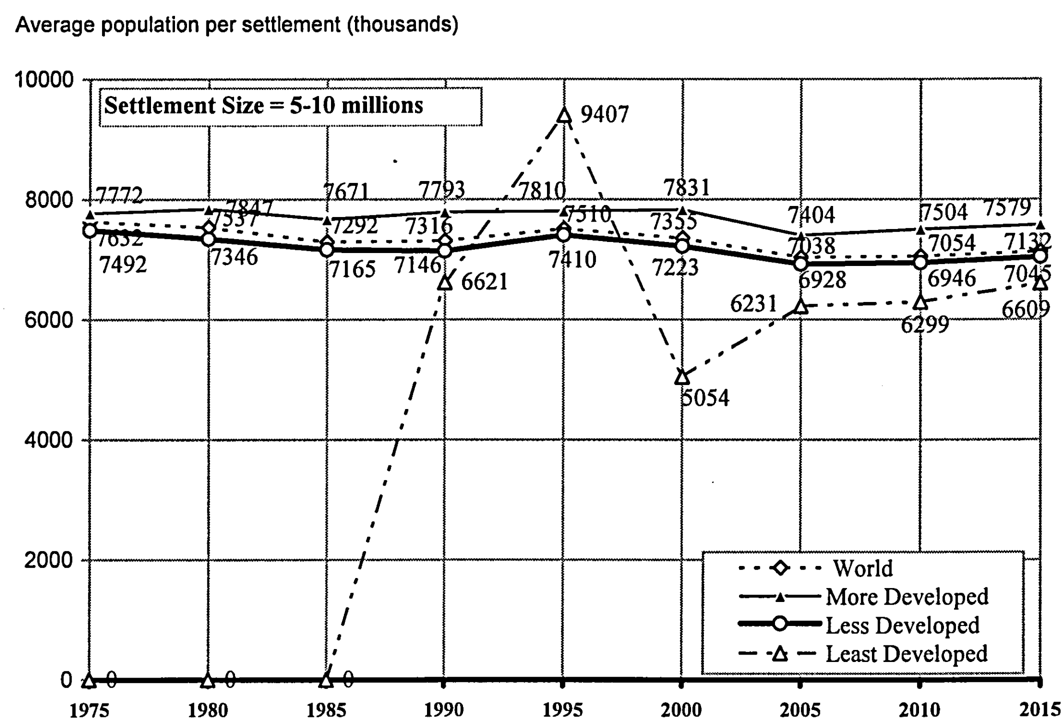
Figure 4.5: The average size of urban settlements of more than 10 million inhabitants

Urban settlements of 5-10 million inhabitants and those of 1-5 million inhabitants present similar trends, though at lower rates, regarding their shares of total urban population and regarding changes in their average size during 2005-2015 period. In least and less developing countries, settlements of 5-10 million inhabitants show that their shares of total urban population are growing at higher rates than that of more developed countries (Figure 4.6). Moreover, the average size of these settlements is growing at a rapid rate in the least developed countries while it is growing at low rates in both less and more developed countries (Figure 4.7). This is despite the fact that while the number of settlements of this size category has declined in more developed countries from 8 in 1975 to 5 in 2000 and expected to be 6 in 2015, it has increased in less developed countries from 8 in 1975 to 18 in 2000 and expected to be 31 in 2015. For least developing countries, this number was only 1 in 1990 and expected to reach 5 in 2015. This situation demonstrates that settlements of 5-10 million inhabitants have an increasing role in urban system of least and less developing countries more than that in more developed countries.



Source: Prepared by the researcher; Data compiled from: UNPD, 2002. World Urbanization Prospects: The 2001 Revision, 173.

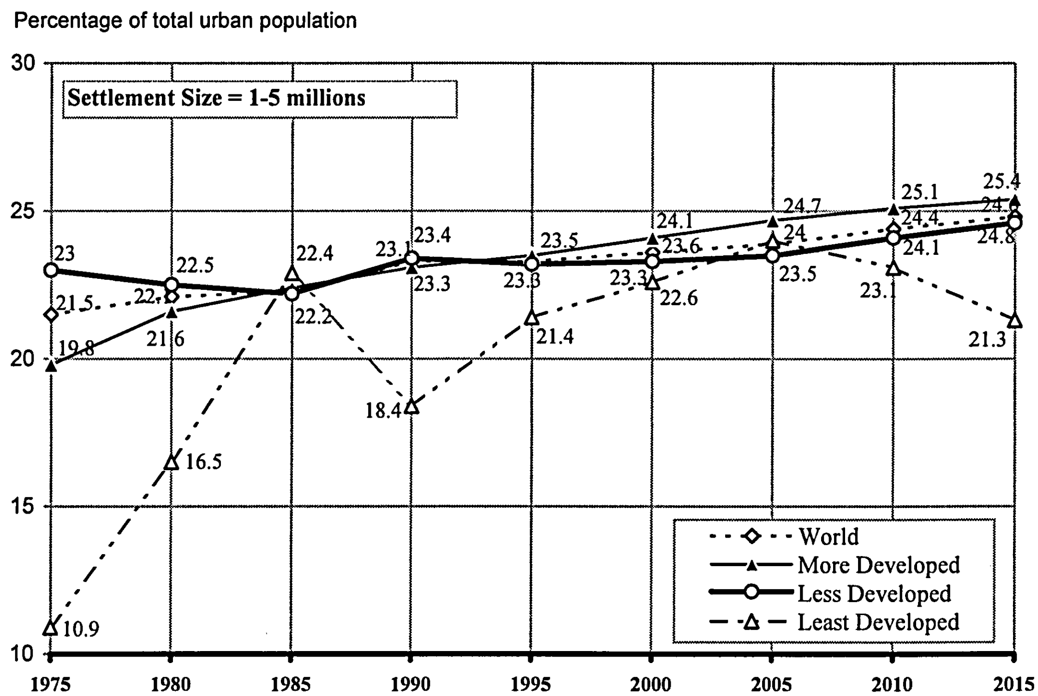
Figure 4.6: Urban population shares of urban settlements of 5-10 million inhabitants



Source: Prepared by the researcher; Data compiled from: UNPD, 2002. World Urbanization Prospects: The 2001 Revision, 173.

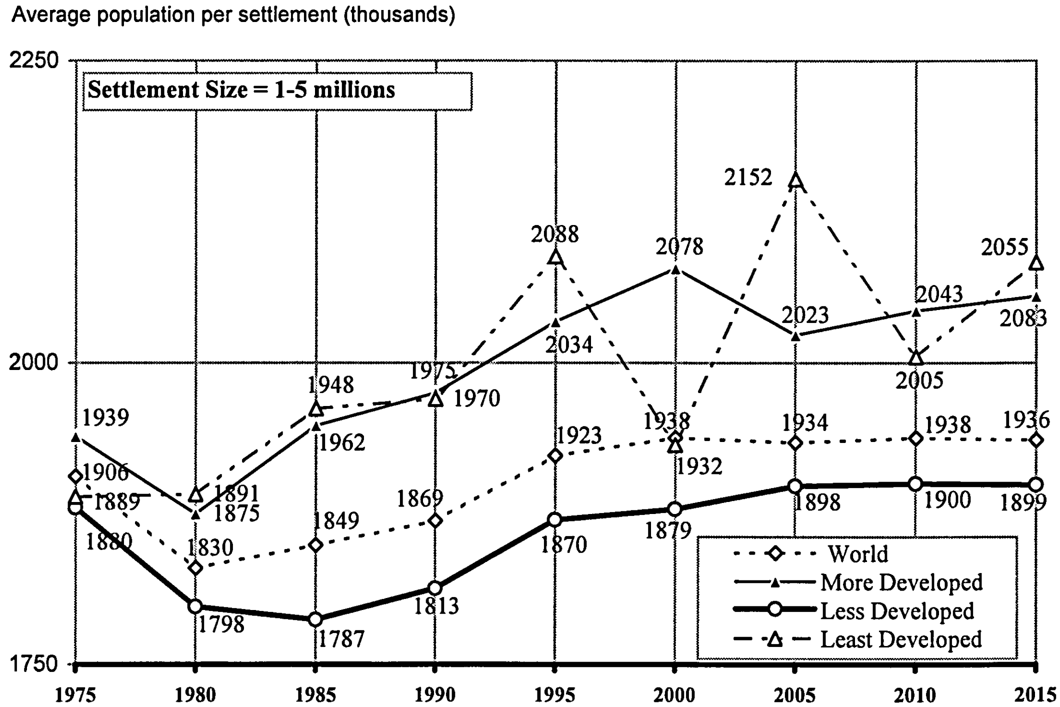
Figure 4.7: The average size of urban settlements of 5-10 million inhabitants

On the other hand, smaller settlements of less than 5 million inhabitants show a different trend regarding their shares of total urban population and regarding changes in their average size. In least and less developed countries, these settlements show that their shares of total urban population are declining at higher rates than that of more developed countries. For settlements of 1-5 million inhabitants, their share of total urban population is the highest in more developed countries and increasing in both more and less developing countries while it is declining in least developing countries (Figure 4.8). Moreover, the average size of these settlements in more developed countries is declining during 2000-2005 and expected to increase at a modest rate till 2015 (Figure 4.9). This shows that urban system in these countries experience more urban deconcentration in this category of settlements. In contrary, the average size of these settlements continues to increase at higher rates in least developed countries.



Source: Prepared by the researcher; Data compiled from: UNPD, 2002. World Urbanization Prospects: The 2001 Revision, 173.

Figure 4.8: Urban population shares of urban settlements of 1-5 million inhabitants

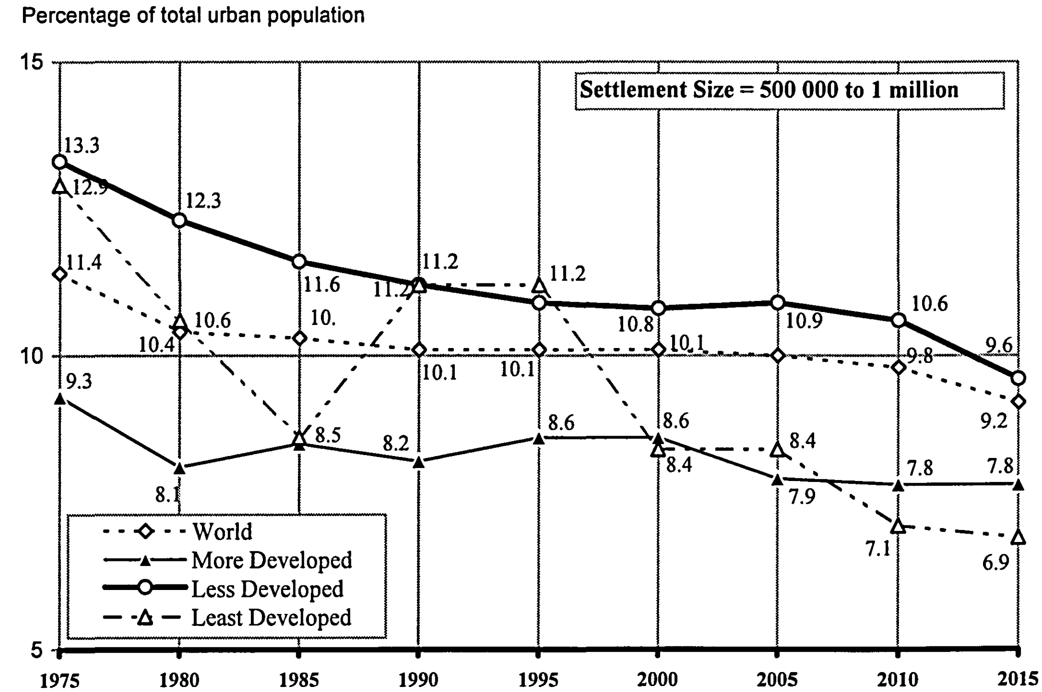


Source: Prepared by the researcher; Data compiled from: UNPD, 2002. World Urbanization Prospects: The 2001 Revision, 173.

Figure 4.9: The average size of urban settlements of 1-5 million inhabitants

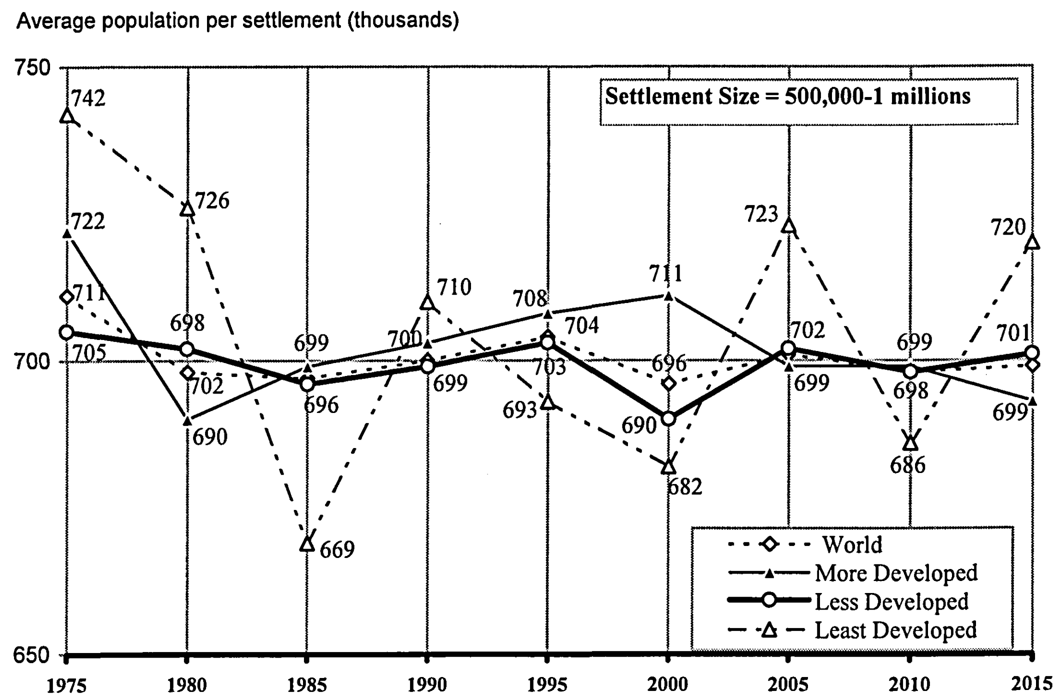
Settlements of 500,000-1 million inhabitants show similar trends as their share of the total urban population is decreasing in both less and least developed countries while increasing in more developed countries (Figure 4.10). Also, the average size of these settlements is expected to decline in more developed countries during 2010-2015 period while it is expected to increase during the same period in both the less and least developed countries (Figure 4.11). The decreasing size and the declining share of this settlement category of total urban population in less and least developed countries show that this settlement category is less effective in their urban systems.

This trend is more evident in settlements of less than 500,000 inhabitants. Their share of the total urban population is sharply declining in both less and least developed countries while almost unchanged in more developed countries (Figure 4.12).



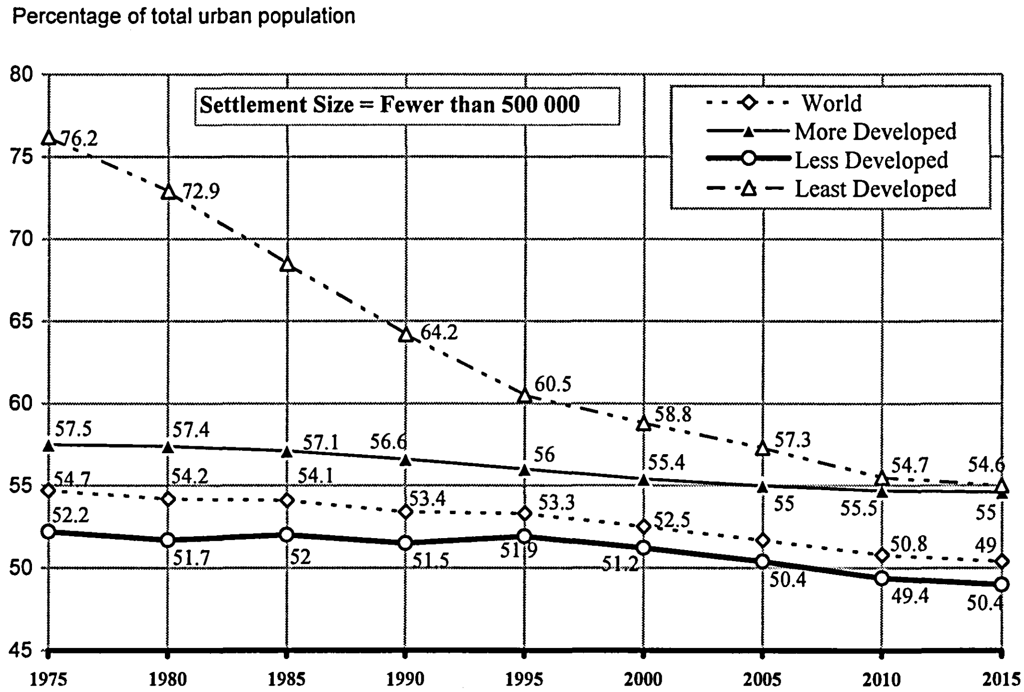
Source: Prepared by the researcher; Data compiled from: UNPD, 2002. World Urbanization Prospects: The 2001 Revision, 173.

Figure 4.10: Urban population shares of urban settlements of 500,000-1 million inhabitants



Source: Prepared by the researcher; Data compiled from: UNPD, 2002. World Urbanization Prospects: The 2001 Revision, 173.

Figure 4.11: The average size of urban settlements of 500,000-1 million inhabitants



Source: Prepared by the researcher; Data compiled from: UNPD, 2002. World Urbanization Prospects: The 2001 Revision, 173.

Figure 4.12: Urban population shares of urban settlements of less than 500,000 inhabitants

This analysis clearly shows that there are contrasting trends regarding the growth of different settlement-size categories in more developed countries (usually of more technological capabilities) and those in less and least developed countries. This situation demonstrates that the prevailing level of technology in a society is of considerable impact on shaping urban change patterns in that society. More developed countries show declining rates in the growth of large and medium cities and higher rates in the growth of smaller cities compared to both less and least developing countries.

In addition, this analysis clearly demonstrates that urban systems in developing countries suffer growing urban structure imbalances regarding the ever-increasing size of large metropolitan areas and the mounting trend of urban concentration and the declining role of small urban settlements. Controlling such imbalances requires the adoption of rational urban development approaches that take into account the future impacts of technology and that employ these technologies in overcoming such imbalances.

4.3 PATTERNS OF URBAN CHANGE IN DEVELOPING COUNTRIES: THE CASE OF AFRICA

After reviewing the main differences of urban change patterns in developed and developing countries, presented in Section 4.4, and to provide a more detailed examination of these issues, the thesis tries in this chapter to closely investigate urban change patterns in Africa, as a group sample of developing countries, giving more emphasis for patterns of urban change in Egypt and South Africa as they are of the largest urban populations in Africa and having the first two 'Mega Cities' in the continent (UN, DESA, 2002). In addition, the thesis tries in this chapter to discuss the role of globalisation and economic growth in shaping urban change patterns in Africa. Also, it highlights the main urban problems and the quality of life in large cities of Africa.

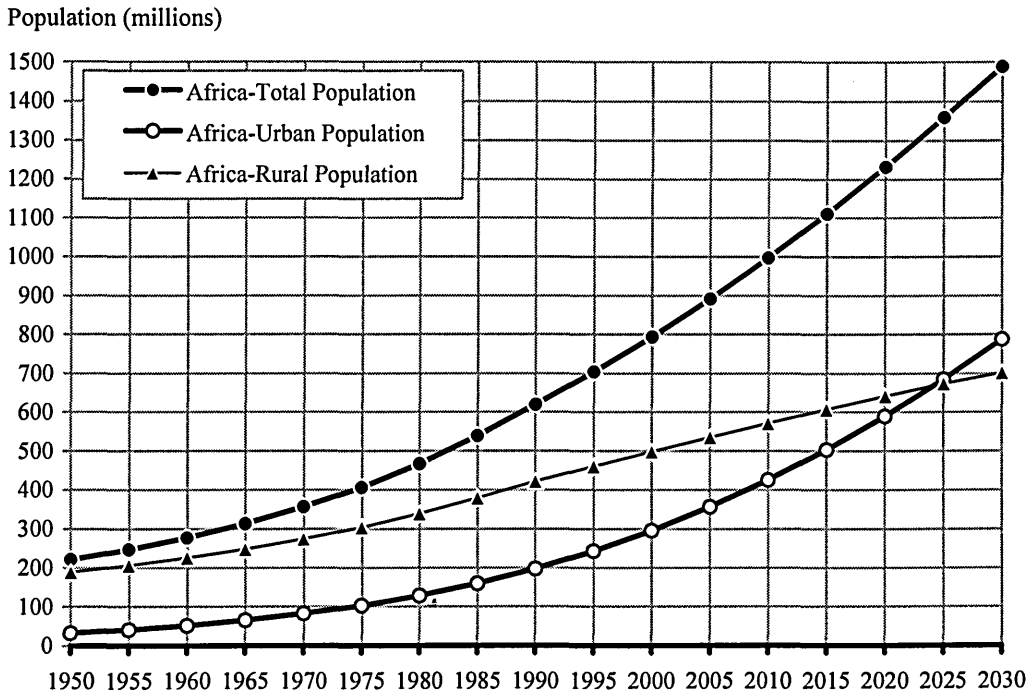
4.3.1 Patterns of Urban Change in Africa

Usually, residents of urban areas in African countries are regarded as fairly well off compared with their rural counterparts. Their incomes were reported to exceed those generated in rural economic activities. Therefore, rural-urban income gap was regarded correctly as the main cause of rapid urbanization, which was largely fuelled by rural-urban migration. Higher income, however, was not the only advantage that the urban populace was deemed to have, higher living standards is another important factor. Access to superior services, such as piped water, schools, and clinics, was a significant advantage. Another important factor was that African governments tended to subsidize urban food prices. All these factors have simultaneously fostered urbanisation in Africa.

As a result, urban systems in almost all African countries have faced many unprecedented changes during the last five decades. Although these changes were similar to those experienced in all developing countries, the rate and the scale of urban changes in Africa were very much beyond the capacity of the socio-economic systems of many African countries. Rapid urbanisation and the concentration of urban population and the emergence of primate cities are the main patterns of urban change in Africa.

4.3.1.1 Rapid Urbanisation:

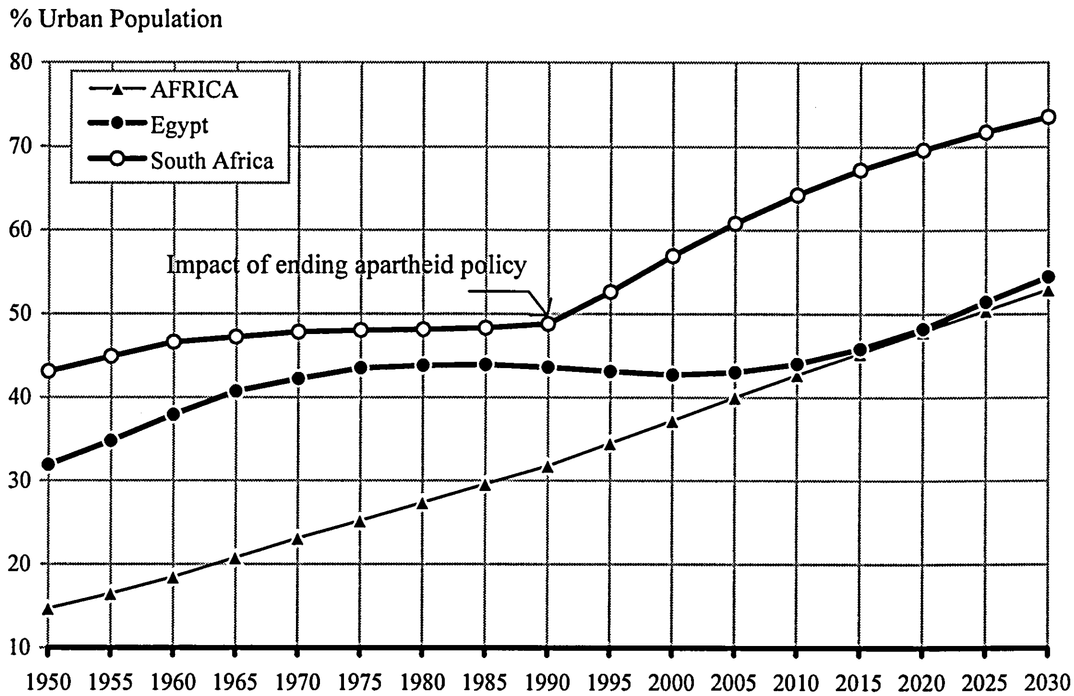
At the beginning of the 1960s less than a fifth (18.5 per cent) of Africa's population lived in urban areas. This percentage has been doubled to reach 37 per cent in year 2000 and expected to reach 53 per cent in year 2030. During 1995-2000, the annual urban population growth rate was 3.91 while the total population annual growth rate was only 2.41. The total urban population of the continent has increased from only 51 millions in 1960 to 295 millions in 2000 and expected to reach 787 millions in 2030 (Figure 4.13).



Source: Prepared by the researcher; data from: UN, DESA, 2002

Figure 4.13: Growth of urban and rural populations in Africa during 1950-2030.

In 2001, Egypt has had the largest urban population in the continent (29.5 millions), followed by South Africa (25.3 millions) (UN, DESA, 2002). The percentage of urban population in the two countries is increasing rapidly. Figure 4.14 clearly depicts that the average percentage of urban population in Africa is increasing sharply since 1950. However, such percentage is higher for both South Africa and Egypt during 1950-2002 period and expected to further increase till 2030.



Source: Prepared by the researcher; data from: UN, DESA, 2002

Figure 4.14: Growth of urban population percentage in Egypt and South Africa during 1950-2030.

Although the percentage of urban population in Africa is low when it is compared to that in developed countries, urban growth rates in Africa have been consistently among the highest in the world over the past 35 years, approximately the period since most African countries were decolonized and colonial restrictions on rural-urban mobility and migration rescinded (Simon, 1997). Also, the increasing level of industrialisation in many of the African countries, such as South Africa and Egypt, is one of the main driving forces behind such trend.

4.3.1.2 Urban Primacy and Concentration of Urban Population:

The rapid rate of urbanisation in Africa has been accompanied by a more rapid rate of increase in the size of many of its large cities. In 1950, there were only two cities in Africa with more than 1 million inhabitants (Cairo and Alexandria). By 1960, Johannesburg and Casablanca had also reached 1 million; while by 1970 there were eight cities of this size - four in North Africa, two in South Africa, and only two elsewhere in the continent: Lagos and Kinshasa. The number of these cities has grown to 15 in 1980, to 35 in 2000, and expected to reach 61 in 2015. The number of cities of more than 5 million inhabitants has grown from 1 in 1975 to 3 in 2000, and expected to reach 5 in 2015 (UN, DESA, 2002).

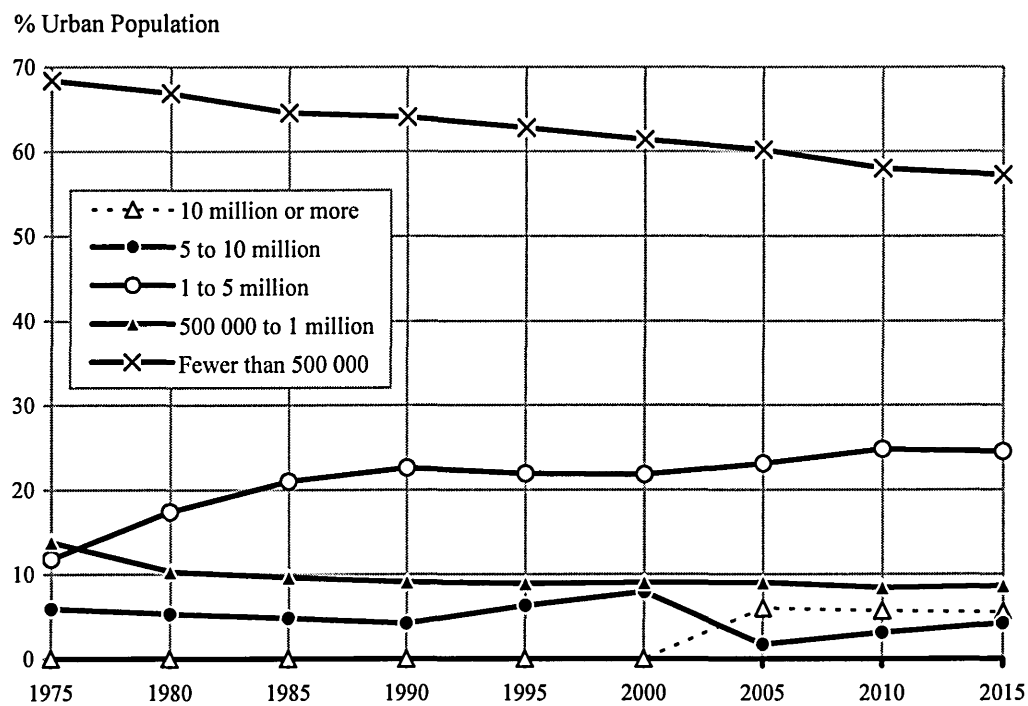
Another striking feature of Africa's urbanization is that although the number of its mega-cities is increasing, the size of these cities is considerably increasing UN, DESA, 2002. While the average size of settlements of more than 1 million inhabitants is rapidly increasing, the average size of settlements of less than 1 million inhabitants is declining (Table 4.1).

Table 4.1: Change in the average size of different size-categories of cities in Africa 1975-2015 (1000).

	1975	1980	1985	1990	1995	2000	2005	2010	2015
10 million or more	0	0	0	0	0	0	10614	12197	13748
5 to 10 million	6079	6843	7666	8296	7673	7727	6231	6608	7034
1 to 5 million	1733	1596	1673	1858	1903	2007	2162	2072	2203
500 000 to 1 million	744	693	668	715	678	678	713	660	690

Source: Prepared by the researcher; data from: UN, DESA, 2002

This phenomenon has been associated with a rapid rate of urban concentration in these large or primate cities. While the percentage of urban population in the large cities is increasing, such percentage is considerably declining in small cities of less than a million inhabitants. Figure 4.15 presents the change of urban population percentage in different city-sizes since 1975 to 2015.



Source: Prepared by the researcher; data from: UN, DESA, 2002

Figure 4.15: Change in the percentage of urban population in different size-categories of cities in Africa 1975-2015

Because of the relatively low rate of population natural increase in urban areas, the increasing rate of urbanisation and urban concentration in Africa is usually **related** to the increasing rural-urban migration (Zachariah and Condé, 1981). Early migration theories suggested that the volume of migration was related to urban-rural income differentials. Because of continued rapid migration despite of increasing unemployment and the inability of formal sector job creation to keep up with growth of the urban labour force, many of these models were modified to consider not only urban wages but also the probability of obtaining a formal sector job (Rakodi, 1997; Lipton, 1977).

Based on the statistical analysis of the percentage of urban population in different size-categories of cities in Africa 1975-2015, it appears that many but by no means all of the primate cities have continued to grow very rapidly. Jamal and Weeks, (1988, 1993) relate this to the relative lack of attractive alternative destinations for migrants and the prospects of access to facilities and income-earning opportunities, even during recession and structural adjustment, which have relatively reduced traditional rural-urban income disparities.

Regarding the nature of urban primacy in Africa, El-Shakhs (1997) argues that almost all the mega-cities of Africa, with the exception of Cairo, Egypt and Johannesburg, South Africa, may not be considered primate on the basis of population alone. However, their dominant positions within their urban systems become clearly evident if their shares of the formal socio-economic activities, their privileged quality of life (personal income, education, levels of services, and amenities among others), or their shares of decision-making power and political control in their systems are taken into consideration (Rondinelli, 1988). El-Shakhs (1997) stressed that such dominant positions have inadvertently been bolstered further by the introduction of Structural Adjustment Programmes (SAPs), because of the relatively superior competitive advantage of these cities.

The increasing concentration and dominance of many large cities in Africa are accompanied by mounting problems, diseconomies, and disparities. These problems as well as opportunities spurred efforts by both the private sector and governments towards decentralization and counter-primacy measures. These measures took a variety of forms, ranging from administrative decentralization and strengthening local governments to radical measures such as the building of a new capital in Nigeria or the new desert cities in Egypt. As these processes pick up momentum, the real or perceived advantages of primate cities may tend to become less and less compelling; and smaller and medium-sized cities may become more and more attractive to migrants and to investments.

4.3.2 Is there a link between economic and urban growth in Africa?

Although there are many forces that affect urban change, especially in Africa where the political and social factors play a significant role, economy is generally seen as of a prime impact on urban change. However, the relationship between economic and urban growth is very complex and far from direct. This clearly manifested in the different views and debates about such relationship. It is the purpose here to investigate the possible role of the economy on shaping urban change patterns in Africa.

4.3.2.1 Economic Growth and Urbanisation Level in Africa

Africa presents a strange phenomenon of rapid urbanisation without economic growth. However, this strange phenomenon is an invalid claim against economic-urban growth association argument as such phenomenon is mainly related to the special socio-economic and political changes that took place in Africa during the past six decades. There are two main explanations for such strange phenomenon. First, one of the main reasons why urban change has been so rapid in recent decades is that it began from such a small base. The European colonial powers, who controlled virtually all of Africa 60 years ago, had kept down urban populations by imposing restrictions on the rights of their national populations to live and work in urban centres. The removal or weakening of the colonial apartheid-like controls on population movements was one of the main reasons why urban populations grew very rapidly just before or after the ending of colonial rule (Potts, 1995). For example, urban growth dynamics over the last 40 years in South Africa, Namibia and Zimbabwe cannot be understood without taking into account the profound impact of controls on people's movement imposed by white minority regimes on the composition and growth of cities. For South Africa, the lifting of long-applied restrictions on national population movement and on African urbanisation in 1986 and then the ending of the apartheid government, urban population have considerably increased (see Figure 4.14). Also, these political changes made the country an increasingly popular destination for refugees and migrants from other African nations, which had a profound impact on urban development (Crankshaw and Parnell, 2002). Second, the achievement of political independence was one of the main reasons for rapid urban population growth in Africa. Newly independent governments had to build the institutions of governance that nation-states need and also to expand and improve the higher education system that had been so undeveloped under colonial rule. This obviously boosted growth in the urban centres that were the main political and administrative centres. Many studies view the rapid growth of sub-Saharan African cities over the last 50 years as a serious problem (Satterthwaite, D. 2002).

In support of the economic-urban growth association argument, David Simon (1997) argues that African urbanisation rates were highest during the immediate post-colonial period, coinciding with the economic boom years of the 1960s and early 1970s. And that thereafter, the process slowed down somewhat in many countries, before accelerating again. Economic crisis, growing indebtedness, and the impact of structural adjustment during the 1980s and early 1990s have created a more complex and diverse picture.

4.3.2.2 Economic Growth and Urban Concentration in Africa

There is an overwhelming consensus that the relatively higher economic growth rates in some African cities, compared to that in rural areas, were a direct cause of urban concentration and urban primacy of many of these cities. This consensus is based on some important arguments.

For these cities, being the place of residence for politicians, senior civil servants, and diplomats has helped to bias public expenditure on specialist health and other services and infrastructure towards them. In addition to this, the need for access to government offices has in turn made them the most likely locational choice for both transnational and domestic investments. Although transnational investment in services in African countries is limited, such investments are usually concentrated in largest cities (Thrift, 1987). Also, FDI is even more concentrated than domestic investment in the largest cities, because of executives' greater knowledge of the city economic environment and the presence of commercial facilities to intermediate between extraction/production and the international market (Sit, 1993).

In addition, the locational attractions of the city are often magnified by policy, mainly with respect to transport tariffs, energy and service prices, and incentives for industrial development. In many African countries, official policies to encourage decentralization are often counteracted by the spatial effects of non-spatial policies.

For many large African cities, their leading economic functions in the international and national economy, compared to that of small and intermediate cities, have a multiplier effect, generating both formal and informal sector employment in wage and consumer goods and services industries. Despite the decreasing ability of the formal sector to absorb increased numbers in the labour force in large African cities (Rogerson, 1997), many of these cities continue to exert an attraction for migration. This is, in part, a result of the deteriorating socio-economic conditions in rural areas. For rural areas, and despite the pro-agriculture policy changes which have formed part of SAPs, many of these areas provide few economic opportunities for their growing populations. Also, although the deterioration in infrastructure and services that has resulted from public expenditure cut-backs has been countrywide, rural areas started in a disadvantaged position. Although the chance of a better life in large cities is much of a gamble, it continues to attract rural migrants (Dogan and Kasarda, 1988). Also, one of the main reasons that helped many of African large cities to continue to exert an attraction for migration is the limited economic role of small and intermediate cities. The low investments directed to these cities in addition to their limited role as service provision centres are among the main reasons that limited the economic role of these cities at the national level.

4.3.3 Globalization and Urban Change in Africa

The foundations for Africa's incorporation into the world economic and political system were established during the colonial period. Despite the attempts of African countries to secure both political independence and economic autonomy, the colonial period left a political, economic, and urban legacy that survived the 1960s. Although political independence did bring some degree of autonomy, this was largely eroded by superpowers interests and continued economic dependence. Moreover, African states were overwhelmed by a wide range of domestic political difficulties, resulting in political instability and administrative weakness (Chazan et al., 1988). These two problems largely influenced patterns of urbanization and adversely affected the capacity of the public sector to manage urban growth in almost all African countries.

Colonial urbanisation was marked by a reorientation of urban patterns and systems to serve the needs of trade and administration. Consequently, some existing settlements prospered, while others stagnated or decayed, and a series of new centres was established (Gugler and Flanagan, 1978; Mehretu, 1983; Coquery-Vidrovitch, 1991). Since independence, there has been a relatively little change to this pattern. Most of this change has been associated with administrative rather than economic change. The rate of urban growth has significantly increased due to expansion of public sector employment, attempts to industrialize, development of transportation systems, an increased rate of natural increase, and relative neglect of rural areas Rakodi, 1997).

Despite the policy reforms applied in many African countries to redress anti-agricultural, anti-rural policy bias, and the efforts made to encourage investment in secondary cities and small urban centres, further concentration in the largest cities has occurred. This is mainly because large cities continue to provide the most profitable locations for investment and the best prospects for migrants, despite the decline in formal sector employment resulting from recession and the implementation of structural adjustment programs (Rakodi, 1997).

4.3.4 African Large Cities in the Global Urban System

The rapid urban concentration and urban primacy of many large African cities highlighted the need to define their position in the global urban system. It is evident that the internationalization of capital has led to the emergence of a hierarchy of cities with particular roles in the capitalist economic system (Rakodi, 1997). At the apex of that hierarchy are the so called "world or global cities," which are sites for the control and management of transnational corporations (TNCs) operations, specialized business services, and nodes in the world banking and commercial system (Friedmann and Wolff, 1982; Sassen, 1985; Thrift, 1987; Sassen, 1994). Second to these global cities are the regional or continental cities, which perform similar functions within the world capitalist system to global cities, but within a more restricted geographical region (Sit, 1993, Yeung and Lo, 1996). The third level in that hierarchy is national cities, which are foci for national accumulation but also provide a location for transnational offices and operations, banks, and corporate services, and are thus linked into the world economic system (Sit, 1993; Simon, 1992, 1993, 1995).

Not surprisingly, and taking into account Africa's marginality to the world economic system, none of the 'world cities' is located in the continent, although Cairo, Johannesburg, and Nairobi have regional roles. Moreover, Africa is not even part of the semi-periphery, and the functional city systems linked across national borders that have emerged in Asia are not evident in Africa. Most large African cities are centres of national economies, although they are connected to the world economy through unequal trade, investment, and aid relationships (Simon, 1992, 1993, 1997; Rakodi, 1997).

4.3.5 Urbanisation and the Quality of Life in Large African Cities

Urban life in Africa has never been easy, and even become harder in recent years. In addition to the severe inadequacy of public resources relative to need, the rate of growth in formal economic employment opportunities in Africa has never kept pace with population increase. Consequently, many large cities in Africa are currently facing serious problems of urban unemployment, shelter deficiency, increasing pollution, and inadequate infrastructure, social facilities, and management capacity of large cities (Simon, 1997; Devas and Rakodi, 1993; Drakakis-Smith, 1993)

Although, the sheer scale of so-called "mega-city problems" in Africa is not as severe as in Latin America and some parts of Asia, and given the state of most African economies, these problems may be extreme. Urban poverty, unemployment, environmental problems will be examined next in this section.

4.3.5.1 Urban Poverty and Unemployment:

Urban poverty is one of the most characterising phenomena for almost all African large cities. Although accurate and recent city-wide data on income distribution are rare in Africa, many surveys show that the anti-urban policies, that Structural Adjustment Programmes (SAP) have insisted on in almost all African countries, has largely been misplaced, since by the time of their implementation the presumed privileges of urban residents had already largely disappeared. The SAP policies of the 1980s and 1990s have drastically, and sometimes tragically, increased the hardships of urban residents, most of whom were already poor and vulnerable (Potts, 1997).

In many surveys, the levels of income reported were so low that it is hard to see how households can feed themselves, let alone cover other necessary costs, such as housing and transport to work, or vital welfare expenditure on health, education, or clothing. Jamal and Weeks (1993) argue that there is much evidence that average rural incomes frequently exceed the incomes available from most formal wage work in the cities. The reversal of the income gap in Africa has been clearly documented for Nigeria, Uganda, and Tanzania (Jamal and Weeks, 1993; Collier, 1988; Mtatifikolo, 1992).

The fact that urban poverty may now surpass rural poverty is of particular significance to any study of the nature of urbanization in Africa. The nature of the rural-urban income gap is, in theory, the most important factor influencing rural-urban migration, and hence urban growth rates (Potts, 1995, 1997).

In addition to the reversal of urban-rural income gap, Deborah Potts (1997) argues that the boost to urban living standards that used to derive from superior access to affordable public services compared with rural areas has also very significantly diminished in many African cities. Cuts in health and education expenditure mean that schools and clinics are quite unable to cope with the demand and the private alternatives are unaffordable for the urban poor. The crucial area of housing has also suffered. Although the need for low-income housing was never satisfied in the 1960s and 1970s, the adoption of more realistic approaches to this sector in the 1970s had led to some improvements. The cease of arbitrary demolition of unplanned settlements, and "squatter" upgrading programmes went some way to providing basic services in some of these settlements and enhancing security of tenure. Also, the site and service housing approach helped the poor to some degree, although the hoped-for benefits were often reduced by stubborn insistence on overly high building and service standards squeezed out many of the intended beneficiaries (Amis and Lloyd, 1990; Stren, 1990; Potts with Mutambirwa, 1991). However, during the 1980s and 1990s, public housing programmes in almost all African countries often languished or ceased altogether, owing to lack of finance (Dubresson, 1997).

4.3.5.2 Environmental Problems

Although the UNEP/WHO (1992) study of air pollution in mega-cities with populations of over 10 million did not include any African city, this does not give cause for complacency and does not reflect the severity of current environmental problems of many African large cities. African industrial cities and those with high numbers of motor vehicles - the two principal sources of pollution - such as Cairo, Johannesburg, Lagos, Durban, and Cape Town, suffer significant environmental problems. However, the UNEP/WHO 1992 report stressed that the mega-cities of the South suffer from poorer air quality and the associated problems more than those of the increasingly post-industrial North. Rapid urban growth in the South, especially in Africa, is certainly widened this gap. In addition, inability of public sector authorities to provide infrastructure, enforce regulations governing land development and industrial emissions significantly contribute to environmental problems in Africa.

In addition to their severe economic problems, the urban poor in almost all African cities are highly exposed to many environmental hazards. They are most likely to depend on untreated water, to live in risky areas, to be not provided with sanitation and solid waste collection services, and to live in overcrowded conditions and work in unregulated enterprises (Rakodi, 1997). Their vulnerability to ill health arising from environmental problems is aggravated by poor nutrition and inadequate access to health care.

Despite its serious impacts, action on environmental problems is always late and occurs, in almost all cases, when the better-off are affected, as for example by air pollution, contaminated food, or bad effects on economic activities such as tourism. And in many cases, such action is late and comes after a disaster. Therefore, many unsustainable practices and environmental problems are not tackled until disaster occurs or until organized groups increase their pressure for change. Action on environmental problems in African cities is needed to tackle negative externalities such as pollution directly and as well as to monitor the upstream resource-using and downstream disposal or recycling of wastes in the city and its region (Rakodi, 1997).

Despite the numerous problems of urban poverty and unemployment, shelter deficiency, and increasing pollution in African large cities, David Simon (1997) argues that although these phenomena are conventionally constructed as "problems', by national elites and professionals, it is far from clear that all urban residents, especially some of the urban poor, would share such sentiments. He argues that if migrants found conditions significantly worse than in their (rural or other urban) areas of origin, many would return there. Although this argument does not mean that people are necessarily happy with their lot, or that they do not suffer hardship and very real threats to their health and well-being, it neglects the fact that the majority of these people are so poor and can not afford the cost of relocation and search for a place and job in a new location. Despite the higher unemployment levels in urban areas, they still offer more jobs, especially in underclass jobs such as garbage collection, which the urban and the rural poor are looking for and which do exist in rural areas.

In order to understand the nature and the extent of current urban problems in Africa's primate cities, the thesis presents in section 5.3 an analysis of the main urban primacy problems in Africa's largest city; Cairo, Egypt.

Conclusion:

In this chapter the thesis has thoroughly investigated the relationship between technology and patterns of urban change and identified the main differences in patterns of urban change in technology advanced countries and developing countries. Also, the thesis has examined urban change patterns in Africa, as a group sample of developing countries. Through this chapter, the thesis has reached some important conclusions.

First, technology affects the size of urban settlements. The successive changes in settlements size from small to large and primate during the agricultural, industrial and post-industrial eras reflects the role of technology in introducing these changes. The development of urban systems has been classified into five stages based on the relative size of settlements in each stage and the corresponding spatial patterns of population movement – which depends, to large extent, on the nature and level of technology prevailing in each stage.

Second, technology affects the spatial distribution of urban settlements through affecting the size and the function of these settlements and the relationships between them. Developments in telecommunications, transport, railroads, the automobile and aircraft technologies, have considerably modified the locational advantages of existing urban centres, have created opportunities for new centres in previously less accessible areas, and have permitted different spatial patterns both within cities and the surrounding hinterlands.

Third, there is an association between the level of technology prevailing in a society and patterns of urban change in that society. The thesis empirical analysis of urban change patterns in countries of different technological capabilities (developed, less, and least developing countries) reveals two main important facts (section 4.2). First, developed and developing countries present different trends regarding the shares of different sizes of settlements of their national urban populations. In more developed, and more technically advanced countries, the share of large urban settlements is considerably decreasing and the share of smaller ones is increasing. This is while almost all developing regions present a different pattern of increasing share of large settlements and sharply declining share of smaller ones. Second, developed and developing countries present contrasting trends regarding the average size of settlements. While the average size of large urban settlements is declining in more developed countries, it is rapidly increasing in developing countries. This analysis shows that there is a strong correlation between the level of technology prevailing in a society and patterns of urban change in that society. In addition, this analysis clearly shows that urban systems in developing countries suffer two main problems: the increasing size of its primate cities and the rapid rate of urban concentration.

Fourth, urban systems in Africa, as a group sample of developing countries, suffer the same problems of urban concentration and the increasing primacy of its large cities. In addition, Africa presents a strange phenomenon of rapid urbanisation without economic growth. Urban poverty, unemployment, and environmental pollution are serious problems in almost all African cities, especially primate ones.

In the next chapter, and after analysing urban change patterns and problems in Africa, the thesis will thoroughly examine urban change patterns and problems in Egypt. Also, the thesis will closely investigate the main urban problems that accompanied the increasing primacy of Greater Cairo region, as an example of primate cities in developing countries.

AN ANALYSIS OF URBAN CHANGE PATTERNS AND PROBLEMS IN EGYPT

Introduction:

The thesis tries in this chapter to provide reasoned answers to two main questions that usually arise in the area of this research: First; is Egypt facing urban change? And if so, what are the main features of such change and their corresponding problems? Second; are the technological capabilities of Egypt sound enough to affect the future of urban change in the country? In reaching for an answer to each of these questions, this chapter starts by presenting an overview of the development history and current development status in Egypt and its technological capabilities. Then, the research presents an extensive analysis of current urban change patterns and problems in the country. Finally, the thesis closely investigates the main urban problems that accompanied the increasing primacy of Greater Cairo region, as an example of primate cities in developing countries.

5.1 EGYPT: DEVELOPMENT HISTORY AND TECHNOLOGY STATUS

5.1.1 Geographic Settings:

Egypt lies in the northeast corner of Africa, connecting Asia with Africa and the Red Sea with the Mediterranean that produced the unique connection between the west and the east through the Suez Canal. The country is essentially desert of about 1,000,000 square kilometres, and is a part of the desert belt of northeast Africa. This desert has been, until modern times, uninhabited except for the 'Nile Valley'. The Nile flows through Egypt from the south to the north, forming its own valley as a strip of agricultural land between the parallel ranges of hills. On the west side of the Nile, the hills form the Western Desert Plateau in which lies a series of scattered oases. On the east side, the hills form a north-south chain of mountains that cascade down to the Red Sea. North of Cairo, the Nile is divided into two main branches forming the fertile agricultural lands of the Delta. The arable land of the Nile Valley and the Delta amounts to about five percent of the country's area. Another important division of Egyptian territory is Sinai Peninsula, lies between the two branches of the Red Sea in the south and the Mediterranean Sea in the north. Figure 5.1 depicts the main geographic features of Egypt.

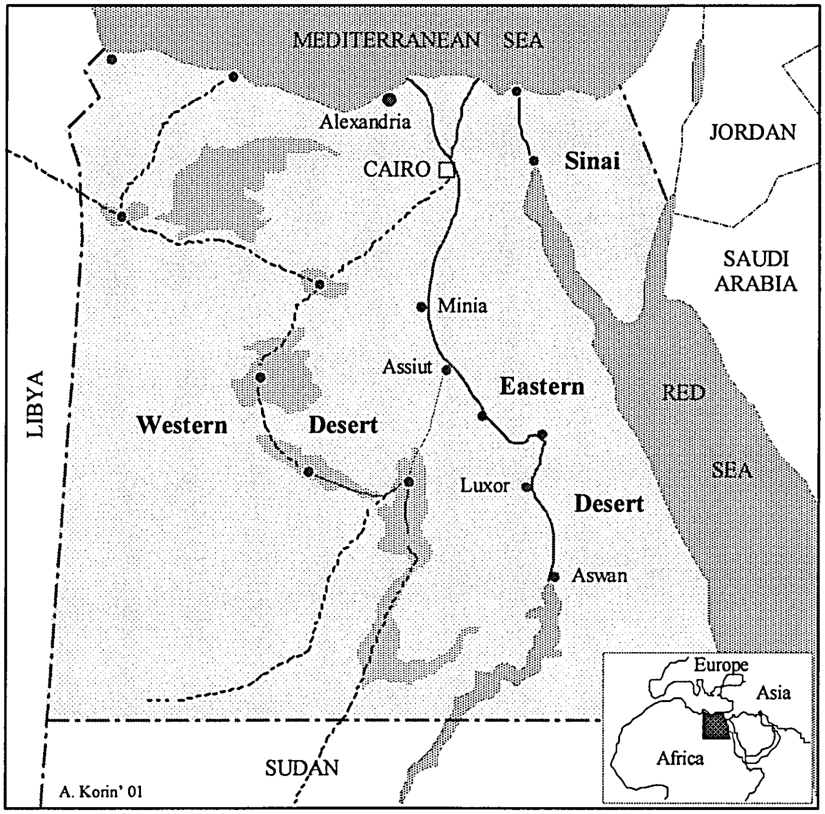


Figure 5.1: Geographic Settings of Egypt

5.1.2 Development History

The start of modern development in Egypt dates back to the start of the nineteenth century when Egypt had started to modernise its development capabilities. The development strategy was based on agricultural expansion and the establishment of a sound industrial base. The government has expanded the area under cultivation and planted crops specifically for export, such as long-staple cotton, rice, indigo, and sugarcane. The surplus income from agricultural production was used for public works, such as irrigation, canals, dams, and barrages, and to finance industrial development and the military. In industry, the government set up modern factories for weaving cotton, jute, silk, and wool. Factories for sugar, indigo, glass, and tanning were set up with the assistance of foreign advisors and imported machinery. Industries employed about 4 percent of the population, or between 180,000 and 200,000 persons of over fifteen years of age. The textile industry was protected by government embargoes prohibiting the import of the cheap textiles from abroad. Commercial activities were geared toward the establishment of foreign trade monopolies and an attempt to acquire a favourable balance of trade (Metz, H. 1990).

Such development trend continued at varying rates until 1879. During that period, an additional 506,000 hectares were brought under cultivation, representing a sizeable increase in both production and income. To service the cotton crop, which was the basis of Egypt's prosperity, roads, bridges, railways, harbours, and telegraph lines had been constructed. During that period, 112 canals, 13,440 kilometres long, were dug; 400 bridges were built; 480 kilometres of railroad lines were laid; and 8,000 kilometres of telegraph lines were erected. Towns and cities were modernized by the expansion of public services such as water distribution, transport, street lighting, and gas supply. Public education was reorganized and expanded, and a postal service was established. The army and the government system were expanded and modernized (Metz, H. 1990).

By 1880, the country went through many economic and political problems that had been aggravated by the First and the Second World Wars and extended to the middle of the twentieth century. By 1952, the first republican government came to power; it was the first time for Egypt to be governed by the Egyptians since the days of Pharaohs. The government paid significant attention to securing enough funds to develop the country. In 1956, Egypt nationalised the Suez Canal. By 1960, Egypt constructed the Aswan High Dam, which saved Egypt from the yearly flooding and water shortage during the last ten years; and represents the main source of electric power in the country up till now.

Since 1952, Egypt went into war with Israel for three times in 1956, 1967 and 1973; a war every decade. These wars had further deteriorated the economy and added a very heavy burden of debt. After signing the peace treaty with Israel in 1978 and gaining control over all the Egyptian territory, the Egyptian economy is experiencing a very rapid growth rate. It can be said that by 1980, only about 20 years ago, Egypt had started its real modern development age. Since then; Egypt has redirected its resources for building the infrastructure, starting new large-scale development projects, and promoting ambitious social and urban development programs.

5.1.3 Technology Status

The technological capabilities of Egypt have increase substantially during the last 30 years. In the area of telecommunications, the number of telephone lines increased from 0.51 million to 3.36 million to 4.3 million in year 1981, 1994 and 1997 respectively. Automatic phone service covered 220 cities in 1994 compared to only seven cities 13 years earlier. Furthermore, the number of Fax lines increased by 63 folds between 1986 and 1994 (Huzayyin, A. 1995; CAPMAS 1999). Moreover, cellular phone service is now covering the whole country with a very high subscription rate.

In the area of transportation, Egypt has experienced substantial growth of motor vehicles of all types, especially intercity taxi and private cars. During 1965 to 1979, the vehicle fleet has increased sharply from 126,000 in 1965 to 501,000 in 1979 to 2,343,000 in 1998 (PADCO, Inc. *et al* 1982; CAPMAS, 1999). On the national level, car ownership increased sharply from about 4 to 12 to 38 cars per 1000 inhabitant in years 1965, 1979 and 1998 respectively. In Cairo, car ownership sharply increased from 10 to 15 to 40 to 75 cars per 1000 inhabitant in year 1974, 1980, 1984, and 1998 respectively (Afifi, A. K. 1991; CAPMAS, 1999). To cope with this unprecedented growth of motor vehicles, lengths of paved road network increased from 17,700 km in 1981 (SIS, 2001) to 50,000 km in 2000/01 (CIA, 2001). In addition, Egypt constructed the Cairo underground metro to be the first in Africa and the Middle East. The first metro line was opened to service in 1987. This 42 km line is currently carrying about one million passengers every day. The second metro line opened in 1999, about 20 km long, designed to carry some 4 million passengers every day. These few indicators show how much technology achievements had influenced the urban development in developing countries. During this period, the international road on the Mediterranean Sea affording the road link between Asia and Africa had been completed. The road connection with Sudan with a total length of 290 km had been completed to provide the first road link of inland Africa to North Africa and Asia. Also, considerable achievements have been made in both rail and air transportation.

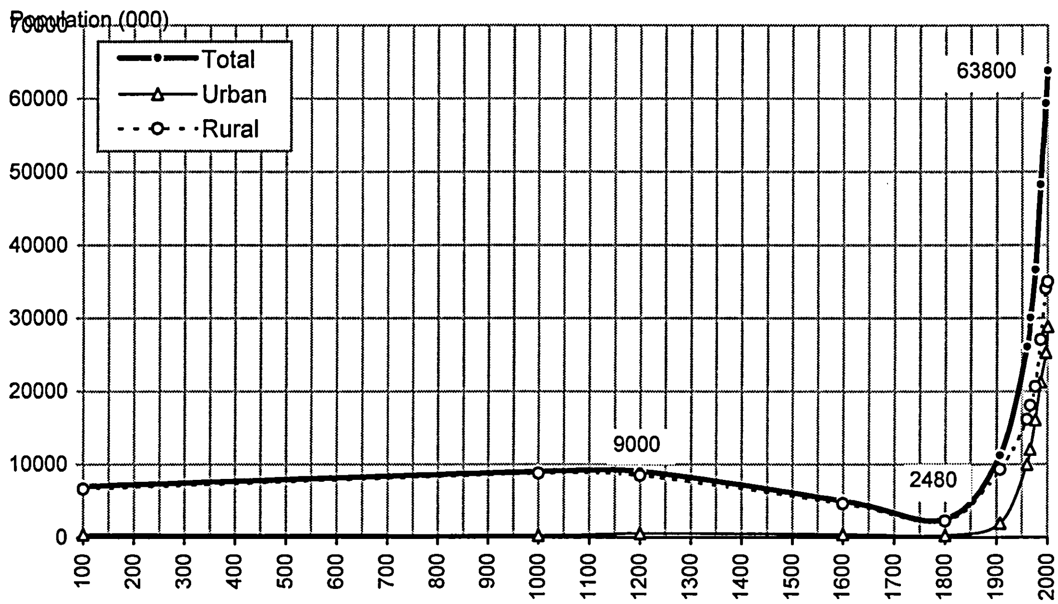
Concerning energy production, the generated electric power rose from 18 billion kw/h in 1981/1982 to 77 billion kw/h in 2000/2001. The consumed electric power increased from 17.4 billion kw/h in 1981/82 to 65.4 billion kw/h in 2000/01. Over the period 1981-2001, the electricity sector has achieved an annual growth rate of 8.2%. Average per capita share of consumed power rose from 430 kw/h in 1981/82 to 1,350 kw/h in 2000/01 (SIS, 2001). Hydroelectric power is an important source of energy in Egypt. During the 1980s, the Aswan High Dam on the Nile River provided half of Egypt's electricity. This percentage has fallen while energy demand has increased, but in 1998 hydropower still contributed 22% of the total energy generated in the country. Aside from hydroelectricity, Egypt is boosting its use of renewable energies such as solar and wind power. The Egyptian Authority of New and Renewable Energy made many agreements with USA and Japan. As a result, renewable energy consumption in Egypt is on the increase, having jumped 10% to 176 trillion Btu in 1997 (EIA, 2000). All health and service units on desert regional roads and all remote wireless telephone exchanges are powered by solar energy.

As a result of the increasing capabilities of water technologies, the available capacity of water stations rose from 4.70 million m^3/day in 1981/82 to 16.8 million m^3/day in 2000/01, at an annual growth rate of 6.9%. Consumption increased from 3.30 million m^3/day in 1981/82 to 13.2 million m^3/day in 2000/01, at an annual growth rate of 7.5%. The per capita share of water consumption rose from 78.50 litre/day in 1981/82 to 201.9 litre/day in 2000/01, at an annual growth rate of 5.1% (SIS, 2001). Also, sanitary drainage capacity and the design absorptive capacities of lifting stations increased from 2.20 million m^3/day in 1981/82 to 14.09 million m^3/day in 2000/01, at an annual growth rate of 10.3%. Available capacity of treatment stations rose from 0.85 million m^3/day in 1981/82 to 7.3 million m^3/day in 2000/01, at an annual growth rate of 12% (SIS, 2001). According to the UNSD - United Nations Statistics Division (2002), Egypt ranks the first in Africa and the Middle East regarding the percentage of population with access to improved drinking water and sanitation resources, with a percentage of 97 and 98 percent respectively.

This clearly shows that the technological capabilities of Egypt are rapidly growing and will have considerable impacts on shaping the future of urban development in the country.

5.2 PATTERNS AND PROBLEMS OF URBAN CHANGE IN EGYPT

During the period before the start of the twentieth century, Egypt's population was growing at very low rate, doubling in about 4000 years and growing from 5 million in 2000 B.C. to only 9.7 million in 1896 A.D (PADCO, Inc. *et al* 1982). By the start of twentieth century, Egypt experienced unprecedented population growth, from 11.3 millions in 1907 to 66.4 million by the turn of the century and doubling every 34 years (TTSD, 2001). Figure 5.2 presents the temporal change of the total and urban populations of Egypt during the period extending from 2000 B.C. to 2000 A.D. It depicts that Egypt's population have experienced unprecedented growth during the last two centuries, especially in the last half of the twentieth century. Such growth was at an astonishingly high rate, doubling about 26 times in the last 200 years; a matter that reflects the fact that Egypt had experienced radical social, economical, and technological changes.

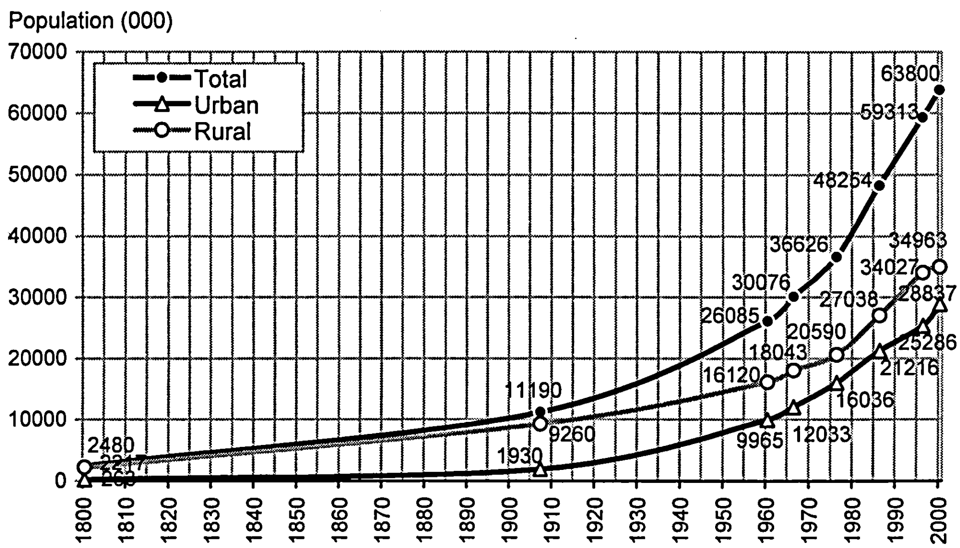


Source: Prepared by the researcher, Data from: 100 A.D. – 1800: PADCO, Inc. *et al* 1982.
1907-1996: CAPMAS, 1999. 2000: World Bank, 2001-b. Egypt: Data Profile.

Figure 5.2: Egypt's Temporal Urban and Total Population Growth

The urban population in Egypt has grown very rapidly from 2.250 million in 1937 to 12.033 million in 1966 to 28.837 in 2000, doubling about 13 times in the last 63 years. During the twentieth century, the percentage of the urban population to total population has grown from 17 percent in 1907 to 45 percent in 2000. Although, rural-to-urban migration was the main reason for the growth in urban population, this does not slow down the growth rate of the rural population. Figure 5.3 presents the change in urban and total populations of Egypt during the last two centuries.

If the fact that the Egyptian classification of settlements as urban or rural is not determined by population size, but rather by a combination of administrative procedures and purposes, are taken into account, urban growth in Egypt will be much higher. According to the Egyptian Census definition, "urban" comprises all cities and towns in a governorate (province), together with their constituents of smaller administrative units such as *kisms* (district/county) or *shiakhas* (within the district). On the other hand, "rural" includes all villages with their associated hamlets (CAPMAS, 1999). Based on this classification, there are many villages that are larger in size than towns. Therefore, the urban classification in Egypt does not appropriately reflect the reality of urbanisation in the country. Therefore, if Egypt adopted the Indian definition of urban settlements (as communities of more than 5,000 inhabitants), around 80 percent of Egypt's population would be urban or, and if applying the definition used in the Philippines, 100 percent would be living in cities (Bayat, A. and Denis, E. 2000, 192; Moriconi, F. 1995).



Source: Prepared by the researcher; Data compiled from:

2000 B.C. – 1800: PADCO, Inc. *et al* 1982. 1907-1996: CAPMAS, 1999. 2000: World Bank, 2001-b. Egypt: Data Profile.

Figure 5.3: Egypt's urban and total population growth during the last two centuries

As a result of this unprecedented growth of urban population, existing cities have experienced a very rapid and unbalanced growth during the twentieth century. The number of urban settlements has increased from 100 in 1947, to 158 in 1976, to 214 in 2000; their share of the total population increased from 31.4 percent to 43.5 percent to 45.1 percent respectively (PADCO, Inc. *et al* 1982; World Bank, 2001-b. Egypt: Data Profile).

In a serious effort to control the unbalanced urban growth, and during the last 25 years, Egypt had built 19 new cities with a planned capacity of about 8 million residents. During 1982-2001, 327,000 housing units had been completed in these new cities. In addition, 14 new towns had been planned and another 28 towns are under study. Moreover, existing cities have been radically expanded, especially large cities such as Cairo, Alexandria and all other regional cities. About 2.5 million housing units had been added to these cities during the same period; 95% of which are built by the private sector (SIS, 2001).

Despite all these efforts, Egypt's urban system is still suffering serious structural imbalances. These imbalances are in fact identical to those identified and examined in the previous chapter about technology and patterns of urban change in developing countries. The research defines two main features of such an imbalance in Egypt: first, is the increasing concentration of urban population in certain regions of the country; and second, is the differential growth of the different classes of settlement sizes which resulted in increasing size difference between large and small urban settlements. In the following sections, both of these points will be thoroughly examined.

5.2.1 Urban Concentration

Urban concentration is the main striking characteristic feature of Egypt's urban system. Because of the influential economic and political role of primate cities, they were the main targets of rural-urban migration. Although the number of urban settlements of more than 1 million inhabitants has grown from only 1 in 1947 to only 3 in 1996 out of the country's 211 urban settlements; their share of the total urban population was about 49 percent in 1996 and reached 51.14 percent in 2003. This situation proves that the country suffers high urban concentration levels.

Because of the low natural population growth rate usually experienced in urban areas, interregional migration is regarded as the main cause of urban concentration in Egypt. Inter-governorates migration in Egypt is generally characterised by: a) being from South to North and the Canal Zone; b) being from all of Egypt's hinterland to Cairo and Alexandria; c) migration streams from urban areas are mainly going to urban areas, but are usually from small to large urban centres; and d) recently a growing share of urban out-migration is heading to rural areas. Many academic and governmental studies have shown that the biggest convergence of migration streams culminates in the Greater Cairo Region (GCR), which includes Cairo, Giza, and Qualyoubia governorates (Zohry, A. 2002; Adams, 1986; Aldakhil, 1999; El-Boraey, 1984; El-Kurdy, 1974; Ibrahim, 1986; Nassef, 1985; Shoieb *et al.*, 1994). In addition, new cities policy adopted in Egypt since 1977 did not play any significant role in correcting this situation. Next, the thesis will examine each of the characteristics of internal migration and the development of new towns in Egypt.

5.2.1.1 Migration from South to North and the Canal Zone

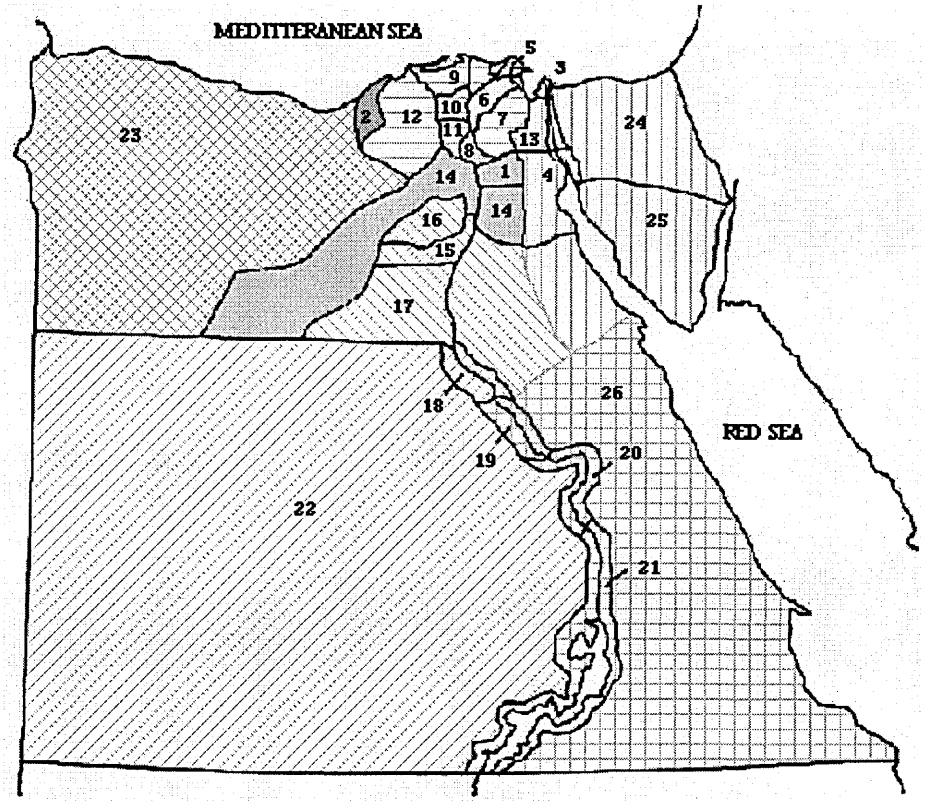
In the present context, South refers to the governorates of Middle and Upper Egypt which are located to the south of the GCR (Figure 5.4). It includes Fayoum, Minia, Beni-Sueif, Assiut, Souhaj, Qena, and Aswan governorates. These governorates represent a relatively narrow strip of green land on both sides of the Nile. As a function of limited opportunities for either vertical or horizontal agricultural expansion (i.e. intensification of the already highly intensive agricultural regime or expansion of cultivation to new areas), mounting population pressure has been markedly felt for the last hundred years. One response to this pressure has been a steady stream of out-migration to the north. Assiut, Souhaj, Qena, and Aswan have been the major suppliers of out-migrants to the North – mainly to Cairo, Alexandria, and the Suez Canal governorates. The net loss from the South to the North is about one million over the first six decades of the twentieth century (Zohry, A. 2002; Hassan, A.M.N. 1969). This figure is very much lower than the volume of internal migration recorded in recent decades, but it must be borne in mind that the total Egyptian population was low – only 19 millions in 1947. El-Badry (1965) contends that during these same decades, these four southernmost governorates exported a net 13.0 percent of their total population to other regions in Egypt, mainly Cairo, Alexandria, and the Suez Canal. During the last four decades; from the 1960s to the 1990s; the same trends continued but at varying rates.

5.2.1.2 Migration from the hinterland to Cairo and Alexandria

The two largest Egyptian cities have been the greatest magnets of migration streams. Beside their net population imports from the South, noted above, the two cities attracted similar streams from the Delta.

Concerning Cairo, its net gain from the South averages about 40 percent of its total in-migrants. The Delta governorates contributed the balance of 60 percent during the twentieth century. Cairo has long been a net population importer, with the biggest suppliers being Menoufia, Souhaj, Assiut, Gharbia, Daquhlia, Qualyoubia and Qena. Only in very recent years does the momentum of (recorded) population arrival seem to be declining.

Similarly; Alexandria has been a net migration gainer since the start of the twentieth century, although at a rate lower than that of Cairo. Like Cairo, the city of Alexandria received most of its migrants from Menoufia in the Delta, and from Souhaj, Qena, and Aswan in the South.



——— Governorate's Border ——— Regional Border

Governorates

1. Cairo	8. Qalyoubia	15. Beni Sueif	22. New Valley
2. Alexandria	9. Kafr El Sheikh	16. Fayoum	23. Matrouh
3. Port Said	10. Gharbia	17. Minia	24. North Sinai
4. Suez	11. Menofia	18. Assuit	25. South Sinai
5. Damiata	12. Behaira	19. Souhaj	26. Red Sea
6. Daqahlia	13. Ismailia	20. Qena & Luxor	
7. Sharqia	14. Giza	21. Aswan	

Planning Regions

Greater Cairo	Delta	Matrouh	Assuit
Alexandria	Suez Canal	North Upper Egypt	South Upper Egypt

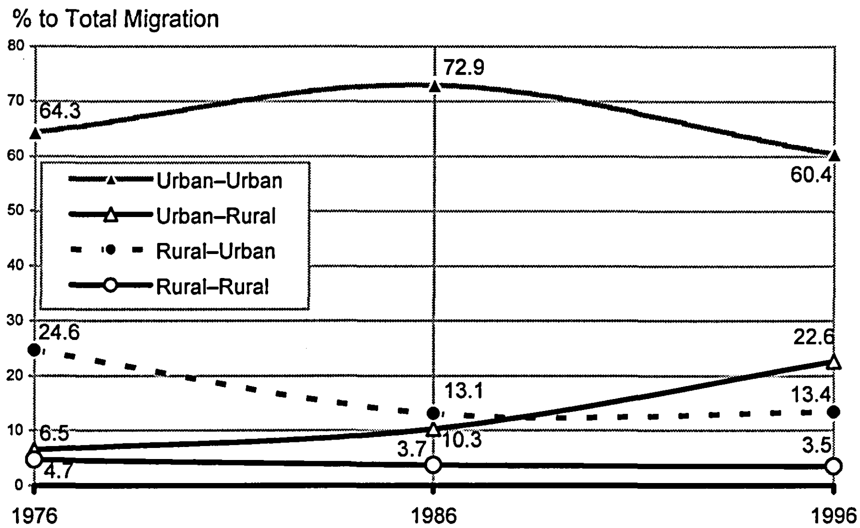
Source: Prepared by the researcher; Data from: Al-Bahnasawi 1995, 175; ITU 2001-A, 1)

Figure 5.4: Geographic distribution of the Egyptian governorates and Planning Regions

5.2.1.3 Migration Streams: Origin and Destination

In understanding urban changes in Egypt, it is important to define the origin and the target of main migration streams in the country. Figure 5.5 depicts an overview of inter-governorate migration for urban and rural areas by rural/urban origin or destination for the last three censuses: 1976, 1986, and 1996. This figure shows two important characteristics of population movement in Egypt. First, is that the urban-to-urban movement are usually the highest of all other movement. However, the ratio of urban-to-urban movement has shown a considerable decline since 1986. More importantly, the majority of such movement has usually been from small- and intermediate cities to large cities such as Cairo and Alexandria. Second, is that the urban-to-rural movement is the only progressively growing stream, growing from 6.5

percent in 1976 to 10.3 percent in 1986 to 22.6 percent in 1996. This attitude reflects the mounting environmental and economic problems in urban areas and it also reflects the increasing competitiveness of rural areas after the majority of these areas have been provided with the basic infrastructure facilities; mainly electricity, water, and paved roads. However, there is a slight increase in rural-to-urban movement, increasing from 13.1 percent in 1986 to 13.4 percent in 1996.



Source: prepared by the researcher, data from: Zohry, A. 2002, 29; CAPMAS 1996.

Figure 5.5: Urban/Rural Migration by Type of Movement, Egypt, 1976–1996

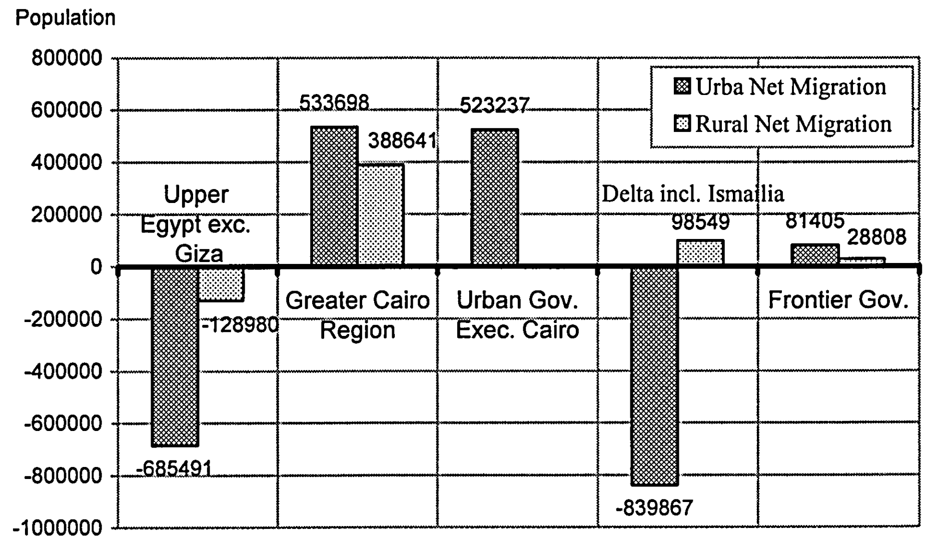
As shown previously, the urban population was mainly concentrated in two main urban centres; Cairo and Alexandria. The most recent census, in 1996, showed that these two entirely urban governorates absorb 40 percent of the total national urban population; 27 percent in Cairo and 13 percent in Alexandria. This is while the remaining 209 cities of Egypt house only 60 percent of the national urban population. More strikingly, the urban population in all Upper Egypt Region that includes 64 cities; is only 16 percent of the total national urban population, a little more than Alexandria and only a half of Cairo.

Table 5.1 presents migration movements at the regional level during 1986-1996 period. Figure 5.6 and Figure 5.7 depict the magnitude and percentage of net migration at the regional level based on 1996 census. These figures show that the Greater Cairo Region (GCR) and the urban governorates of Alexandria, Port Said, and Suez were the main target for population migration with net in-migration of about 1.056 million people in their urban centres and about 388,000 people in their rural areas. This is while the Delta and Upper Egypt regions have lost about 840,000 and 685,000 of their urban population. The highest percentage population loss was in the Upper Egypt region that lost about 17 percent of its urban population during this period.

Table 5.1: Migration movement on the governorates and regional levels, 1986-1996

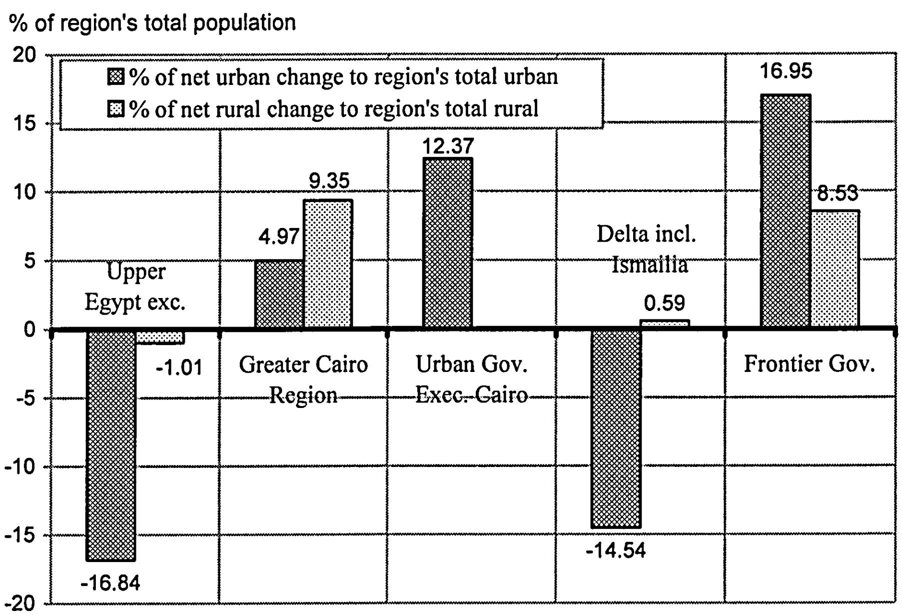
	Urban					Rural				
	Urban Population	In	Out	Net	% Net to urban	Rural Population	In	Out	Net	% Net to rural
Upper Egypt	4069453	165690	851181	-685491	-16.84	12792355	125289	254269	-128980	-1.01
Greater Cairo R.	10731714	1718383	1184685	533698	4.97	4154721	448246	59605	388641	9.35
Urban Gover. Exec. Cairo	4228938	676629	153392	523237	12.37	NA	NA	NA	NA	NA
Delta Gover. incl. Ismailia	5776114	431946	1271813	-839867	-14.54	16741663	487454	388905	98549	0.59
Frontier Gov.	480216	105687	24282	81405	16.95	337860	36111	7303	28808	8.53

Source: Calculated by the researcher; data compiled from: Zohry 2002; CAPMAS, 1996 Census report.
NA- Not Applicable - urban governorates



Source: Prepared by the researcher; data from: Zohry, A. 2002; CAPMAS, 1996.

Figure 5.6: Magnitude of net urban migration at the regional level, 1996.



Source: Prepared by the researcher; data from: Zohry, A. 2002; CAPMAS, 1996.

Figure 5.7: Percentage of net urban migration at the regional level, 1996.

5.2.1.4 New Towns and Urban Concentration:

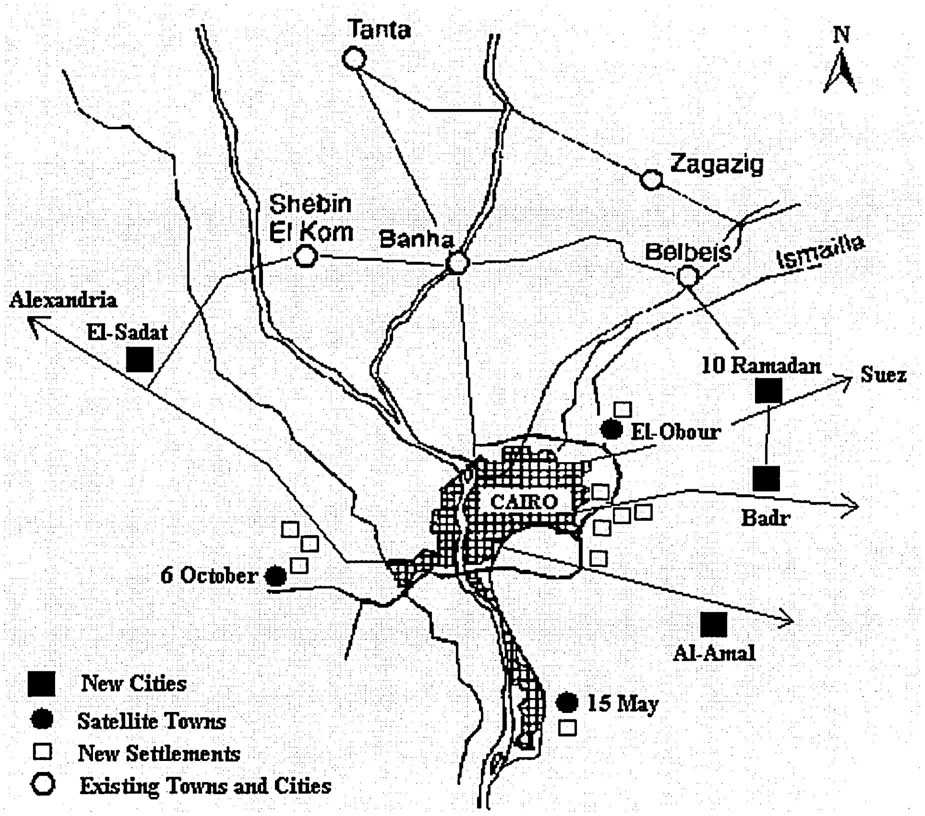
The adoption of the new towns strategy in Egypt is relatively new. This strategy has been divided into three generations. The start was made in 1977 by the construction of the first generation cities at distances of between 40 to 95 kilometres from Cairo and Alexandria. In this generation, three independent cities of sizes ranging from 350,000-500,000 inhabitants (10^{th} of Ramadan, Sadat, 6^{th} of October) and four satellite cities of smaller sizes (15^{th} May, New Damietta, New Burj El-Arab, and Al-Salehia) were built. The second generation consists of five cities of smaller sizes. Of which two are around Cairo (Al-Obour and Badr), one near Alexandria (Nobaria), and two in the North Upper Egypt Region (New Bani-Suef and New Minia). The third generation consists of three cities in South Upper Egypt (New Assuit, New Souhaj, and New Aswan) and ten urban centres around Cairo. Infrastructure works in the majority of Upper Egypt new towns are not finished yet.

Despite these efforts, new towns in Egypt did not significantly correct the problem of urban concentration in Egypt for two main reasons: (1) the development of these cities is very slow, and (2) their share of urban population is very small (Jossifort, S. 1995; Sutton, K. and Fahmi, W. 2001, 141). Table 5.2 shows that the percentage occupancy in these cities is very low. Second, the majority of new cities especially those of the first generation were built around Cairo and Alexandria, aiming mainly to mitigate urban problems in these large agglomerations (Figure 5.8). This situation is expected to further increase urban concentration in these cities as it opens many new housing and job opportunities. Such opportunities in addition to the usual advantages of large urban agglomerations will certainly increase the attractiveness and population concentration in these large cities.

Table 5.2: The targeted and percentage occupancy of new cities around Cairo, 1996.

	Target Populations	1996 Population	% Occupancy
10th Ramadhan	500,000	47,839	9.57
6th October	500,000	35,477	7.10
15^{th} May	100,000	65,865	65.87
Badr	250,000	248	0.10
Sadat City	500,000	16,312	3.26
El Obour	250,000	No data	---

Sources: Compiled from: Sutton, K. and Fahmi, W. 2001; Stewart, D. 1996; CAPMAS 1996; and Denis, E. 1999.



Source: Adapted from: Yousry, M. and Aboul Atta, T. A. 1997 and GOPP, General Organisation for Physical Planning, Egypt. 1982

Figure 5.8: New cities, satellite towns, and new settlements around Greater Cairo Region

5.2.2 Differential Growth of Different Settlement Sizes

Another important characteristic problem of the Egyptian urban system is the unbalanced growth of different sizes of cities. Large cities are usually growing faster than smaller ones, which usually lose their population in favour of large cities. As shown in the previous section, urban-to-urban migration is the highest of all migration streams in the country.

Table 5.3 clearly demonstrates that although primate cities of over one million inhabitants have shown a decline in their relative share of the total urban population during 1976 to 1996 period, their share starts to increase again since 1996 reaching about 50% of the national urban population in 2003. More strikingly; these primate cities were only three in 1996; Cairo, Alexandria, and Giza; and four in 2003 adding Shubra Al-Khaymah to them. Regarding large cities (500,000-999,999), there was only one city in this category since 1986 with a share of around 3.4 percent in 1996 and considerably declined to 1.8 in 2003. Both the Intermediate Cities (100,000-499,999) and Small Cities (20,000-99,999) have the second largest share of the national urban population of about 23.6 and 22.6 respectively in 2003. But it should be noted that in 2003 there were only 32 intermediate cities while there were 147 small cities. This proves that small cities offer a more dispersed urban population than other categories. Concerning smaller settlements (less than 20,000); they have experienced a sharp decrease both in number and the relative share of the national urban population. Their number has declined from 58 cities in 1986 to only 30 in 2003, and their relative share of national urban population has declined from 11.14 percent to only 0.62 percent during the same period.

Table 5.3: The Number and the Population Change of Different Urban Settlements' Sizes in Egypt Since 1976.

Size Class	Number of Cities				% of Urban Population			
	1976	1986	1996	2003	1976	1986	1996	2003
Primate (1,000,000-over)	2	3	3	4	56.67	51.38	48.80	51.14
Large Cities (500,000-999,999)	0	1	1	1	0	3.38	3.44	1.82
Intermediate Cities (100,000-499,999)	17	20	24	32	18.34	19.91	22.75	23.67
Small Cities (20,000-99,999)	86	104	125	147	19.86	14.19	23.77	22.75
Smaller Settlements (< 20,000)	53	58	58	30	5.13	11.14	1.24	0.62
		186	211	214	100	100	100	100

Source: Prepared by the researcher; Details for 1976 from: PADCO, Inc. *et al* 1982; Details for 1986, 1996, and 2003 are calculated by the researcher based on data from: (CAPMAS, 1976,1986, 1996); (City Population, 2003); and (The World Gazetteer, 2002).

The development of the last three categories (intermediate, small, and smaller settlements) is of considerable importance to control the dominance of the primate cities category and to attain a more dispersed urban population all over the country. Also; this is important to improve the living and the environmental conditions of the primate cities as well. Cairo, with about 10 million inhabitants in 1996, marks the second highest population density in the world, after Hong Kong, with a density of about 23,166 person/km^2 (Demographia, 2001). As a result of this very high population density, slum areas are wide spread in these large agglomerations. During the 1987–1992 period, the Greater Cairo Region (GCR) informal housing market increased in size by 69%, while the overall GCR housing stock increased by 34% In 1992, about 19.4 percent of the GCR urban population, or nearly 2.5 million people, were living in slum and informal communities (El Araby, M. 2002). In addition, the slum housing stock was expected to increase by 81% to roughly 426,000 units by 1996 (CAPMAS, 1991, 111).

Because of the fact that the Egyptian definition of urbanisation is mainly concerned with administrative purposes, focusing on urban settlements according to the government's definition may be misleading and hides another important pattern of unrecognised urbanism in Egypt. In fact, there is an alternative process of urbanization, namely, that which concerns mostly small towns and the struggling urban villages with a population of 10,000 or more. Although these settlements are usually classified as rural, they start acquiring many urban characteristics such as greater social distance and anonymity among their inhabitants, a more extensive exchange of goods and services, division of labour and occupational diversity. Moreover, modern transportation, telecommunication and television, and new consumption patterns have enabled these villages to develop some aspects of urban life. The efficient provision with electricity and infrastructure is a significant factor contributing to the emergence of some urban life aspects in rural communities. The majority of rural households (86 percent) enjoy electricity and well over half of them (57 percent) have access to running water.

The agglomeration process of this type of community has a momentum that tends to reproduce the process. As more people gather in these communities, diversification increases and new activities and occupations are created which, in turn, make these locations more attractive to those in over congested urban centres. Occupations in such urban villages are no longer limited to the traditional farmers and shepherds but include many modern occupations such as teachers, mechanics, drivers, lawyers, doctors, employees of day-care centres and government officials. The radical change in housing style is another important way of showing how the countryside is being urbanized. The rapid increase in construction of flats (as opposed to typically rural dwellings) signifies a convergence in the living conditions between urban and rural areas. In 1996, for example, there were as many apartment buildings being constructed in rural areas as in the cities, and the number built in rural areas was double that of ten years earlier (Bayat, A. and Denis, E. 2000, 194).

5.3 Problems of Urban Primacy: the case of Cairo, Egypt

The previous analysis of Egypt's urban system clearly reveals that urban primacy is a characterising phenomenon of that system. Although this phenomenon reflects the relative advantages of primate cities on the national and regional levels, it creates many serious problems in these cities. In this chapter the thesis tries to examine the main problems of urban primacy in Greater Cairo Region (GCR), as it is one of the best examples of urban primacy centres that suffer many serious socio-economic and environmental problems. However, and to give a broader idea about the GCR's role on the national and international levels, the thesis will start this section by highlighting the main factors behind the increasing primacy of the region.

5.3.1 Primacy Factors in Greater Cairo Region

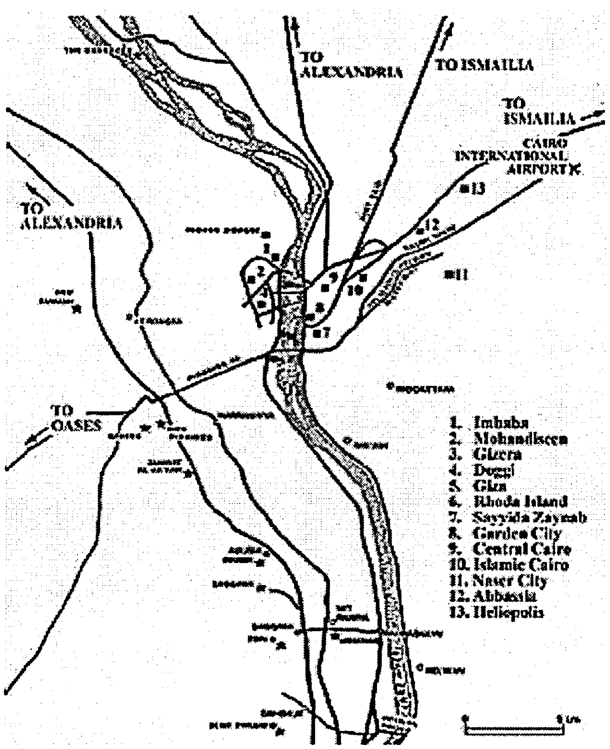
In investigating the factors behind the increasing primacy of Greater Cairo Region, the thesis will focus on the demographic, economic, and political factors as they are the main factors behind such phenomenon in Cairo and as they are getting more influential with the increasing primacy of the region.

5.3.1.1 Demographic Factors:

At the start of the twentieth century, Cairo was already a rather crowded capital, with more than half a million inhabitants. However, its population has increased very rapidly to 11.2 million in 1996, just before the end of that century (CAPMAS, 1997) and reaching about 16 million inhabitants in 2003 (The World Gazetteer, 2003). This means that the GCR's population is increasing at an annual average rate of approximately 4.7% since World War II. Moreover, the GCR's share of national total population has increased from 12.5% in 1960 to 22.7% in 1996, and is expected to reach 25% by the year 2010 (El Araby, 2002). More strikingly, the GCR population was about 40% of national urban population in 2003 (The World Gazetteer, 2003). All of these facts demonstrate the increasing primacy of GCR. Rural-urban migration is seen as the main driving force behind the urban primacy of the region (Yousry and Aboul Atta, 1997). High rates of natural increase in Egypt partly account for rapid urban growth rates, especially in Cairo and almost all urban centres in Egypt where population natural growth rate is very much lower that that in rural areas. The analysis of population migration streams and magnitude in Egypt, presented in section 6.2.1, clearly demonstrates that Cairo was the main destination of many of these streams. Within the urban sector, and as shown in section 6.2.2, Greater Cairo Region has witnessed higher rates of population growth than medium- and small-sized centres.

While the population of Egypt has increased by more than 5 times in the twentieth century, Cairo's population has increased by nearly 16 times.

In 2002, The Greater Cairo Region ranked the tenth largest mega-city in the world and expected to grow to 16 million by the year 2006 (World Bank, 1997; El Araby, 2002). Although the GCR occupies 928 km^2, Cairo marks the second highest population density in the world, after Hong Kong, with a density of about 23,166 person/sq. km (Demographia, 2001). The region is spatially distributed over three governorates: Cairo, Giza and Qaliubiah and contains the cities of Cairo, Giza, Shubra El Kheima, five small towns, 10 villages and contiguous suburban and agricultural areas (Fig. 5.9). Moreover, five satellite towns; the Tenth of Ramadan, Sixth of October, Obur, Fifteenth of May and Asalam; are located adjacent to the boundary of the region but not included in it. Therefore, while acquiring an increasing share of national population, growth within the GCR is experiencing an increasing urban growth in the periphery areas. While the population of Giza and Qalubiah increased by 49.5% during the 1976–1996 period, the population of Cairo increased by only 24.8% during the same period (MHNCU, 1988 and 1992).



Source: adapted from Touregypt, 2001

Figure 5.9: The Greater Cairo Region (GCR)

Because of its largest share of both urban and total national population, Cairo and, to a lesser extent, Alexandria, with a population of about 3.9 million in 2003, dominates the urban system and there is a wide gap between these two cities and the remaining settlements. Yousry and Aboul Atta (1997) stress that indices of primacy in Egypt are among the highest in the world.

From the administrative point of view, GCR is currently the most important urban agglomeration in the country and serves as the main centre of government, finance, commerce, education and culture, as well as a transportation hub. These features also make the GCR the national citadel of the expertise, resources, and political power needed to combat chronic economic, social and environmental problems.

5.3.1.2 Economic Factors:

Since the start of the British colonization of Egypt in 1882, government policies have favoured urban areas and particularly large centres, and consequently a strongly primate settlement system was developed, focusing on Cairo as the political and administrative centre. Alexandria was also developed as a port that links the country with the outside world and to facilitate the export of agricultural products. After the 1952 revolution and gaining independence, this attitude has continued as the government has directed its major resources towards these large urban centres for efficiency, political, and sometimes prestige reasons. It was believed then that it is more efficient to develop urban centres because of the availability of services, infrastructure, power, and skilled labour. Moreover, the favoured strategy, for political as well as developmental reasons, has focused on industrialization and concentrated industrial activities in urban centres, especially Cairo. This is while rural areas did not receive much attention, with the exception of a few instances where rural development experiments have been carried out, such as in Mudiriat El Tahrir in the 1950s and Salhia in the 1970s. The underdevelopment of rural areas has been the driving force behind rural-urban migration.

Since 1952, when Egypt began to implement its national industrial plan, the share of the industrial sector in the total economy increased from 8 per cent in 1952 to 22 per cent in 1961 and to 42 per cent in the late 1970s. Since early 1980s, it has decreased in relative terms, to 25 per cent and 28 per cent in 1980 and 1985, respectively, leaving the lead to the service sectors since 1983. Most of this industrial development was concentrated in the GCR. In 1976 more than 55 per cent of Egypt's industrial establishments, 48 per cent of industrial employment, and 51 per cent of industrial output were located in the GCR. Although these percentages have fluctuated since, industries are still highly concentrated in the GCR.

During the last 50 years, the GCR region has witnessed dramatic economic changes, including the transformation of the Egyptian economy from state-controlled to state-organized economic mechanisms. During the 1990s, and because of these economic transformations, the region observed the growth of national economies, which expanded in real terms at an annual average rate of approximately 6.2% during 1994–1997 "boom" period (Rodenbeck, 2000). Furthermore, the GCR's role in the Egyptian economy significantly increased during this period, and accounted for over 45% of GDP, and nearly 40% of manufacturing output in 2001 (Bush, 2001). The Economic Reform Policy emphasizes the stimulation of private investment and promotion of national-export-oriented industrialization, based primarily on manufacturing activity. The measures adopted include privatization, public sector reform, price liberalization, and opening markets to the world economy (Bush, 2001). This process led to a rapid transformation of small-scale industries into other GCR-based service businesses, and increased the number of large manufacturing-oriented and service industries in the region (El Araby, 2002). Since 1980s major investments have been directed towards industrial development in the new cities, particularly those near the GCR such as 6 October and 10 Ramadan Yousry and Aboul Atta (1997). Such process had further pushed its economic pre-eminence.

As a result, the GCR share of the national GDP has increased from 42.4 to 50.1% during the 1986–1996 period (Rodenbeck, 2000). By the end of 1990, GDP per capita in the GCR was roughly US$ 1890, whereas GDP per capita in the rest of the country was barely US$ 820. El Araby (2002) argues that the trend towards an increasing GCR share of economic output shows no sign of abating in the near future. Moreover, increasing spatial disparities in economic activity have also produced growing disparities in household income. During 1975-1988 period, the share of total income earned by Egyptian households in the lowest 20% of the household income spectrum declined from 6.1 to 4.5%, while the share earned by households in the top 20% increased from 38.9 to 55.0%. By 1995, the spatial disparity in income had also become extreme, with monthly household income in GCR averaging US$ 124, in contrast to the rest of the country, where it was only US$ 68 (USAID, 1997). This increase in income disparity gave Egypt the distinction of having the most inequitable income distribution among several countries in Africa and elsewhere (El Araby, 2002).

Concentration of investments and the widening income disparities in favour of GCR led to the concentration of services in the region, which in turn became an important factor in attracting more migrants from rural and urban areas to it.

5.3.1.3 Political Factors:

The centralization of government in Egypt is a major factor in Cairo's increasing urban primacy. Moreover, decision makers, government ministries and institutions, central offices for all Egyptian organizations, major investors, and elite groups that possess economic and political power are all concentrated in Cairo. Many studies (such as Todaro, 1981; Yousry and Aboul Atta 1997) have discussed the role of the elite group in the concentration process and came to two main points. First, that élitism implies the concentration of power and influence over decision-making in a few hands Second, that when economic planning decisions on what to produce and for whom to produce are made under elitist conditions, income generation and distribution will be biased in favour of groups influencing those decisions. Conversely, individuals and groups excluded from the decision-making process will be losers, as reflected in greater income inequality and poverty.

Before 1952, the elite consisted of those of aristocratic origin and top bureaucrats related to colonization and the ruling system. After the 1952 revolution, the elite group consisted of the top military class, which ruled the country since then. Over time, especially since early 1980s, this has been slightly transformed into a wider elite of families and social groups with close relations with the ruling system. These types of relationships facilitated political power and wealth accumulation in Cairo (Yousry and Aboul Atta 1997).

Also, and from a prestige point of view, the government has emphasized the development of Cairo as Egypt's display window to the outside world. Extravagant services were concentrated in high-class districts and on major roads. Because public investments were concentrated in the core region and not in peripheral regions, inequalities increased within the country and further increased the primacy of GCR.

GLOBALISATION AND INTERNATIONAL RELATIONSHIPS

Many studies (El-Shakhs, 1971; Ibrahim, 1984; Moselhi, 1988, 1995; Yousry and Aboul Atta 1997) suggest that a notable part of the growth of GCR is due to its international relations and its position within the world system. Egypt has been integrated into the world economy since the dawn of civilization owing to its strategic location at the centre of the old world. By the nineteenth century, this integration became more evident with the opening of the Suez Canal, the expansion of the port of Alexandria, and the construction of Suez and Port Said ports.

After the 1952 revolution and independence, the government's industrial development programme was based on high-technology and capital-intensive processes imported from the former USSR and Eastern countries. During the 1970s, Egypt began its "open-door" policy aiming at attracting foreign investment, particularly from the United States and Western countries, as part of the process of shifting to a mixed economy. This period was marked by high inflation rates, sharp rises in imports, significant imbalances in both the trade account and government budgets, and, above all, growing foreign debt. Within Egypt, Cairo has been the centre of financial activities, housing multinational corporations and institutions, and has, as a result, become more and more integrated into the world economy. To fulfil this role, additional high-class residential areas, infrastructure facilities, and services were developed, reinforcing Cairo's growth and primacy.

In addition, Cairo is strongly interrelated with its surrounding regional subsystems: the Arab world, the Islamic world, and Africa. In the Arab world, Egypt is the largest country in terms of population and represents its heart. Cairo is the seat of almost half of the Arab political, economic, and cultural organizations, particularly in the Arab League, and an important banking centre. It provides military support to other Arab countries, as well as being a major source of labour (Findlay, 1994). Cairo is also considered to be the cultural centre of the Arab world by most Arab states (Eddie Ibrahim, 1987). In the Islamic world, Cairo plays an extremely important role owing to the existence of Al-Azhar Mosque and University, which are the centre of Islamic knowledge. In Africa, Egypt has several times been elected as head of the Organization of African Unity, including twice during the 1980s. Cairo is also the seat of many African political, economic, social, and sporting organizations. All these aspects have further increased the primacy of GCR.

5.3.2 Problems of Urban Primacy in Greater Cairo Region

Because of the increasing primacy of Greater Cairo Region, Cairo suffers from serious physical, economical, social, and environmental problems. In this section, the thesis tries to highlight the most serious problems in the GCR: urban poverty, social problems, housing shortage, emergence and growth of slums; transportation and infrastructure; social problems and inequality; and environmental problems.

5.3.2.1 Urban Poverty: Social Problems, Housing Shortage, and Slum Growth in GCR

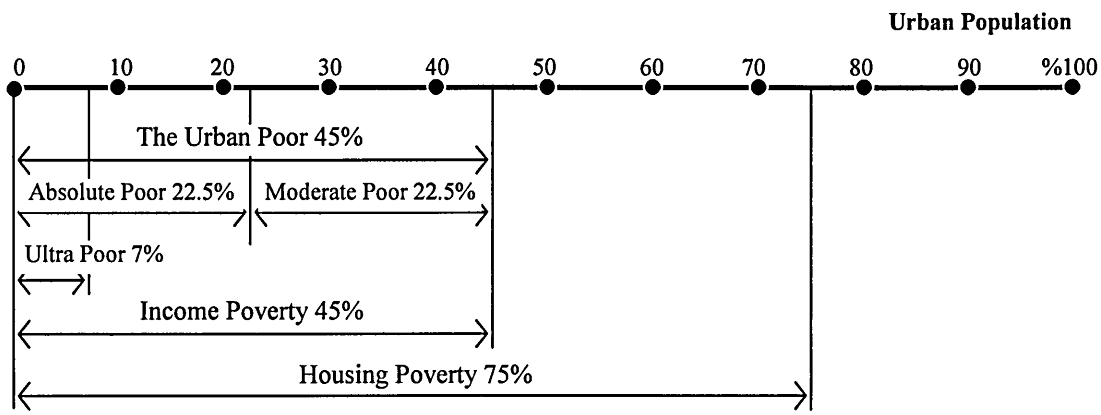
The increasing primacy of GCR has resulted in the increase of urban poverty in the region, which in turn has created many social problems, aggravated housing problems, and accelerated the growth of urban slums in the region. The thesis tries here to examine the extent and the impacts of each of these problems.

- GROWING URBAN POVERTY

Since the adoption of the "open-door" or "economic liberalization" policy in 1974 and the recent implementation of the IMF's structural adjustment program, socioeconomic disparity in Cairo, the largest urban agglomeration in the country, is growing rapidly. The proliferation of more than 100 squatter communities with some six million inhabitants signifies only one, but perhaps the starkest, outcome of such disparity.

Since then, income poverty has been on the rise, "reaching the critical area of food intake to the extent of severely undermining the productive potential of future generations of Egyptians" (Fergany, 1998). Unemployment risen from 10.7% in 1986 to 14.1% in 1992 and is now estimated to be 17% (Danida, 2002). Karima Korayem (1995) pointed out that between 1981 and 1991 rural poverty doubled and urban poverty increased more than 1.5 times. This is while the richest of urban households (the top 10 percent) which controlled about 26 percent of disposable income in 1981 had, by 1991, increased their share to 32.6 percent.

The percentage of urban poor in Egypt increased from 37.5% of the urban population in 1991 to reach 45% by income in 1996 (Abdelhalim, 2002). According to UNDP's Egypt Human Development Report (1996), 22.5% of urban population are absolute poor (cannot afford basic needs) of whom 7.7% are ultra poor (cannot afford basic food consumption), and 22.5% are in a moderate poverty (Figure 5.10).



Source: UNDP, 1996; Amer and Taher, 1992; El-Kasaby, 1992; Mahmoud, 1992; Abdelhalim, 2002

Figure 5.10: Types and Scale of Urban Poverty in Egypt

Due to the high levels of unemployment, inflation, and real income decline, and despite slight improvement in macro-economic indicators, the living standard of the majority of the urban population is deteriorating. Moreover, 'capability poverty', which means the deprivation from capability to be well nourished and healthy, of healthy reproduction, and to be educated and knowledgeable, has also risen due to the limited and inequitable access to socio-economic resources. This in turn affected the housing conditions of the poor by absorbing a large section of their income for health and education at the expense of other expenditures including housing. Capability poverty in Egypt is 34%: 21% in urban areas and 43% in rural areas (UNDP, 1996). Income and capability types of poverty lead to 'housing poverty' (UNCHS, 1996), whereby the urban poor cannot afford adequate housing without compromising their living standard. Housing poverty in Egypt transcends income and capability poverty by about 30%, reaching 75% of total urban population. Although capability poverty is not that high in urban Egypt compared to rural areas, housing poverty is the reverse.

For GCR, and taking into account the impacts of its increasing primacy, Karima Korayem (1995) pointed out that by early 1990s more than half of Cairo and adjacent Giza were classified either as "poor" or "ultra-poor". Under such conditions, urban poor in Cairo cope with these economic realities either by stretching their resources through working for longer hours or by cutting down on their expenditures. Seeking cheap, or sometimes a free inadequate shelter in cemeteries, is a matter of no choice for them to cut housing expenditures in a city suffering acute shortage in housing supply.

- SOCIAL PROBLEMS

The rapid increase in GCR's population that accompanied the increase of its primacy has created many social problems in the region. This situation has been aggravated by the negative consequences of the implementation of IMF's structural adjustment program that highly increased the socioeconomic disparities in Egypt, and especially in Cairo. Levels of unemployment, real and disguised, have risen sharply in the region, particularly during the past decade. Wage jobs in the formal sector have not kept pace with demand. As a result, the informal sector, which it was hoped would diminish over time, has shown clear signs of expansion. Interclass and inter-sector disparities have widened over time to add a new dimension to the polarization process, despite protests by the urban poor and, increasingly, the lower rungs of the middle classes (Yousry and Aboul Atta 1997).

Although data on income distribution in Egypt are very scarce, income disparities became more obvious in recent years. The CAPMAS 1974 surveys showed that the share of the top 20 per cent of the population was around 47 per cent of total income, while the share of the lowest 40 per cent was 17 per cent. In 1980, a study by the World Bank showed that the share of the top 5 per cent of the population had increased from 17 per cent of the national income in the late 1960s to 27 per cent in the late 1970s; and the share of the lowest 20 per cent had decreased from 7 per cent to 5 per cent during the same period (Abdel Khalek and Tignor, 1982). In addition, Karima Korayem (1995) pointed out that in 1991 the richest of urban households (the top 10 percent) was controlling about 32.6 percent of disposable income, up from about 26 percent in 1981. Moreover, the share of wages in national income, which decreased from 50 per cent in 1967 to less than 34 per cent in 1986, indicates the shift towards an increasingly unequal distribution of wealth.

Social problems, such as lack of safety, illiteracy, crime, homelessness, extremism, and violence have appeared in some parts of GCR, affecting both rich and poor areas. It has become evident, during recent decades, that government institutions are unable to cope properly with the ever-increasing rate of growth of Cairo.

- HOUSING SHORTAGE

Many housing studies indicated that 45% of the urban population in Egypt have an insufficiency problem by early 1990s: 33% lack access to housing and 12% are using inadequate shelter (UNDP, 1996; Amer and Taher, 1992; El-Kasaby, 1992; Mahmoud, 1992; Abdelhalim, 2002). In addition to increasing volume of migration to Cairo, the decline in average household size in GCR has significantly increased demand for housing. During the 30-year period of 1960 to 1990, and for a number of reasons, including increasing levels of education and a highly successful family planning programs, the average household size in GCR declined from 6.23 to 4.47 people (NUPS, 1960; 1970; 1980; NUPS, 1992). Correspondingly, while the GCR population increased by 161% during the same period, the number of households increased by 263%. This phenomenon of smaller households, though far more numerous, is currently generating tremendous demands for housing.

The shortage in housing supply in Egypt was a direct result of economic and regulatory problems the country has experienced during the last five decades. Housing supply was mostly provided by the private sector until the late 1950s, when rent control laws were applied. As a result, many of developers in the housing market shifted their investment to other sectors. Consequently, the total number of housing units built per year by both public and private sectors decreased from 56,000 units in the early 1950s to fewer than 30,000 in the late 1960s (Yousry and Aboul Atta 1997). Low- and medium-cost housing was financed by personal and family savings, loans from the General Organization for Housing Cooperatives and the Bank of Housing, as well as low-interest loans to governorates to finance public housing.

The change in Egypt's economic policy during the second half of the 1970s caused drastic changes in the housing market. The annual number of units built increased steadily to reach more than 180,000 in 1990. The role of the public sector diminished and was limited to the provision of low- and medium-cost units, mainly in the new towns and settlements around the GCR. Private investment in the housing and real estate sectors has increased continuously in the past two decades, despite the fact that these sectors are, in theory, tightly regulated and rent controlled and suffer from credit shortages. According to estimates by the Ministry of Housing and Reconstruction, private sector gross investment in housing grew from £E 732 million in 1982/83 to £E

2,950 million in 1991/92, to about £E 4,500 million in 2002/03, representing about 25 per cent of the total private investment in Egypt.

Despite all these efforts, housing shortage is still acute in Egypt, especially for the urban poor. Together with a growing section of the middle-income, the urban poor encounter unaffordable housing development costs and/or rents due to increasing commercialisation. The lack of access to housing restricts the formulation of new families, increases overcrowding, and creates many social, economic and spatial pressures that are difficult for the urban poor to cope with, given their limited resources.

Under these conditions, the urban poor face a web of social, economical, and spatial problems in both formal and informal housing options. Formal options are insufficient (less than 10%) and inaccessible to the majority of the urban poor due to high standards, restrictive regulations, unaffordable terms of provision, and/or inappropriate features. Site and services housing approach, although offering a reasonably accessible option, was limited to few experimental projects that encountered problems in implementation and were discontinued. The only resort for the urban poor is informal housing, where they reside together with two thirds of the relatively poor (65% of the urban population). Although the bulk of informal housing is of a comparable standard to the formal, the process is affected by the government's disapproval and the subsequent lack of planning, technical support, and access to resources, which all affect its adequacy, quality and cost.

- EMERGENCE AND GROWTH OF URBAN SLUMS IN CAIRO

Following the Second World War, and under the pressures of growing urban poverty and the shortage in housing supply, slums and deteriorated urban areas start to appear in almost all Egyptian cities, especially in GCR. Emergence of slums in GCR can be chronologically classified into two main stages.

During the first stage, which started early 1940s, slums appeared inside the city in areas very close to the CBD. These areas were at an average distance of about 3.2 km from the CBD. During this stage, three forms of slums appeared: (1) deteriorated urban pockets in the old centre of the city, (2) squatters and poor quality shelters in forms of tin shacks and tents (called *Eshash*) built on vacant lands in central area and along some of the major roads, and (3) living in and around cemeteries (Musailhi, 1995). For the deteriorated urban pockets, they are mainly inhabited by the urban poor originally from Cairo who were unable to maintain their buildings or to move to urban areas of better conditions. High population density and lack of maintenance and infrastructure are the main causes for the deterioration of these areas. Regarding the tin shacks and poor quality shelters (*Eshash*), they are usually inhabited by the poor rural migrants (see Figures 5.11 and 5.12).

Regarding living in cemeteries, it was the first type of slums that appeared in Cairo. Such process has started by the undertakers and poor religious people who used to provide the service of burying the dead. As housing shortage problems became more acute, poor people start residing in cemeteries. It should be noted here that cemeteries in Cairo are of two types. The first one is that where bodies are buried underground with only a small stone appears over-ground. The second type of cemeteries is the courtyard cemeteries, where bodies are buried underground in an uncovered courtyard, and it usually includes two rooms or more, a kitchen, and a small toilet. Also, people can build new rooms in the cemetery courtyard and in the in-between spaces. In addition, such cemeteries are highly decorated and of good architectural styles that can hardly be found outside such cemeteries (Musailhi, 1995). Despite the inhuman condition of living with the dead, it provides the urban poor a form of shelter and central location in the city. More interestingly, 40% of cemeteries' residents think it is a logical solution as they believe that the government will not provide housing for them; 40% think it is an arbitrary situation and accept to move if alternative housing is provided; and 20% refuse to move and have vested interest in staying (Soliman and Shenoda, 1988; p. 353).

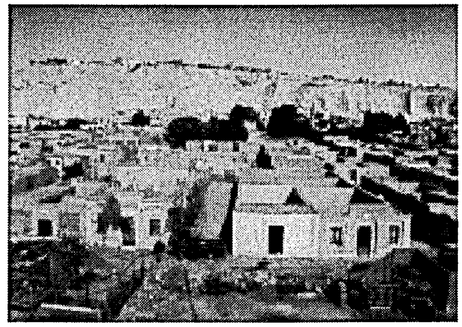


Figure 5.11: Cemeteries in Cairo being used for residence

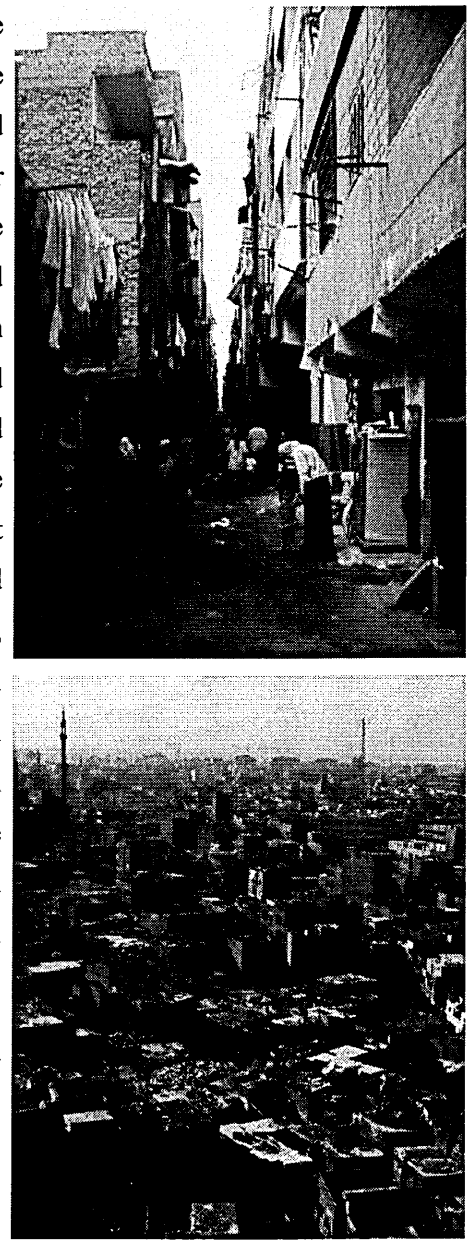


Figure 5.12: Slum typology of informal housing on the outskirts of Cairo

The second stage of slum emergence in GCR started early 1960s. During this stage, slums start to appear on the fringes of the built up areas in the form of what so called "*ashwa'iyyat*" or "informal or unapproved subdivisions". Informal housing, in the form of illegal subdivisions for low- and middle-income classes, is usually built on privately owned land (generally agricultural land) that is subdivided into small parcels without informing the local authorities and then sold to buyers without any legal deeds. Consequently, no building permits are issued. The magnitude of this process is far greater than the capacity of government authorities to organize or control it. The result is usually unplanned, high-density, and low-quality developments deprived of basic services and infrastructure. However, when such areas reach a population size large enough to exert political pressure, the government is forced to provide them with water, electricity, and sometimes sewerage networks. Therefore, many housing studies do not classify some of these informal housing areas as slums as they are of a comparable standard to formal housing projects (Musailhi, 1995; Soliman, 2002).

Figure 5.13: Informal housing in El-Konayesa Area, Giza

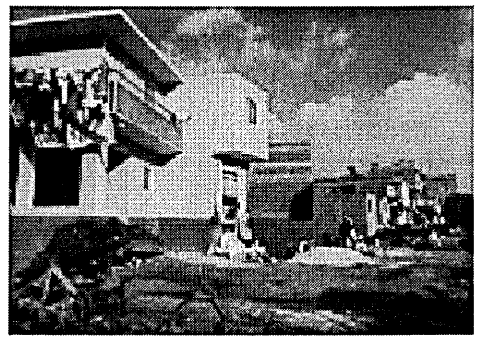


Figure 5.14: Owner-occupied popular housing, El-Konayesa, Giza

Informal housing is estimated to represent more than 70% of the urban housing built in the last four decades (Abdel-Kader, 1991; Hanna, 1996; Abdelhalim, 2002). According to Ministry of Housing (MoH) estimates, informal settlements comprise about half the built up area of large cities such as Greater Cairo, and 84% of its urban mass by origin (MoH, 1998), given that many formal areas are originally consolidated informal developments. According to 1996 census, there are 68 informal areas in Cairo and 69 in Alexandria (CAPMS, 1996). However, MoH (2000) reported that there are 1034 informal areas in Egypt as a whole, covering 344 km^2, the majority of these areas is expected to be Cairo and Alexandria. Soliman (2002) estimated that 2.63 millions of informal housing units exist in Greater Cairo.

Figure 5.15: The lack of sewer network; collection from tanks by truck, El-Konayesa

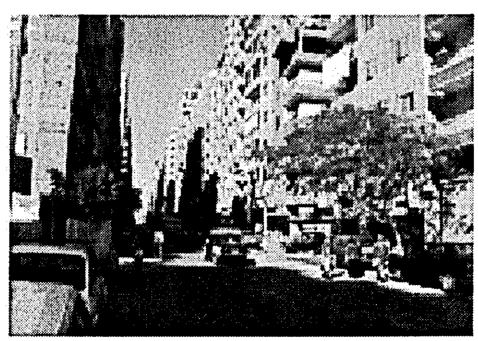


Figure 5.16: Informal housing projects of comparable standard to formal housing, Faiysal area, Giza

According to the 1996 census, 28% of Cairo's population live in informal housing areas. However, other studies have estimated that 40% (Dorman, 2000) to 45% (Harris and Wahba, 2002) of Greater Cairo residents, or about 6.4 millions, live in informal areas (Soliman 2002). These figures demonstrate that informal housing constitutes the bulk of ongoing housing development such that it now represents the norm of urban growth in GCR. Urban poor is the largest section of such populations, for whom informal housing can be considered the main option for being the most affordable and suited to their needs.

- The correlation between slums, urban poverty, and social problems in GCR

Fathy Musailhi (1995) stresses the strong correlation between slums and urban poverty in Cairo. In his study about urban poverty in Cairo, he found that the average yearly income of slum residents is only about LE 189 (about US$ 54), which is less than the third of the average per capita income at the national level. This study classified families of slum areas in Cairo, according to the family yearly income, into four groups: (1) families of a yearly income less than LE 600 (US$ 171) and represents 10.8% of all families living in slum areas in Cairo, (2) families of a yearly income between LE 600-1080 (US$ 171-309) and represents 60.5% of all families, (3) families of a yearly income between LE 1080-1680 (US$ 309-480) and represents 22.8% of all families, and these of a yearly income more than LE 1680 (US$ 480) and represents 8.4% of all families living in slum areas in Cairo. In addition, the labour force in these slums is only 18.2% of its total population. About 70% of them are employed by the private sector. Garbage collection, street cleaning, private service activities (home cleaning, car wash...), and construction are the main jobs for residents of slum areas in Cairo.

On the other hand, David Sims (2003) argues that in Cairo, as in most Egyptian cities, urban poor are not notably concentrated in particular geographic areas. Poor and ultra poor families are found mixed in with lower and middle income families. A small percentage of poor families may also be found even in older upper class neighbourhoods. Conversely, in most informal areas a small percentage of well-off entrepreneurs and professionals will be found. This mix of income groups or "income heterogeneity" in geographical space is due to a number of historical factors, including the lack of residential mobility due to rent control and imperfect real estate markets. However, urban slums can be easily identified in Cairo. These areas are characterised by the prevalence of poverty, high residential density and deteriorated urban environment.

For the correlation between slums and social problems in GCR, Fathy Musailhi (1995) identified a number of social problems prevailing in slum and poor areas in GCR. The most important of these problems is the spread illiteracy. Three-quarters of people living in these areas are illiterate, which is more than the double of illiteracy level in Cairo as a whole (34%). Also, labour force in these communities is very low and estimated to only 18.3% of its total population, while it reaches 30% in Cairo as a whole. More important, population density in these areas is very high and reaches 128,000 capita / km^2; while it is only about 28000 capita / km^2 in Cairo. Crime is widespread in slum areas and appears in the life of almost one-third of the families living in these areas. Robbery and break-in are the main types of crimes in these areas, however rape crimes is relatively high in these areas compared to the low level of these crimes in Cairo or the Egyptian society in general.

- *Government efforts to improve slum areas*

The hard economic situation that was prevalent until late 1980s was the direct reason that prevented all the successive governments to effectively develop slum and deteriorated areas. In addition, improving the infrastructure networks in large cities took higher priority, and has further delayed the government intervention in improving slum and deteriorated areas.

Recently, the Egyptian Government has recognised the acuteness of the socio-economic problems prevalent in deteriorated and under-served urban areas in GCR. Starting in 1992, after some poorer urban areas were perceived as breeding grounds for Islamic fundamentalism, the government launched a programme to improve many of the deteriorated informal areas throughout Egypt. In Greater Cairo a total of 81 informal areas were identified, of which 63 were deemed up-gradable and 18 smaller pockets were slated for demolition and the resettlement of the inhabitants (Ministry of Local Development 2001).

In GCR, the government, and in cooperation with some international organisations such as the World Bank, the UNDP, and some European development organisations, was successful in upgrading many deteriorated urban areas in Cairo; mainly Zainhom and Zabbaleen (garbage collectors) areas. In Zainhom upgrading project, squatters in an area of about 5 hectares have been demolished and new housing blocks were built. During this process, 941 families have been relocated in government owned housing blocks, out of them 348 families have returned to the new houses built in the area. In the current stage of this project, 1802 families will be relocated. In Moqattam Zabbaleen area, similar upgrading program has been applied. In such program, the zabbaleen (garbage collectors) were encouraged to convert their homes from tin shacks into stone and brick buildings. In doing so, the government had set up a loan fund for housing construction, offering architectural services to loan beneficiaries and other community members. The upgrading scheme also aimed at cleaning up the settlement to improve sanitation. This was partly achieved through the construction of a compost plant transforming organic waste to a high quality fertilizer. With the participation of Oxfam, a "Small Industries Program" has been initiated to upgrade the residents' waste cycling capabilities by introducing mechanization into the process.

In early 2004, Ministry of Local Development reported the completion of upgrading programs in 284 slum areas (out of 1130 areas in need for development in the country) and that upgrading programs in 588 slum areas are taking place. Also, Ministry of Local Development reported that the total governmental investments in upgrading slum and informal areas since 1993 have reached about LE 5.2 billions. In addition, it reported that it is planned to invest about LE 1.5 billion during the 2002-2007 plan for improving infrastructure in slum and informal areas.

5.3.2.2 Transportation and infrastructure

The sharp decline in the efficiency of GCR's transportation system is the most evident impact of the increasing primacy of the region. Although the road network in GCR represents nearly 25 per cent of its total area, which is acceptable according to planning standards, its practical capacity is inadequate. Although there are many reasons for this, such as lack of maintenance, poor driving habits, low vehicle occupancy, and lack of parking lots and garages; the increasing number of vehicles in the region, that accompanied its increasing primacy, is one the main reasons for the poor performance of transportation system in GCR. Car ownership in GCR sharply increased from 10 cars per 1000 inhabitant in 1974 to 75 in 1998 (Afifi 1991; CAPMAS 1999), and it is estimated that more than 1.2 million vehicles were on the road in 2003, up from only 0.53 million in 1983 (Yousry and Aboul Atta, 1997).

Because of this rapid increase in the number of vehicles in GCR, that accompanied its increasing primacy, slow and idling traffic are currently among the most serious transportation problems in the region. In 1989, the average travel speed on main roads in the Cairo metropolis was only 8.1 km per hour during peak hours in downtown areas (TETC, 1991). Moreover, it is increasingly difficult to identify peak travel periods in Cairo, for congestion now exists throughout the metropolis from early morning to late evening. During the last two decades, idling traffic has become an issue of national consequence, as because of this unproductive activity millions of dollars of fuel are wasted annually. Egypt's Ministry of Transportation estimated the cost of fuel consumed while idling in traffic to be US$ 500 million per year. For the GCR, it is estimated that each of the nearly 1.92 million households living in the GCR in 1996 "paid" US$ 260 per year or the equivalent of 16 weeks of average household income, solely for the purchase of fuel to be wasted while idling in traffic (El Araby, 2002).

In 1986, about 56% of final energy demand was in the transport sector, up from 46% in 1973. More importantly, the 56% share was the highest such level of 13 African countries surveyed by World Bank (UNDP, 1991). Only South Africa, with a 36% share, approached the Egyptian figure. While the share is projected to fall slightly to about 52% by 2001, largely due to increased consumption in other economic sectors, the share of final energy demand in the transport sector will still be much higher than in neighboring countries. In the light of the increasing primacy of the GCR, the region will remain in contention for having the world's worst traffic conditions well into the future due to the limited potential of proposed projects to ameliorate prevailing conditions, let alone solve traffic problems (El Araby, 2002).

For infrastructure, the increasing primacy of GCR and the accompanied rapid urban growth has overloaded the existing old water and sanitation networks and equipments. Also, the rapid urban expansion on the fringes of Cairo and the extension of infrastructure networks to these areas has resulted in the loss or wasting of a considerable share of its capacity. Although the General Organization for Water in the GCR was providing almost 3 million m^3 of potable water per day in 1996, which is sufficient by international standards to supply the population, more than 25 per cent of this capacity is lost or wasted due to the lack of maintenance of pipelines, equipment, and fittings (Yousry and Aboul Atta, 1997). The old water network and the small pipe diameters add more problems to the distribution of water to many of the new areas on the fringe of the city. For the sewer network the situation is even worse, even in districts connected to the system. Because of the sharp increase in population densities that accompanied the increasing primacy of the region, the discharge in many districts of the GCR far exceeds the capacity of the sewerage system. This causes frequent overflows and represents a dangerous source of pollution.

Moreover, garbage collection and disposing is a serious problem in Cairo, where more than 7,000 tons of garbage is produced daily in 2000 (UNCSD, 1997; El Araby, 2002). Sixty per cent of which is collected by private contractors and the remaining 40 per cent is collected by local municipalities. Informal sector operators based in "refuse settlements- or *Zabbaleen* areas" pay for the rights to collect refuse from wealthier parts of the city, using female household labour to sort it into recyclable waste for sale, organic waste for animal fodder, and unusable waste, which is burnt. However, and because of the increased volume of solid waste and the geographical expansion of the city, neither the private contractors nor the municipalities are able to keep up with the need (Yousry and Aboul Atta, 1997).

5.3.2.3 Environmental Problems of GCR's Urban Primacy

Each of the previously mentioned problems of the increasing primacy of GCR has its adverse environmental impacts on the region. The cumulative environmental impacts of these problems have resulted in the deterioration of air quality and public heath, water quality, and waste treatment.

-AIR QUALITY AND PUBLIC HEALTH

In GCR, current air quality conditions pose a far greater risk to public health than it is currently known. Traffic and industrial emissions are the major sources of air pollution in GCR.

Traffic emissions:

According to UNCSD (1997), motor vehicle emissions currently account for 60–70% of all air pollution in GCR. Based on studies conducted by the national environmental board (UNCSD 1997) vehicle emissions along major roads in the more intensively developed portions of the region were found to be dangerous to human health between 1989 and 1997. Using an air quality index of 100 as the maximum acceptable tolerance level, the board measured an annual average of 277. Another study found that approximately 900,000 of GCR downtown residents – almost 10% of the region's total population – suffered from respiratory illnesses due to air pollution (Rodenbeck, 2000; El Araby, 2002). In 1990, a UNICEF study found that Cairo's children have the highest blood lead levels in the world, even exceeding the levels found among the children of Mexico City, long viewed as the city with the worst air pollution in the world (UNICEF, 1990). The introduction of low-lead fuel in 1991 and natural gas in 1999 were positive steps to improve the city's air quality.

Industrial emissions:

Industrial emissions are the other major source of air pollution in GCR. Concentration of many polluting industries, such as steel and cement industries that were established in GCR during early 1960s to meet the increasing need for jobs, has significantly contributed to air pollution in the region. Not only has the number of industries grown rapidly in the recent past, but also many factories now burn lignite (a soft coal) to cut operating expenses (CAPMAS-b, 1997, vol 1, SA7, p 50). As long as pricing policies favour lignite over cleaner fuels – and readily available ones – the growing number of factories in the GCMR could also result in exceptionally high levels of industrial air pollution.

WATER QUALITY

The Nile, that once served as the basis for the Egypt's description as "Egypt is the gift of the Nile", some of its canals that go through Cairo now receive all manner of untreated industrial and domestic pollutants and have become dangerously polluted. In many parts of these canals, the level of dissolved oxygen (a measure of the "ability" of water to support life and synthesize organic pollutants) is almost zero. Within the GCR, about 1.5 million m^3 of wastewater are released into waterways every day. To improve water quality in GCR, the government has recently approved a sewerage and secondary treatment system. However, such system is only capable of treating 510,000 m^3 of wastewater per day, or only 33% of current wastewater volume (El Araby, 2002). Therefore, and despite such improvements, water quality is not anticipated to improve radically due to predictable population growth.

WASTE MANAGEMENT

The increasing primacy of GCR has created serious problems of waste management in Cairo. In 1987, the GCR was burdened with the task of collecting and disposing of 6100 tons of garbage per day, and increased by 17.6% to reach about 7000 tons per day in 2000 (UNCSD, 1997). That is while the population of metropolitan Cairo increased by only 4.5% during the 1987–1996 period, a matter that reflects a growing trend of increasing levels of waste per capita as incomes and purchases of heavily packaged consumer items increase (El Araby, 2002).

Although collection rates have improved dramatically over time, the treatment and disposal of garbage is still a major problem in GCR. Under current rates of waste generation, the three open dumpsites in GCR will reach capacity in six to seven years. Moreover, most of the estimated 2760 tons of refuse generated daily in the five towns outside the metropolitan Cairo were disposed of in a similar manner. In addition, the rapid emergence of manufacturing activities during the last two decades has resulted in a shift from largely organic forms of refuse to greater quantities of hazardous (and toxic) waste. Most of this waste, along with increasing amounts of medical waste, is disposed of in much the same way as garbage. Until 1997, there was only one hazardous waste treatment plant in the GCR, with a treatment capacity of only 40,000 tons per year (UNCSD, 1997). This means that less than 3% of the hazardous waste generated in Metropolitan Cairo since 1991 was treated prior to disposal.

Generally, it can be asserted that domestic and industrial waste generated in GCR has never been adequately and safely treated and disposed of. Moreover, the increasing primacy and the high population growth expected in GCR in the coming years is likely to mean greater generation of hazardous and toxic wastes, as well as the distinct possibility that these wastes will generate irreversible and significant adverse public health and environmental impacts (El Araby, 2002).

Conclusion:

In this chapter, the thesis has analysed patterns and problems of urban change in Egypt. Also, it has thoroughly examined the problems of urban primacy in Greater Cairo Region. Through this chapter, the thesis came to some important conclusions.

Through reviewing the development history and the technology status in Egypt, it can be asserted that the technological capabilities of Egypt are rapidly growing and will have considerable impacts on shaping the future of urban development in the country.

Through the investigation of urban change in Egypt, the thesis came to three important conclusions. First, the urban system of Egypt suffers high urban concentration levels in certain regions of the country; namely Greater Cairo, Alexandria, and Canal cities. To these very small regions, all migration streams are heading from all over the country, from both the urban and rural areas. Upper Egypt regions are the main losers of both urban and rural populations. Second, new towns built in Egypt since 1977 were of very limited influence in correcting this pattern of urban concentration. Third, the urban system of Egypt suffers high differential growth of the different settlement sizes as large cities are usually growing faster than smaller ones which usually lose their population in favour of larger cities. In 2003, 51% of the country's urban population were in only 2 large cities of over a million people in size: Greater Cairo (Cairo, Giza, Shubra Al-Khaymah) 38 percent, and Alexandria 13 percent.

The detailed analysis of urban problems that accompanied the increasing primacy of Greater Cairo region reveals three important facts. First, despite the numerous advantages of the region that usually attracts more people and investments to it, such increasing primacy created a web of social, economical, and urban problems. Second, urban poverty and its associated social and urban problems are high and growing in GCR. Housing shortage and emergence and the growth of slums are very high and rapidly growing in the region despite the government efforts to control them. Third, the region is facing mounting transportation, infrastructure, and environmental problems. These mounting problems of the increasing primacy of GCR call for a more comprehensive vision at the national level to control and minimise the increasing primacy of the region and to overcome its problems in the region itself and in the country as whole. In doing so, the adoption of some national policies, designed to control and minimise regional disparities, is a necessary approach.

In the next chapter, the thesis proposes three approaches for managing the urban future in developing countries: urban decentralisation, small-size settlements, and the incremental planning and development of urban settlements.

PROPOSED APPROACHES FOR MANAGING THE URBAN FUTURE IN DEVELOPING COUNTRIES

Introduction:

The previous analysis of urban change patterns and problems in developing countries (Chapter 4) and the extensive analysis of these problems in Egypt (Chapter 5) show that these countries suffer mounting problems of urban concentration and differential growth of different settlement sizes. Taking these problems into consideration and based on the analysis provided in the previous chapters (2, 3, and 4) about technology and its impacts on urban change in both the developed and developing countries, the thesis proposes three complementary approaches for managing the future of urban development in developing countries during the next 30 to 40 years. These approaches are: urban decentralisation, small-size urban settlements, and the incremental planning and development of future urban settlements. These approaches are seen to be appropriate for managing future urban development in developing countries and are expected to be highly facilitated by the future technological achievements. In this chapter, each of these approaches will be examined regarding its advantages, disadvantages, the role of technology in the adoption of each approach, an appraisal of its application in Egypt, and the ways in which the appropriateness and applicability of each of these approaches will be assessed.

6.1 URBAN DECENTRALISATION

In the light of the increasing technological impacts and the mounting urban problems in developing countries, the research argues that urban decentralisation would be an appropriate approach to meet the future urban impacts of technology and to help overcome the mounting urban concentration problems in these countries. But, before proceeding to the discussion of the different aspects of urban decentralisation, it is better to start by defining the meaning of such an approach.

Webster's Dictionary (2001) defines "decentralization" as the dispersion of functions and potentials from central authorities, usually in large urban centres, to suburban areas and outlying districts. Rondinelli *et al* (1984, 9) defined decentralization as the transfer of responsibilities and functions from central governments and its agencies to the local authorities. In that sense, decentralisation is mainly concerned with the spatial distribution of population, activities and resources. Kammeier (2002, 6) argues that decentralization could be defined in at least four distinctly different dimensions - political, administrative, fiscal, and economic decentralization (market-related policies) -

with separate objectives and instruments for implementation. He also argues that these dimensions are complementary and should not be handled separately. The core of most of these definitions and approaches to is the issue of organisational strategy that focuses on the political and economical issues. Concerning technology impacts on urban decentralisation, Kain (1975, 80) described the urban decentralisation process as being "the result of several important technological and economical changes that have made decentralisation is more feasible, more economic, or more desirable choice for increasing numbers of households and businesses".

The definition of "urban decentralisation" varies greatly according to the scale of the decentralisation process. At the local level, urban decentralisation revolves around questions of overcrowding, decongestion and space standards, primarily with respect to the living conditions in the older urban areas. At that level, urban decentralisation usually deals with the distribution of population and industry in city's core and outer rings and the emerging forms of suburbanisation, edge cities, and satellite towns. At the regional level, urban decentralisation deals mainly with the regional imbalances of urban systems. At that level, urban decentralisation aims to overcome the urban problems of a given city within its regional context. At that level, urban decentralisation usually deals with the distribution of both population and investments between the different regions of the country and the magnitude and directions of migration streams between them. In that context, urban decentralisation is mainly a tool for, and an objective of, the national development policy. Urban planners, during the 1970s and 1980s, often used the term "decentralization" in a sense of spatial deconcentration, focusing on better distribution of population, services, and industries (Kammeier 2002, 6).

In investigating the importance and effectiveness of urban decentralisation for developing countries, the research adopts the following four-stages process. First, it presents an analysis of the main arguments for and against urban decentralisation, especially for developing countries. Second, it investigates the possible role of technology as an enabler of urban decentralisation in developing countries. Third, it presents an appraisal of the application of the decentralisation approach in urban development process in Egypt. Fourth, it analyses the methods used by the research in assessing the future importance and applicability of urban decentralisation approach.

6.1.1 Arguments for Urban Decentralisation

Almost all urban planning theorists view urban decentralisation as a necessary approach for achieving a more sustainable urban development. Ebenezer Howard is one of the most influential proponents of urban decentralization. In introducing his book "Garden cities of To-Morrow" (1902), he asserted the growing consensus against the concentration of more people in the already over-crowded cities. In support of his arguments for decentralisation, Howard critically examined the evils of slum housing, gin palaces, long work journeys, foul air, fogs and high rents in these overcrowded cities. Consequently, he suggested that city dwellers should be relieved of these disadvantages through being moved into new 'garden Cities" beyond a 'green belt' of agricultural land around existing overcrowded cities (Osborn 1966, 42). The UK New Towns Act (1946) was mainly aiming at decentralisation that is based on Howard's vision: the decongestion of urban areas through the transfer of people and jobs to New and later Expanding Towns. Moreover, Lewis Mumford viewed decentralisation as a necessary approach to avoid the danger of turning "town and country" into an "amorphous suburban mass" (Mumford 1966, 34). Consequently, decentralisation became a major aim of post-war British urban policy (Coursey 1977, 11). Since then, more attention has been paid to what is called "the missing half" of Howard's case for decentralisation. This argument means that the planned transfer of families and jobs would not provide a better and more ample life only for the working class families who moved out, but it would also improve conditions for those who remained behind, in the inner areas, which should be redeveloped or rehabilitated at lower density with generous provision of open spaces (Ward 1973, 13).

Coursey (1977, 13) argues that the advent of the motor vehicle and other technological innovations changed the nature of the case for decentralisation in other ways Howard could not have envisaged: it became a widespread autonomous trend both for households and firms. Consequently, higher incomes and changes in production technology led to a demand for higher space and environmental standards, and improvements in transport technology made this possible.

Although most of the frequently stated advantages of decentralisation are mainly focusing on its effects at the local level, the most important advantages of urban decentralisation are at the regional level. At the regional level, the urban decentralisation approach addresses urban problems within their regional and national contexts that usually influence urban localities, as the urbanisation process is in fact a product of complex and interdependent socio-economic relations between urban units and their regional, national and sometimes the international domains. Therefore, managing urban areas within these perspectives is seen to be more effective and more rewarding for the urban areas and their rural hinterlands. In many cases, urban decentralisation at local level could represent in itself some sort of urban concentration, as is the case of new towns around Cairo (section 5.2.1.4). Although these towns were an attempt to achieve some urban decentralisation of Cairo's population, this process has improved life quality and the economic prosperity of

Cairo's urban region, compared to other regions of the country, and consequently increased its attractiveness to new migrants from different urban and rural regions of Egypt. Therefore, although this process represents urban decentralisation at local level, it is an urban concentration process at national level.

6.1.1.1 Advantages of Urban Decentralisation for Developing Countries

For developing countries, where the pace of urban growth and urban concentration has reached critical levels, urban decentralisation, especially at the regional level, is of particular importance. The constantly high rates of population natural increase and the rapid rural-urban migration are simultaneously causing immense growth in urban population in these countries. The continuously increasing size of Third World cities and its impacts on concentrated poverty and urban deterioration has drawn the attention of national planners, policy makers and researchers alike. Most of the national governments in developing countries have begun to realise that the concentration of activities and population in a few leading cities and the resultant deterioration in living conditions in them are serious threats to the achievement of their stated development goals.

Concentration of urban population in large urban agglomerations; especially those in developing countries in Asia and Africa such as Bombay, Tehran, Jakarta, Cairo, and Lagos; have resulted in many serious problems at both local and regional levels. At the national level, many of these settlements have grown to form large urban agglomerations of multimillion inhabitants. Controlling or managing the growth of such large urban agglomeration is far beyond the capacity of developing countries. Consequently, all these countries suffer serious imbalances in the distribution of urban population at the national level. In Egypt, the Greater Cairo Region grew rapidly to reach more than 12 million inhabitants in 1994, which was more than 45 percent of the national urban population (Yousry and Aboul Atta 1997). In 2003, 51 percent of the country's urban population were in only 2 large cities of over a million people in size: Greater Cairo (Cairo, Giza, Shubra Al-Khaymah) and Alexandria. In a situation like this, urban growth is very hard, if not impossible, to control, as the in-migration from both rural and other urban settlements from all over the country is very high. Countries in this situation suffer high economic and social regional disparities. These disparities, which are usually in favour of large urban agglomeration, if not controlled, will further intensify the in-migration process. Therefore, urban decentralisation at the regional level is expected to be highly effective in controlling these disparities and consequently in managing urban development in these countries.

At the local level, and for reasons of scale and intensity, large urban centres in developing countries suffer serious problems; such as traffic congestion, urban unemployment, shelter deficiency, increasing pollution and urban decay, and inadequate infrastructure, social facilities, and management capacity. These increasing problems supported the growing consensus about urban decentralisation towards smaller urban centres as an effective policy in managing urban development in developing countries (Simon 1997, Gilbert and Gugler 1992; Simon 1992; Drakakis-Smith 1993; Kasarda and Parnell 1993). However, urban decentralisation requires that out-migration from retarded rural and small urban settlements are to be kept to minimum. This requires the adoption of national development policies that minimize the economic and social development gaps between these retarded regions and the large metropolitan centres.

El-Shakhs (1997) argues that the increasing concentration and dominance in many African urban systems are accompanied by mounting problems, diseconomies, and disparities. The resulting dissatisfactions as well as opportunities spurred efforts by both the private sector and governments towards decentralization and counter-primacy measures. These efforts came in a variety of forms, ranging from administrative decentralization and strengthening local governments to radical measures such as the building of a new capital in Nigeria or the new desert cities in Egypt. As these processes pick up momentum, the real or perceived advantages of primate cities may tend to become less and less compelling, and smaller and medium-sized cities may become more and more attractive to migrants and to capital.

In addition to the advantages of urban decentralisation in minimising and controlling the problems in large urban concentrations, such an approach has many advantages at both regional and national levels. First, dispersed urbanisation, especially towards desert and remote regions, would foster the regional development activities and facilitates the utilisation of the national natural resources. Second, urban decentralisation would minimise the expansion of large urban concentrations on the limited agriculture land, especially when we know that the urban growth in Egypt consumes about 40,000 acres of the prime agricultural land each year, and that during the past two decades alone, urban sprawl consumed more than 30 per cent of that land (Said, R. 2000). Third, dispersed urbanisation is expected to minimise the acute regional disparities in many of the developing countries and to ensure the dispersion of investments and services to the retarded regions (Van den Berg, 1998; Krakover, 1986; Sonis, 1978). This is expected to minimise the out-migration of the skilled and more-educated personnel from these regions.

6.1.2 Arguments Against Urban Decentralisation

Criticism of urban decentralisation is largely based on the alleged failure of the "other half" concept of Howard's case for decentralisation as older and inner parts of large urban areas continue to suffer many problems and as the conditions for non-movers did not improve as it is expected. Such problems have been described as the state of "multiple deprivation" in the "inner city" (Coursey 1977, 14). There is an increasing consensus of opinion that social problems are mainly concentrated in large cities and particularly in their inner areas (Shelter 1972, p.15). For inner areas in large urban centres, urban decentralisation is seen to have increased public welfare costs arising from the increasing concentration of socially disadvantaged, increased urban service costs per head and spare infrastructure capacity owing to the combination of fixed overheads and falling population (Power and Mumford 1999; Eversley 1970, 1972; Stone, 1975) Urban decentralisation is also seen to be the cause of these problems as it facilitates the inner city to lose the successful population and activities and to retain ever-higher proportions of those requiring support.

However, it is also argued that urban concentration is necessary for economic growth and the development of economies of scale. This argument is based on the fact that urbanisation level and economic growth go hand-in-hand in developing countries. But this argument neglects that urbanisation could be distributed in a number of small settlements instead of being concentrated in a large one. And the point is that some sort of balance in using resources is to be achieved. Resources should not be spread too thinly/evenly across cities with insufficient concentration in certain cities to exploit the economies of scale in production which were cited above, nor be over-concentrated in one or two excessively large cities. The implication is that there is an optimal degree of urban concentration, and that both over and under- concentration is very costly in terms of economic efficiency and national growth rates (Henderson 2000, 2).

Moreover, it is argued that the resources allocated to assist decentralisation are pre-empting resources required for the pressing tasks of urban renewal. In a similar vein, the Greater London Council (GLC) accepted a recommendation to slow down the development programmes of new towns around London and to divert the saved resources to urban renewal in London (GLC 1975). Similarly, Stone (1975, 189) argued that it may be necessary to reduce or even phase out the growth area policy and to allocate the resources freed to improving the standard of the built environment and services in older and larger cities.

Although such arguments against urban decentralisation are important and require more attention, the majority of the problems claimed to be associated with urban decentralisation are in fact a direct result of decentralisation processes that focus only at local level without addressing the regional dimensions of these problems. In many cases, such as the case of Cairo, while urban decentralisation efforts have been successful in relocating a large number of city population out the city core and other deprived areas, a larger number of in-migration from other regions are accumulating in these deprived areas. This situation supports the argument that the proposed urban decentralisation approach would be more effective if it addresses local urban problems within their regional and national context.

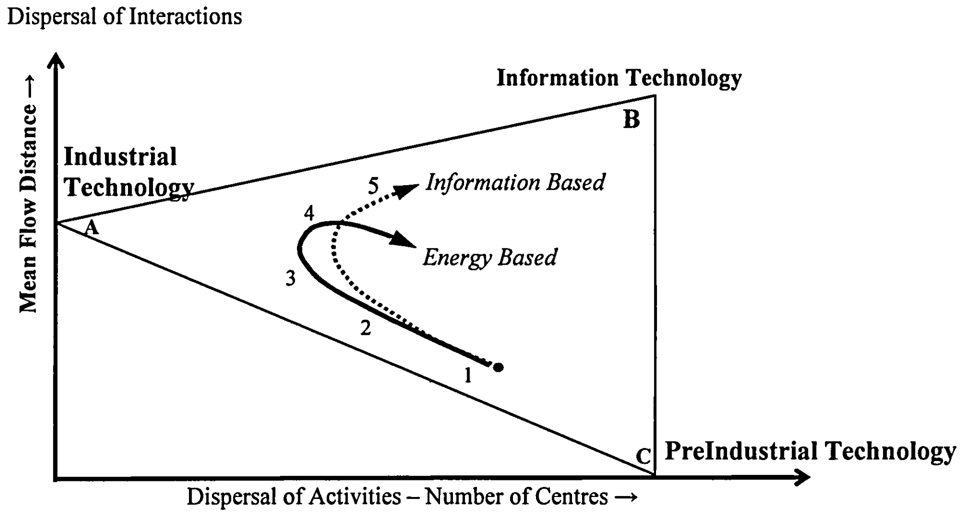
Moreover, these arguments focus mainly on urban problems at the local level and neglect the numerous advantages of urban decentralisation on both the regional and national levels. While only urban cores of large urban areas have claimed to be disadvantaged by the decentralisation process, many medium and small-size cities in rural areas have benefited from this process. Without urban decentralisation, urban cores would have deteriorated more as population density could have been higher and urban renewal programmes could have been less efficient and more expensive.

6.1.3 Technology as an Enabler for Urban Decentralisation

Many urban studies argue that technological achievements have significantly influenced the distribution of urban population. This argument is mainly based on the experience that all countries of the industrial world have shown a considerable degree of urban decentralisation while countries in the developing world are still experiencing growing trends of urban centralisation. The comparative analysis of the relationship between technology level and prevailing patterns of urbanisation in both the developed and developing countries, presented in section 4.4, has confirmed this argument. The rapid advancements of modern technology have supported the argument that while the technology of the Industrial Age has fostered urban concentration and the emergence of large metropolitan areas, technologies of the Information Age are expected to promote urban decentralisation activities.

The logic of the expected changes towards urban decentralisation is based, to a great extent, on the experience gained with the previous 'spatial technology', namely the automobile, the railways, and telecommunications. During the twentieth century the automobile substituted the horse-drawn carriage, and to some extent also rail lines, and thus substantially enabled people to expand their choice of residential location (Muller 1986, 24). In the United States, and to a lesser, but significant degree in Europe, the sprawl into the suburban bedroom communities was followed by a suburbanisation of retail and employment, escaping the growing congestion and the increasing blight of central cities. Edge cities are one consequence of this centrifugal force which pushes first residences and then retail, employment and leisure activities out of the central city of the metropolis (Garreau 1991). Large metropolitan areas spread even further into what is becoming known as "exurbia", where physical amenities of rural settings can be combined with urban production and particularly consumption patterns (UNCHS-Habitat 1995).

Brochie, Newton, Hall, and Nijkamp (1985, 12) have studied the role of technology in the spatial diffusion of urbanisation. They argue that technology affects the dispersion of urban activities and the interactions between them. Their argument is based on the idea that the dispersal of non-residential activities may be measured by their mean distance from the urban centre or by the number of dispersed centres within the metropolitan area, and the dispersal of interactions may be measured by the mean flow distance. They expressed these two parameters as the two axes of a graph, representing an activity-versus-interaction space (Figure 6.1). The triangle ABC represents the feasible limits of that space. Point C represents pre-industrial or low urban technology (non-motorised travel) and low density concentration. Point A represents the extreme of concentrated industrial technology, supported by public and private radial mass transport systems, and high-rise buildings. It represents the industrial society and its organisational structure, dependence, hierarchies, concentration, limited choice, representative democracy and institutional help. Point B represents an urban system that is based on information technology in which dispersed activities interact electronically – the fully interconnected, wired city. It represents the information society, interdependence, networks, diversity and participatory democracy. Point C represents pre-industrial or the alternative society, independence, 'low tech' or 'high touch', self-help and the informal sector (Brochie *et al* 1985, 13).



1- Centralisation during decline in population *2- Absolute centralisation*
3- Relative centralisation *4- Relative decentralisation*
5- Absolute decentralisation

Source: Brochie, J. *et al* 1985, p.12

Figure 6.1: Technology and the Spatial Dimensions of Urban development

According to their suggested trajectory of the urban system over time, early stages of metropolitan development are accompanied by a movement inwards, or concentration. The later industrial and post-industrial development stages are accompanied by an outwards movement. They suggest that information-based industries will move towards B, especially where interactions are primarily electronic. They argue that this movement may be slowed by the need for some of these industries to retain 'high touch', face-to-face interaction for transactions needing trust. Material- and energy-based industries, too, are expected to take a lower trajectory, especially when the interactions are largely energy-based, and when the movement of heavy materials is involved. Therefore, they argue that changes occurring in a society and its urban systems as a consequence of the information revolution are by no means similar or unidirectional, but on the contrary, they are diverse, profound and multifaceted (Brochie *et al* 1985, 13). In their study of land-use and transport interactions Mackett and Lodwick (1985, 254) acknowledged the argument of Brochie, Newton, Hall, and Nijkamp (1985) calling their graph (shown in Figure 6.1) an "urban technological triangle".

The previous analysis of urban impacts of different technology sectors (presented in Chapter 3) demonstrates that these technologies could facilitate urban decentralisation. For transportation technologies, Peter Hall (1970) asserted that there is a close interrelationship between the available forms of urban transport and the form of urban growth. Pacione (2001, p.248) stressed that the development of railways and trams during the nineteenth century was crucial in separating home and workplace, encouraging functional specialization of land uses in the city. Also, Many urban experts such as Hall 1993, Pacione 2001, Herbert and Thomas 1997, Hart 2001, argue that transportation technologies of the Post-Industrial era would facilitate population deconcentration, post-suburbanisation - the emergence of edge cities – on the local level, and would promote urban decentralisation and diffusion of settlements on the regional level (table 3.2, Chapter 3).

For telecommunications technologies, and almost thirty years ago, Manuel Palao and Garcia-Suelto (1975) emphasised the regional impacts of telecommunications and argued that ICTs would contribute to physical decentralisation. They argued that new ways of using ICTs should be found both to ease problems of city congestion and to improve the quality of life in rural areas. In a similar vein, Roger Pye and Thomas, H. (1976) confirmed that telecommunications were extremely important in decisions about office relocation. They were perceived to be important by managers responsible for such decisions. Office workers who were relocated from some firms in London had fewer meetings, even before relocation, than was typical. After relocation, many meetings had to be retained with people in London and the costs of the travel could negate the other considerable costs savings that might be obtained on relocation especially if this was to a site outside the South East of England. In view of the large potential of telecommunications as a substitute for travel, they expected that telecommunications would be a powerful instrument to encourage relocation. However the research also showed that the use of telecommunications would, on its own, only encourage more offices to relocate to the area around London. Relocation to other regions, especially to those less developed, would be assisted through the use of telecommunications only if there were policies promoting this movement (Pye and Thomas 1976, 92).

Many recent studies have supported the previous arguments of Manuel Palao and Garcia-Suelto (1975), and Roger Pye (1979). Peter Gordon and Harry W. Richardson (1997, 95) argue that the rapid advances in communications technologies would facilitate the movement out of cities that the automobile had initiated. They argue that today's cities will continue to become less compact and the city of the future will be anything but compact. Many other studies argue that technology will eliminate the need for cities as centres of interaction (Moss and Townsend 2000, 32; UNCHS-Habitat 1995; Cairncross 1997, 18). Nicholas Negroponte (1996, 165) and Wheeler *et al* (2000, 3) argue that the post-information age will remove the limitations of geography. Digital living will be less and less dependent upon being in a specific place at a specific time, and the transmission of place itself will start to become possible. Even the concept of the "edge city," is an indication of how both transportation and communication technologies are considered as forces that have fostered the out-migration of work and housing from the central city (Moss and Townsend 2000, 32).

Similarly, future achievements of both renewable energies and urban utilities technologies are expected to facilitate urban decentralisation as they offer economic alternatives to overcome energy and utilities problems in remote and rural areas. Clearly, these technologies add more freedom in locating urban development projects and allow them not to be strictly located near electricity grids or water and sanitary stations (see sections 3.3.3 and 3.4.3).

6.1.4 An Appraisal of Urban Decentralisation in Egypt

Although policymakers in Egypt, as in all the developing countries, claim to have adopted of urban decentralisation, it seems that such approach have been applied only at the local level. The analysis provided in section 5.2.1 clearly demonstrates that government efforts mainly focused on alleviating urban problems of primate and large cities of the country.

The three 'generations' of new towns in Egypt were built around very close to these large cities. The sequence of these 'generations' has been in accordance with urban concentration level of these cities. Cities of the first generation were built in 1977 around Cairo and Alexandria. In this generation, three independent cities (10th of Ramadan, Sadat, 6th of October) and four satellite cities of smaller sizes (15th May, New Damietta, New Burj El-Arab, and Al-Salehia) were built. The second generation consists of five cities of smaller sizes; of which two are around Cairo (Al-Obour and Badr), one near Alexandria (Nobaria), and two in the North Upper Egypt Region (New Bani-Suef and New Minia). The third generation consists of three cities in South Upper Egypt (New Assuit, New Souhaj, and New Aswan) and ten urban centres around Cairo. All cities built in both North and South Upper Egypt regions were in fact very close to the main large cities of these regions. This shows that the adopted urban policy was mainly focusing on alleviating the urban problems of these large cities through displacing some their population to these new satellite towns. Therefore, these new towns may have been successful in attracting some of the local population, but they did not significantly correct the regional problem of urban concentration in Egypt. This is mainly because building the majority of these cities around Cairo and Alexandria has opened many new housing and job opportunities in these cities and increased their attractiveness to both rural and urban population of other regions. As a result, and during 1986-1996 period, the GCR and the urban governorates of Alexandria, Port Said, and Suez were the main target for population migration with net in-migration of about 1.056 million people in their urban centres and about

388,000 people in their rural areas. This is while the Delta and Upper Egypt regions have lost about 840,000 and 685,000 of their urban population. The highest percentage population loss was in the Upper Egypt region that lost about 17 percent of its urban population during that period.

This analysis, in addition to the analysis of migration streams of urban population in Egypt presented in section 5.2.1.3, clearly demonstrate that the adopted urban decentralisation policy was mainly at the local level with limited effect at the regional level.

6.1.5 Urban Decentralisation: Approach Assessment

Through reviewing the literature about urban impacts of technology and urban decentralisation and through the analysis of urban problems in Egypt, it becomes clear that urban decentralisation would be an effective approach for overcoming mounting problems of urban population concentration in developing countries. In a further step to assess the appropriateness and applicability of urban decentralisation, the thesis will survey the opinions of both technology and urban development experts about such approach through the forecasting survey presented in the next three chapters.

In doing so, the forecasting survey investigates several points of considerable importance for examining the appropriateness and applicability of the urban decentralisation approach. First, the research surveys the opinions and expectations of urban development experts about the appropriateness of such approach and the possibility of future technological achievements (transportation, telecommunications, renewable energy, and utilities) to facilitate its application. Second, the research surveys the expectations of urban experts about whether these technologies would promote local or regional decentralisation of urban population. Therefore, urban experts are asked about their expectations regarding the movement of urban population at both the local and regional levels, and about the location of future urban settlements. Through these questions, and others concerning the size and function of these settlements and the changing home and work environments, it is expected that the thesis will come to a clear idea about the suitability and applicability of urban decentralisation approach for managing urban activities in developing countries. Third, the research surveys the expectations of urban experts about the future impacts of technology on the future size and function of existing settlements.

6.2 SMALL-SIZE URBAN SETTLEMENT

Because of the rapid increase in the size of large urban settlements in developing countries, especially in Egypt where about half of the country's urban population is concentrated in two cities only, and because of the mounting problems associated with this phenomenon, the research proposes the small-size settlement approach as an appropriate approach for managing the future of urban development in developing countries. This argument is based on the idea that the recent and the expected technological achievements would be in favour of small-size settlements. In investigating the rationale of this argument, the research adopts the following four-stages process. First, it sheds light on the expected advantages of small-size settlements and the declining attractiveness of large ones. Second, it investigates the possible role of technology as an enabler of such approach in developing countries. Third, it presents an appraisal for the application of the small-settlements approach in Egypt. Fourth, it analyses the methods used by the research in assessing the importance and applicability of such approach.

Although settlement size may be defined by area or by population, and for the purpose of this study, the thesis uses the population size as a measure of the settlement size because population and settlement size is usually linked in urban studies. In addition, population data is more available and more credible.

6.2.1 Arguments for Small-Size Urban Settlements

Thirty-eight years ago, Constantinos Doxiadis (1965, 6) predicted the emergence of the '*Ecumenopolis*'[1] in the second part of the 21st century. However, he stressed the values that small cities have for their own inhabitants, for those in big cities, and for the world population and civilisation. Regarding their values for their own inhabitants, he argued that if they provide shelter, employment and community life of a quality that is not available in big cities, then they do have a great value for their inhabitants. Concerning their value for the population of big cities, he argues that this is due not only to the services they provide to big cities, especially as centres of primary production, but also due to the fact that small cities preserve human values which are gradually being lost within big cities. Finally, and concerning their value for the entire population and civilisation, he argues that this is due to the fact that we all depend on a complicated system of enormous number of human settlements, ranging from the largest to the smallest ones, and it is not possible to allow any part of that system to

[1] *Ecumenopolis* is the Universal City that is predicted by Constantinos Doxiadis to emerge as dynamic cities are gradually going to be interconnected into a continuous network of built-up areas which in the second half of the 21st century is expected to cover the entire earth with a net-like city having a probable population of about 10-30 billion people.

disintegrate without endangering our possibilities for survival. Moreover, he posed an important question: how do we know that big cities can survive without the small ones? And argued that this has never happened before and that we are not allowed to let it happen without being aware of its repercussions to our welfare.

Currently, the role of small-size settlements in regional development constitutes an important subject of debate. Numerous studies have confirmed the importance of this size-category in attaining economic growth and in developing more balanced urban systems. The academic opinions differ regarding the possible contribution of small-size settlements to the spread of modernisation, their impact on the development of the rural areas, their functioning as service centres, and their role in damming the rural exodus (Hinderink and Titus 2002, 379). However, the conventional wisdom of regional planners and policy-makers is that small towns play an essential role as regional service centres in rural hinterland development through direct production linkages and 'spread' and 'trickling down' effects. In this argument, the reinforcement of the small town production and institutional structures not only contributes directly to rural and regional development, but also is seen as a necessary condition (Rondinelli 1988, 1991; Evans 1992; Gaile 1992, 133).

The role of this size-category of settlements is widely recognised as vital for economic growth and restructuring the regional and national urban systems. This is, in part, because of the recognition that a considerable proportion of the world's population live in them. In 2000, over half the world's urban population and a quarter of its total population lived in urban centres of less than half a million inhabitants (UN, World Urbanization Prospects: The 2001 Revision, 172). Much of this population was in market towns and administrative centres with between 5,000 and 100,000 inhabitants (Satterthwaite, D. and Tacoli, C. 2003, 1). Also in 2000, more than three-fifths of urban population of Africa, the Caribbean and Southeastern Asia were in urban centres with less than half a million inhabitants (as was also the case in Europe) (UN, World Urbanization Prospects: The 2001 Revision, 173-180). This is despite the fact that in many nations, there is an underestimation of the proportion of the population living in urban areas, especially in small centres, as they adopt higher population thresholds for considering settlements as urban[1].

In addition to the fact that the high percentage of population living in small settlements in almost all countries proves that this size-category of settlements have

[1]For example, by 1996, 17.5 percent of Egypt's total population lived in settlements of between 10,000 and 20,000 inhabitants that had many urban characteristics, including significant non-agricultural economies and occupational structures. These settlements are not classified as urban areas (Satterthwaite and Tacoli 2003, 8). If Egypt adopted the Indian definition of urban settlements (as communities of more than 5,000 inhabitants), around 80 percent of Egypt's population would be urban or, and if adopted the Philippines definition, 100 percent would be urban (Bayat and Denis 2000, 192; Moriconi 1995).

some qualities that enabled them to attract and sustain this huge number of population worldwide, there are many recent studies that identified the advantages and the potentials of these settlements. Satterthwaite and Tacoli (2003, 12) stressed the potential role of small and intermediate urban centres for rural and regional development. They argue that these settlements increase rural agricultural incomes by acting as centres of demand and market nodes for agricultural produce from the rural region. In addition, they argue that small settlements reduce costs and improve access to a range of public and private services and goods from within and outside their region by acting as centres for the production and distribution of goods and services to their rural region. Also, they could reach these objectives through function as centres for the growth and consolidation of non-farm activities and employment for rural residents and through the development of small and medium-sized enterprises or through the relocation of branches of large private or public enterprises. Moreover, they argue that this size-category of settlements is effective in attracting rural migrants from the surrounding region through demand for non-farm labour and thereby decreases pressure on larger urban centres.

In addition to their environmental qualities that are of increasing interest for large proportion of large urban centres residents, technological achievements especially in areas of telecommunications and transport technologies have significantly increased the attractiveness of small urban settlements. These technologies have made life in these settlements more attractive as they made them more physically accessible and virtually connected with the rest of their region and country. Moreover, these technologies have introduced in these settlements many of the formerly large-settlements' services, mainly entertainment, shopping, and education. Moreover, the emergence and the growth of telework activities have made these settlements more attractive to a wide variety of new businesses.

In the light of these advantages, the proposed small-size settlements approach is expected to be an effective tool for the adjustment of the urban national and regional imbalances for many reasons. First, and because of dispersed nature of existing rural settlements in Egypt, small-size settlements are expected to be more efficient in meeting the socio-economic needs of the small clusters of rural and urban settlements. Second, these small-size settlements can easily fit within, and adapted to, the regional settings of existing urban and rural settlements. Small-size settlements offer better chances for the incremental development and the continuous evaluation and reassessment of the approach's effectiveness and suitability. A matter that is not achievable with large-size settlements, as is the case in Egypt where a bundle of large settlements were built in a form of what is know as First, Second, and Third "generations". Such adopted policy in Egypt, in addition to the facts that it increased regional imbalances and that the occupancy rate in almost all of these large settlements are very low[1], the resultant problems on the long run are expected to be very hard, if not impossible, to correct. Third, small-size settlements are expected to facilitate the implementation of the proposed urban decentralisation and incremental planning and development approaches, as it would facilitate the dispersion of urban population to a larger number of settlements that could be built according the need. More important, small-size settlements are easier to manage and suit the management capacity of developing countries.

In addition, Gerald Dix (1986, 274) argues that the main advantage of small cities lies in the possibility of developing in them a sense of identity, a feeling of belonging and participation among residents, a corporate spirit and outlook covering the whole population. Such qualities may make government easier and encourage civic development initiatives. On the other hand, he forewarns that if these small settlements grow too quickly they can easily suffer many of the disadvantages of metropolises without ever enjoying their advantages.

These arguments coincide with the ideas of Constantinos Doxiadis (1965, 7) that stress the necessity to give back, to the existing small cities, and develop, in the new ones, the original and fundamental qualities of small cities. To achieve these qualities, he recommends some important actions that can be summarised in the following three points. First, we must give back to small cities the human scale which they are tending to lose by imitating the big ones. Second, is to keep natural resources intact, as the beauty of landscape and intact non-spoiled nature are the basic recourses of small cities. Third, that we should physically develop small-cities in a way that minimise transport, organise their functions in order to provide the best services to all members of the community, and to give them an architectural scale and to improve their esthetical values.

All of these arguments and views confirm the important role of small cities as a tool for economic growth and correcting the regional urban imbalances. Also, they demonstrate that the proposed small-size settlement approach could be of considerable importance for urban development in developing countries.

However, defining the optimum size for the small city is still an important issue. In connection to Henderson's argument (2000, 2) that both over and under- concentration is very costly in terms of economic efficiency and national growth rates, and although defining an optimum size for the future urban settlement is a hard task and depends on

1 The occupancy rate in all new cities around Cairo, which is the highest among all other new cities in the country and after about 25 years of their construction, is less than 10 percent for the five settlements with target population of 250,000-500,000; and 65 percent for the 15th of May city (target population only 100,000), which is in fact a part of Greater Cairo Region. (See: Sutton, K. and Fahmi, W. 2001; Stewart, D. 1996; CAPMAS 1996; and Denis, E. 1999).

the socio-economic conditions and the development level of each country or a region, defining a certain minimum size, however, is a useful criterion. Waugh (1968) suggests that a community of 6,000 is the minimum size needed to constitute a suburban area, since at that size there will be sufficient services to justify recognition as a separate entity. The suburb is seen therefore as a particular kind of central place, yet its service function is unimportant and for some areas of less than 6,000 local services exist. Because of the high level of car ownership of the newcomers to these areas, further development of local services has often been unnecessary (Connell 1974).

In confirmation with these arguments, many countries use smaller number of population as a threshold for settlements to be considered as urban[1]. A recent and valuable study, prepared for the Irish Environmental Protection Agency, that investigates the key links between the size of settlements and their sustainability, has recommended some smaller and some larger sizes as well. It recommends that a minimum population threshold level of 1000–2000 enhances viability for a primary school, some local services and centralised sewage treatment. Also, a settlement with 15,000–30,000 people enables a secondary school, public and commercial services, and some environmental infrastructure. More important, it recommends that a development pattern with settlement sizes in the 1000–2000 and 20,000–30,000 population bands clustered around public transport nodes is likely to be most sustainable (Richard Moles, R. *et al* 2000, viii).

In addition to the size, settlement shape and density are strategic factors in determining its sustainability. Although the thesis recommends that these two points should be thoroughly investigated as important areas of future research, it tries to introduce an initial investigation about the expected impacts of these two factors. Regarding the population density, which was and still an area of extensive debate, there are two main arguments: the dispersed and the compact city. The claimed advantages of the compact city have been well documented. Conservation of the countryside, less car travel and associated emissions, better support for public transport and walking and cycling, increased access to services and facilities, more efficient utility and infrastructure provision, and the revitalisation and regeneration of inner urban areas are the main sustainability advantages of the compact settlement pattern (Burton, 2000). However, even compact city advocates recognise that the evidence to support sustainability claims are complex and often contradictory (Guy and Marvin, 2000). Moreover, some side-effects of intensification have been highlighted, including loss of greenery in towns and increased environmental wear and

[1] *Urban population threshold is only 200 in Denmark and Sweden, 1,000 in Canada (Herbert and Thomas 1997), 2500 in the U.S. (Gibson, C. 1998), 5000 in India, and less than that in the Philippines (Bayat and Denis 2000).*

tear (Williams 2000). However, and despite its all disadvantages, compact city is seen the best urban form for countries of arid desert climates, such as Egypt (Golany 1980; Pearlmutter 2000). Regarding the settlement shape, "shape" usually refers to the moncentric or polycentric form of the city physical structure. Although each of these two patterns has its own advantages and disadvantages, and because of the small size of proposed city and to go with recommendation of the compact city, it seems that the monocentric shape could be the most suitable for the future city in developing countries.

6.2.2 Declining Attractiveness of Large Urban Settlements

A vast literature, old and new, testifies to the crisis of large cities expressed in high ratings on the scales of noise, pollution, crime and some other undesired characteristics. The old metropolitan cities of the industrial countries are becoming less attractive as places of residence and less adaptable to new businesses' requirements (Alexander and Falk 1974, 87). Constantinos Doxiadis (1965, 5) made a strong statement about the security problems in big cities:

> *"For the first time in the human history it is safer to be in the countryside than in the city. In the past the safest place on earth was the centre of the city; now it is the most dangerous both during the day and night".*

Moreover, population over-concentration in large cities increases commuting, congestion, living costs to excessive levels, and the costs of production of goods. Also, it lowers the quality of urban service provision and creates enormous regional disparity problems (Henderson 2000, 2).

In the following sections (6.2.2.1-4), the thesis tries to reassess the traditional advantages of large urban settlements in the light of the increasing urban problems in developing countries and their increasing technological capabilities.

6.2.2.1 Agglomeration Economies Old Arguments

One of the main arguments for the existence and development of large cities is the notion of agglomeration economies. These economies were of considerable advantage for production that derive from the spatial proximity of producers of goods and services in an interrelated economy. Through agglomeration, producers reduce the transportation costs of moving goods from one firm or stage of the production process to another or from the factory to the customer. The agglomeration economy argument works well in explaining the development of the great industrial urban centres in the U.S. and Europe during the late 19th and early 20th century. In the production of durable goods (automobiles, appliances, etc.) it was advantageous for producers to congregate. Such agglomeration economies were also viewed to be advantageous in the service sector, where face-to-face contact through physical proximity served to cut costs and foster the more rapid spread of ideas (Speare and White 1990).

Many economists argue that technological advances of the twentieth century have chipped away at agglomeration economies. Transport achievements including road improvements and the shift toward truck from railroad car, and most recently the development of high-speed electronic communication have worked in this direction. They were effective in promoting suburbanisation and then enabling movement to even lower density settings, including smaller urban areas and rural communities. Now an organization far from a major metropolis can instantly access the financial markets and other sources of news and information, just as it can deliver that information quickly and electronically. For all these reasons many of the so-called back offices of major financial institutions moved out of the high rent downtown areas to suburban or exurban locations (Speare and White 1990; Marsal 2002).In addition to economies of agglomeration, there also exist diseconomies of agglomeration, mainly the increased costs or disadvantages associated with higher density and proximity. Congestion costs are the most frequently mentioned of these. Although proximity should reduce the cost of delivering goods and services by decreasing the length of transport needed, traffic, the bane of the urbanite's daily travel routine, is perhaps the most obvious congestion cost. Recent data from U.S. censuses indicate that workers in larger metropolitan areas spend a longer time getting to work than that in smaller urban areas. Much of this difference is due to congestion; the remainder is due to the greater physical distance to be covered in a larger, more agglomerated urban area (Speare and White 1990; Camagni *et al* 1995).

Although there is an apparent consensus in favour of small-size settlements, there appears to be no consensus on an exact optimum value for city population. Social scientists have tried to estimate the magnitudes and effects of agglomeration economies and diseconomies but no concrete results have been reached as it is very difficult to disentangle the "true" effects of agglomeration on industrial productivity, congestion and pollution (Speare and White 1990).

In 1985, an attempt to estimate the impact of recent changes in agglomeration economies on large industries in the USA had found that the productivity advantages of large cities have declined (Moomaw 1985, 73). In 1986, another study using industrial data from the United States and Brazil found that economies of scale in manufacturing were more due to localization (being near related activity) rather than to urbanization (size of place) (Henderson 1986, 47). Productivity improvement rose with size of place, but then declined. In 2000, Vernon Henderson, using a panel of 80-100 countries every 5 years from 1960 to 1995, concluded that productivity advantages decline with the increase of the size of primate cities. If technological change continues along the same line as it has in recent years, then any productivity advantage of large urban areas will continue to dissipate (Speare and White 1990).

There are many studies that tried to assess the costs and benefits of increasing city sizes. The empirical work of Tolley *et al* (1979), for example, suggests that the social marginal costs of increasing population in large or over-sized cities exceed the marginal benefits. Richardson (1987, p.561) argues, based on his work on Bangladesh, Egypt, Indonesia, and Pakistan, that the social investment costs of absorbing an extra family in typical large urban areas are threefold that of rural areas, and even more for the largest city in a country. As related evidence on private costs, the UN data for 1996 on metro area rents and commuting costs for a sample of 80-100 cities across 15-20 countries world-wide, suggest that, if urban area sizes increase from 25,000 to 2.5 million, commuting and rent costs each rise by 115 percent (Henderson 1999). This literature tends to presume that the social marginal benefits of moving a family to large urban areas do not justify the various costs (Henderson 2000, 3).

It is claimed that more sparse development patterns result in higher public services costs, as more miles of sewers and roads are needed. Although higher costs might be associated with lower densities if infrastructure costs were the dominant factor in public service budgets, there are a number of reasons why the reality differs from the theory on urban costs. Operating costs, not infrastructure costs, represent more than 60 percent of most local government budgets, and those costs tend to be much higher in the more dense central cities (Ladd 1992, 273; Cox 1997). Moreover, the larger, denser local government units tend to have larger bureaucracies and their political processes are more susceptible to special interest control, which usually tend to increase costs (Cox 1999).

6.2.2.2 Environmental Costs of Large Urban Concentrations

At the international level, urbanization's effect on the global environment is very important. Large, modernizing cities are often referred to as "heat centres" and blamed for contributing to the destruction of the ozone layer. Although motor vehicles are the primary cause of pollution in cities, the increased demand for energy to run air conditioning and electrical appliances is contributing to pollution in many cities. Producing such energy often involves burning fossil fuels, which releases such greenhouse gases. These emissions are seen to lead to global warming, which can cause climate change, rising sea-levels, changes in vegetation, and severe weather events. Oxides of sulphur and nitrogen emitted to the atmosphere from cities have led to acid rain that have killed lakes and forests in North America and Northern Europe (Brockerhoff 2000).

Speare and White (1990) argue that large population concentration usually requires higher costs per person for the maintenance of clean water and the safe removal of garbage. Air quality, in particular, may be difficult to maintain at high population densities if there is not a natural flow of air through the area. Some cities, such as Los Angeles, have difficult problems dealing with air quality because air is often trapped.

Smaller cities are seen to have three advantages in dealing with the environment problems. First, because of their smaller size and typically lower density, they have less concentration of pollutants to deal with. Second, because they have a smaller and often more homogeneous population, they may have an easier time mobilizing support for programs to regulate and reduce pollution (Speare and White 1990). Third, because of their small size, their environmental problems could be better managed and controlled by local governments in developing countries.

6.2.2.3 The Social Costs of Urban Scale

Although much of the attention of literature on the costs and benefits of urbanization has focused on economic criteria, social costs are extremely important. These include the relative distribution of income and other resources for urban areas, crime, anti-social behaviour, and racial and ethnic conflict.

Regarding income distribution, there is a growing belief that the rich are richer and the poor are poorer in large cities compared to smaller ones. Using data on income distribution for the 79 largest U.S. metropolitan areas, Speare and White (1990) found that there is a relation between income inequality and the settlement size. In Europe, similar conclusions have been reached using data about Swedish cities (Gustafsson and Johansson 2000, 22). Although, these studies showed a modest relationship, they do suggest that the distribution of income is more unequal in larger metropolitan areas (Speare and White 1990). In large metropolitan areas, costs of living are usually higher, and therefore an equivalent amount of money may provide less in terms of goods and services compared to a rural area or a small city. In addition, large cities are widely known as sites of more crime, personal danger, and other deviant behaviour. Statistically, the rates of robbery and property crimes show the sharpest rise with urban size (Fischer 1988, 104). Moreover, the US Bureau of Justice Statistics showed that homicides were highest in large cities followed by the suburbs, small cities, and rural areas (US Bureau of Justice Statistics, 2001).

The recent wave of drug-related violence has been heavily concentrated in large cities. Moreover, racial and ethnic conflict is distinct in large cities, as urbanization brings into close proximity those of disparate backgrounds. Larger metropolises exhibit higher rates of segregations and ethnic antagonism becomes manifest in big-city politics, where the race of the candidate matters greatly (Speare and White 1990).

The increasing social problems in large cities and the wide-scale population deconcentration experienced in many large cities during 1970s evoked a lively debate on whether or not people were giving up the higher incomes and other benefits of large cities for the higher perceived quality of life in small towns and rural areas. Many studies of residential preferences over the past 40 years have consistently shown that many people who live in large cities prefer to live in smaller cities, towns or rural areas. However, most of those wishing to live in rural areas preferred them to be within 30 miles of a city of over 50,000 inhabitants (Fuguitt and Zuiches 1975, 491). What seems to be preferred is a relatively small scale for one's immediate residential surroundings, but, at the same time, with the availability of shopping, services, cultural and recreational opportunities associated with a metropolitan area (Filion *et al* 1999, 1341; Speare and White 1990).

6.2.2.4 Large Cities and the Natural and Human-made Disasters

Vulnerability of large cities in facing both the natural and human-made disasters is a serious issue that usually overlooked in urban studies. Population concentration in large cities can exact a heavy death toll from natural disasters, as illustrated by Hurricane Mitch, which destroyed much of Tegucigalpa, Honduras, and other Central American cities in 1998, and by major earthquakes near Taipei, Taiwan, and Istanbul, Turkey, in 1999. Many cities of less developed countries are especially vulnerable to flooding and storm damage because they were established in coastal areas, along routes most suitable for trading (Brockerhoff 2000).

In addition to all the above-mentioned environmental drawbacks of large urban settlements, human-made threats especially weapons of mass-destruction and traffic accidents are serious threats to large cities. In the era of spread and proliferation of weapons of mass-destruction, having large cities or metropolitan agglomerations became a very serious strategic mistake. For a country like Egypt, having about 20 percent of the country's total population in a single location, such as Cairo, is really a serious problem. In a situation like this, population dispersion to a number of small-size settlements is the most effective and necessary measure. The same argument is valid for large-scale environmental hazards such as floods and earthquakes. On the other hand, Motor vehicles are a less sensational and yet a more significant environmental threat to urban residents. Vehicle fleet size in less developed countries has been growing exponentially (Newton and Manins 1999, 277). The International Federation of Red Cross and Red Crescent Societies (1998) reported that by 2020, traffic accidents in urban areas are projected to be the third largest cause of death and disability in the world, ahead of war and infectious diseases, including HIV/AIDS (Brockerhoff 2000).

6.2.3 Will Technological Achievements Facilitate the Adoption of Small-Size Settlement Approach?

Throughout history, it is well documented that technology in its different forms and levels has affected the form and the size of urban settlements. In fact, technology was one of the driving forces that brought cities into existence. Before the Industrial revolution, city size was determined by the walking distance of human capacity or the animal they domesticated. Consequently, cities all over the world, both in the East and in the West, were relatively of similar size. By the Industrial Revolution, and the introduction of railways, tramways, and the automobile, cities grown very rapidly. At the start, this growth was very prominent in western countries where these technologies were developed. Then, and after developed countries had transferred these technologies to their colonies, cities in developing countries grew faster. The same argument could be drawn on other technologies, such as energy and infrastructure technologies.

During the last three decades, large cities in developed countries start to experience out-migration and deconcentration processes to the suburbs, the exurbs, and the rural communities. Such movement is seen to be highly facilitated by the influential new technologies, mainly transportation and telecommunication technologies. New transport technologies and the increasing population mobility and telecommunication technologies have facilitated the emergence of many teleactivities that minimise the need to live in large cities (Chapter 3). Also, recent developments in renewable solar and wind energies, making them more efficient and more economic, could facilitate settling areas that are away from the national grid. Also, the development of small water purification and sanitary treatment is expected to support this attitude.

6.2.4 An Appraisal of the Application of Small-Settlements Approach in Egypt

The extensive analysis of the differential growth of different settlement sizes Egypt, presented in section 5.2.2, demonstrates that the proposed small-size settlement approach is not among the main objectives of urban development policy in Egypt. This is true for both old and new urban settlements in the country.

Regarding old cities, large urban agglomerations continue to dominate the distribution of urban population in Egypt. Although the share of primate cities (of more than 1 million population) of total urban population has declined from 56.6 percent in 1976 to 48.8 percent in 1996, it starts rising again and reached 51.1 percent in 2003. On the other hand, and while the urban population share of settlements of 100-500 thousand inhabitants has increased from 18.3 percent in 1976 to 23.6 in 2003 and the share of settlements of 20,000-99,999 inhabitants has increased from 19.8 percent in 1976 to 22.7 in 2003, the share of smaller settlements of less than 20,000 inhabitants has declined sharply from 5.1 percent to 0.6 in during the same period (table 5.3).

For the new cities, almost all of the 16 new cities are of large size. Four of these cities are of 500,000 target population and are located around Cairo, 7 are of 250,000 target population – 6 of them are located around Cairo, 2 are of 120,000 target population and are located in North Upper Egypt Region, 2 of 70,000 target population and located around Alexandria, and only 1 of 35,000 target population located in South Upper Egypt Region.

On the other hand, the last 20 years have witnessed the dramatic spread of large villages (with 10,000 to 20,000 inhabitants) across the Egyptian countryside. Although these settlements are rural either regarding their lifestyle or the agricultural economic base, some studies have classified them as "urban villages" (Bayat and Denis 2000, 193). In 1996, urban villages of more than 10,000 people have increased in number from only 400 in 1986 to about 628 in 1996. Moreover their share of the total population has progressively increased from 3.2 percent in 1947 to 8 percent in 1976, and to 17.5 percent in 1996. This situation reflects the increasing attractiveness and competitiveness of this category of settlements. It also reflects the importance of this category of rural settlements in developing a more balanced urban system in Egypt and confirms Jamal Hamdan's idea (1990) that "urbanism begins in the village"[1].

6.2.5 Small-Size Urban Settlement: Approach Assessment

Although it has been clear through the literature review provided earlier and through the analysis of ever-increasing growth of large urban centres, as is the case of Egypt, that such approach could be appropriate for managing the urban future in developing countries, the thesis will further examine the suitability and applicability of such approach in these countries through the forecasting survey presented in the next three chapters (7, 8 and 9). In doing so, the survey will investigate several points of considerable importance in defining the size of future settlements. First, the survey will ask both technology specialists and urban experts about the appropriateness of such approach and the possibility of future technological achievements (transportation, telecommunications, renewable energy, and utilities) to facilitate its application. Second, as settlement size depends mainly on its function, the research will enquire about the most probable future functions of new settlements. Third, the research will

[1] *Jamal Hamdan, the most prominent urban geographer in Egypt, argues that the village is the origin of the city and is the answer to most of its problems (Hamdan, J. 1990).*

enquire about the possible ways for the provision of infrastructure (energy, water, and sanitation) and services (education, heath, entertainment, ... etc) in future settlements and the possible changes in work environment. Then, the research asks directly about the most appropriate size for future settlements in developing countries. Through these questions, it is expected that the thesis would come to a clear idea about the suitability and applicability of the small-size urban settlements approach in developing countries.

6.3 INCREMENTAL PLANNING AND DEVELOPMENT OF URBAN SETTLEMENTS

Because of the nature of this study aiming at forecasting the future impacts of technology on urban development in developing countries, and despite all the efforts made to precisely define these impacts, a number of uncertainties are still expected. These are: (1) uncertainties in defining the extent and the rate of future technological change in developing countries, (2) uncertainties about developing the necessary capacity in these countries needed to better define the future urban impacts of technology and to devise and implement the policies and strategies necessary to manage such impacts, and (3) uncertainties about the degree of acceptance and adaptability of local populace to the proposed approaches. In addition to these uncertainties, the volume of the expected urban change is high. Therefore, the research proposes the incremental planning and development approach as a necessary approach to best deal with these uncertainties.

By the end of the 1960's incremental planning developed to overcome the shortcomings of Rational Comprehensive Planning (RCP) methodology. In fact, the RCP rose in response to urban growth problems in the Nineteenth Century when scientific methods were applied to find solutions to urban problems (Hodge 1991. p. 83). This planning methodology is evident in almost all official plans and the plan-making process which involve scientific instruments like forecasts, analyses of issues and concerns, studies of anticipated social and environmental impacts and goal statements (Perks and Jamieson 1991. p. 490). To apply RCP approach, the decision-makers should have: (1) a well-defined problem; (2) a full array of alternatives to consider; (3) complete information about the consequences of each alternative; (4) full information about the values and preferences of citizens; and (5) full adequate time, skills, and resources (MacLeod 1996). Hudson (1979, 388) argues that RCP approaches problems from a systems (integrated) viewpoint, using conceptual or mathematical models that relate ends (objectives) to means (resources and constraints) with heavy reliance on numbers and quantitative analysis. Also, it attempts to sidestep the issue of conflict by presuming a discernable public interest. This assumes that a community's various collective goals can be measured in some effective way (Altshuler 1965).

Because of all these requirements, MacLeod (1996) views the RCP approach as unrealistic and can only be applied to relatively simple problems and in a modified form. While in the real world, inherent limitations on resources, information and time make it impossible to use RCP in its purest form. Lindblom (1959) went so far as to argue that its non-implementability takes away any point in using it (Faludi, 117). In a similar vein, Etzioni (1967, 219) considered the impossibility of predicting all consequences or grasping all variables and the lack of resources and time to collect information needed for rational choice in RCP to considerably limit its practicability.

Therefore, and based on these shortcomings of RCP and taking all the uncertainties mentioned before into account, the RCP seems to be inappropriate for managing the urban future in developing countries experiencing rapid technological and socio-economic changes.

6.3.1 Analysis of Incremental Planning

The concept of incremental planning first emerged in 1955 in a study of the Chicago Housing Authority by Martin Meyerson and Banfield who argued that planning practice was different from the theory of planning. For them, planning practice was not a rational activity governed by experts using scientific knowledge but rather an irrational process dominated by petty political concerns (Gunton, T.J. 1984. p. 404). In spite of planners' best efforts, slum clearance schemes, sterile suburbs, communities alienated by planning decisions, environmental degradation and loss of historic buildings revealed problems with the RCP (Wolfe 1994, 27; Perks and Jamieson 1991,. 504). Also, planning came to be perceived as a political process (MacLeod 1996).

Perks and Jamieson (1991., 507) argue that under these conditions, the relationship between planners and the community changed dramatically. In addition, they argue that planning doctrines that had proved adequate in the late 19th and early 20th centuries were successfully challenged as socio-economic conditions and technological capabilities of societies are rapidly changing and as new pluralism of values was taken into account in a more technology-based and multi-cultural society.

The incremental planning approach, developed by Charles E. Lindblom in 1959, was an effective response to the challenges of the 1960s. He described this approach as "partisan mutual adjustment" or “disjointed incrementalism”. Amitai Atzioni (1967, 219-220) argues that according to this approach, the problem confronting the decision-maker is continually redefined. Incrementalism allows for countless end-means and means-ends adjustments that, in effect, make the problem more manageable. Consequently; there is no one decision or "right" solution but a "never-ending series of attacks" on the issues at hand through serial analyses and evaluation. These features make such an approach more appropriate for a situation where high level of uncertainties is expected.

In incremental planning, plans are not constructed by a strict process but by a series of consultations largely based on peoples' actual experiences, needs and aspirations

(Hudson 1979, 389). Moreover, large decisions are divided into smaller ones and distributed among a large number of stages and actors who make decisions independently and pursuing their separate interests in the light of the prevailing conditions at each stage (Friedmann 1987. 129). The state serves as an independent adjudicator seeking compromises between these groups. According to the Incremental Planning approach, this process brings out the public interest in the light of the actual socio-economic and technological capabilities of the society (Gunton 1984, 405).

In the incremental planning approach comparisons are limited to the few factors that differ in relatively small degree from existing policies rather than undertaking fundamental inquiry into alternatives and consequences each time. It is only necessary to study the aspects in which the proposed alternative and its consequences differ from the status quo (Lindblom 1959, 161) Gunton (1984, p. 406) argues that the small differences involved are more agreeable to interest groups and politicians and the reliance on minor changes may allow for greater learning and avoidance of large errors.

John Friedmann (1987, 130) argues that in "*Incrementalism*" social interaction is substituted for mental processes in systematic calculation and that subjectivity is part of this process. Whereas for RCP, exclusion of factors is accidental, in *Incrementalism* it is deliberate, systematic and defensible (Lindblom 1959, 165). *Incrementalism* rejects the notion that policies can be guided in terms of central institutions of a society expressing a collective "good" (Forester 1987, 51).

MacLeod, D. (1996) argues that although incremental decisions outnumber fundamental ones, they do not outweigh them and that fundamental decisions set the context for incremental ones. Furthermore, he argues that no single tradition of planning can do everything. Actually, each of these theories describe only half the planning picture, one provides an ideal model, the second a realistic view of the real world. In practice, planners usually make repetitive attempts to solve problems, starting off being incremental and becoming more comprehensive. They thus take advantage of the strengths of each approach while avoiding their respective shortcomings, a methodology known as "Mixed Scanning". Usually, planning departments use the RCP approach to develop the Official Plan and employ the incremental approach to implement it in daily planning practice.

In fact, incremental planning is usually associated with incremental implementation of the proposed plans. The basic idea of incremental implementation is to blur the distinction between the design and implementation phases. The main idea of this approach is founded on the experience-based assumption that design and implementation decisions strongly affect one another, and thus a rigorous separation of design and implementation does not accomplish its goal.

MacLeod (1996) argues that the greatest strength of incremental planning and development approach is that instead of attempting to be rational and comprehensive it describes decision-making as it actually occurs. Such approach recognizes that policy is continually being made and re-made, thereby avoiding errors that come with radical change in policy and stays within predictive capability (Lindblom 1959, 165). In other words, in this approach defects can be easily and continually detected and isolated and thus avoids the accumulation of errors. In addition, it provides better chances of continual evaluation of the advantages and shortcomings of each stage, and consequently ensures the optimum use of resources. Moreover, incremental planning and development provides better opportunities of compliance with the prevailing socio-economic conditions and technological status of societies and better helps meet the real needs of inhabitants.

Moreover, MacLeod (1996) argues that the basic weakness of incremental planning is its assumption of a pluralistic society composed of and dominated by small interest groups, which makes competition unequal and undemocratic. Therefore, it is argued that decisions reached using incrementalism mainly reflect the interests of the more powerful rather than those of the community in general (Atzioni 1967, 221). Other critics argue that Incremental Planning only addresses a limited range of alternatives and does not allow for fundamental decisions to be made and neglects basic societal innovations (Faludi 1973, 119). Moreover, with its limited consideration of variables, incrementalism has nothing to guide the accumulation of small steps that could lead to significant change (Atzioni 1967, 221).

Despite these drawbacks, and for the purpose of this research focusing on developing countries, Incremental Planning and Development approach is expected to be highly appropriate for many reasons. First, it best deals with the lack of necessary reliable data in these countries. Second, it provides better chances for the optimal use of financial and environmental resources as it continuously evaluates the socio-economic, technological, and environmental changes in the society. Third, it ensures the gradual transition from the existing to the targeted situations and consequently protects societies from the unexpected socio-economic impacts of sudden changes.

6.3.2 An Appraisal of the Application of Incremental Planning Approach in Egypt

Incremental planning is not applied in the urban development policy of Egypt either on the local or the regional level. On the local level, and although the development of each new city was set in stages, all these stages are planned and designed in advance with no possibility of modification in the light of the changing socio-economic and technological condition. This is mainly because almost all infrastructure networks, mainly transportation, are usually built at one time for the whole city. This predefines the physical form of the city and, to a large extent, its population size. In addition, the first stage is usually about the half of the city. Moreover, in many large new cities such as 10th of Ramadan and 6th of October, sparse development activities started in all the stages within the first five years of the city development start. More important, the large size of almost all new cities in Egypt contradicts with the principles of incrementalism.

On the regional level, a number of new cities were built together giving no chance for assessment and evaluation. For example, four cities with total target population of about two millions inhabitants were built almost at the same time around Cairo. This was, in fact, in addition to another six settlements of 250,000 inhabitants each. The large size in addition to the large number of these settlements demonstrates that incrementalism is not applied in Egypt's urban development policy.

6.3.3 Incremental Planning: Approach Assessment

It should be kept in mind, that the main purpose of the research here is to shed light on the importance of incremental planning and development approach and to examine its importance for developing countries. Through the literature review about incremental planning and development of urban settlements and through the analysis of urban problems in Egypt, where the percentage occupancy in almost all new towns that were built 25 years ago still very low (section 5.2.1.4), it becomes clear that incremental planning and development could be an effective approach for managing urban development in developing countries with increasing technological capabilities. In a further step to examine the appropriateness of such approach, the thesis will examine this approach through the forecasting survey presented in the next three chapters.

In doing so, a direct question about the most appropriate approaches for the development of future urban settlements in developing countries during the next 30-40 years had been presented to urban development experts. In that question, urban experts were asked to select from the following options: whole settlement built in one time, gradually built, expansion in the form of new suburbs, or expansion in the form of new independent urban units. Through this question and other questions about the appropriate size and location of future cities, it is expected that the research could draw a general conclusion about the appropriateness of the proposed incremental planning and development approach.

Conclusion:

Through the extensive analysis of the proposed approaches, the thesis has reached some important conclusions.

First, urban decentralisation and dispersion of urban population, mainly at the regional level, is a necessary approach for managing the urban future in developing countries, especially those suffering increasing urban concentration problems. In addition, this approach helps in spreading development activities all over the country and consequently the utilisation of its natural resources in remote and frontier regions. Although policymakers in Egypt, as in all the developing countries, claim to have adopted of urban decentralisation, such approach have been applied only at the local level. It is highly expected that future technological advancements will facilitated the adoption of such approach in developing countries (section 6.1.3).

Second, small-size urban settlement is a necessary approach to avoid the mounting problems of current large-scale urban centres and to help implement the proposed urban decentralization approach. The extensive analysis of the differential growth of different settlement sizes Egypt, presented in section 5.2.2, demonstrates that the proposed small-size settlement approach is not among the main objectives of urban development policy in Egypt. This is true for both old and new urban settlements in the country. It is highly expected that future technological advancements will facilitated the adoption of such approach in developing countries. Technological achievements have significantly increased the attractiveness of small urban settlements. These technologies have made life in small settlements possible and more attractive. The emergence and the growth of telework activities made these settlements more attractive to a wide variety of new businesses. Also, recent developments in renewable solar and wind energies and the development of small water purification and sanitary treatment systems would facilitate settling remote areas.

Third, incremental planning and development of the future urban settlements is a necessary approach to deal with the uncertainties that will always exist regarding the extent of future technological change and its urban impacts, especially in developing countries. It provides better chances for the optimal use of financial and environmental resources as it continuously evaluates the socio-economic, technological, and environmental changes in the society. Moreover, it ensures the gradual transition from the existing to the targeted situations, and consequently protects societies from the unexpected socio-economic impacts of sudden changes.

In a further step to assess the appropriateness and applicability of these approaches, the thesis will survey the opinions and expectations of both technology and urban development experts in the forecasting survey presented in the next three chapters.

AN APPLICATION OF FUTURE RESEARCH IN URBAN STUDIES

Introduction:

Although the analysis presented in the previous chapter revealed that the proposed approached would be effective in managing the urban future in developing countries, the thesis tries to confirm this result and to assess the appropriateness and applicability of these approaches in developing countries. through surveying the opinions and expectations of both technology and urban development experts. Also, through this survey the thesis aims to define the possible impacts of technology on This chapter presents the forecasting survey methodology, questionnaires design, sample selection and data collection, and survey scoring and data evaluation.

7.1 ARGUMENTS FOR AND AGAINST FORECASTING STUDIES

Opinions about the value of studies that attempt to forecast the future are sharply divided. For the opponents of future studies, we have those such as Ackoff (1981, ix), who argue that *"To the extent we can control the future we do not have to forecast it... To the extent that we can respond rapidly and effectively to changes that we neither control nor expect.... we need not to forecast them"*. Proponents of future studies, such as Constantinos Doxiadis (1965, 3) argues that we are compelled to forecast the future and that if we do not we deprive ourselves of the right to see where we are going and we doom ourselves to move in the darkness. In answering whether we may succeed in forecasting the future, he reiterated the ancient Greek saying:

"*Only God knows the future; but wise people can see the tomorrow*".

Other proponents of future studies such as May (1982), stress the need for more future-oriented planning where the typical objective is to generate a number of probable scenarios in order to understand the implications of future movements for the present or to identify those policy and planning decisions required now in order to avoid or achieve possible future conditions. In this context, Newton and Taylor (1985, 313) and Bell and Mau (1971) argue that images of the future are real and deserve examination, as they tend to orient human behaviour and social actions, and consequently provide an insight into what alternative futures are being prepared in the present. This is particularly so under the liberating conditions that technological advanced society makes possible, where the population is not wholly concerned with meeting subsistence needs and where the desire for self-determination is increasing.

The study of the future implies the use of forecasting techniques. Forecasting applies available information to predict consequences of present policies and to propose actions to achieve desired goals. The Webster Dictionary defines the term 'forecasting' as the process applied to calculate or predict (some future event or condition) usually as a result of study and analysis of available pertinent data (Merriam-Webster, Inc. 2001). Forecasting is the estimation of the value of a variable (or set of variables) at some future point in time. In this context, forecasting is mainly concerned with the processes used to make forecasts and to assure that they are properly presented and used. Typically, it is used to predict over time (time series forecasting), and to make predictions about differences among people, firms, or other objects (cross-sectional data) (Armstrong and Collopy 2001). Also, forecasting applies available information to predict consequences of present activities and expected changes to propose actions to achieve desired goals. Tarik A. Fathy (1991, 49) argues that forecasting, however, is not mere prediction; it needs to account for contextual situations, and uses informed judgments about events to draw a wide range of possible consequences. As such, many forecasting methods qualify as tools for planning public policymaking. Yet, the field of planning seldom devotes enough attention to forecasts (Wachs 1985).

Usually, there is some confusion between forecasting and planning. To clarify this, forecasting is concerned with what the future will look like, while planning is concerned with what it should look like (Armstrong and Collopy 2001). Forecasting starts from the present, or even the past, to conceive the image of the future, while planning starts from the future and how it should look like and trace back the necessary actions to be taken in the present. Therefore, forecasting can be considered as an integral stage of planning necessary to minimize uncertainties before setting the planning goals and objectives. Usually, forecasting exercises are carried out in order to provide an aid to decision-making and in planning the future. Typically all such exercises work on the premise that if we can predict what the future will be like we can modify our behaviour and take actions now to be in a better position, than we otherwise would have been, when the future arrives (Beasley 2001).

Forecasting the social impact of technology belongs to a class of social sciences problems that requires a more complex logic than that of simple causality (direct relationship among few variables and their explicit sequences). Tarik Fathy (1991, 49) argues that the dual effects are one of the main reasons for the paucity of the literature on its impact. Moreover, the rapid advances of modern technologies make any study of their consequences much more difficult to pin down. Therefore, a study of the impact of new technologies should account for the fast-paced change by addressing future changes rather than studying only the present moment. In this context, Edward

Cornish (1977) argues that the future lies in the domain of goals, and its plasticity makes it more important to study and more difficult to predict. In view of the fact that the future is not a mere temporal continuation of the past, it is likely to be significantly different from the present.

Boucher (1977, 6-9) stressed the fact that futures studies are generally characterized by the ambition to support decision-making by supplying relevant information for a long-range perspective. The function of futures research is to extend the range of public vision to encompass new alternative futures as well as reduce the uncertainty of events. Futures research methods have the ability to prepare sufficient information with a set of probabilities into the planning process. They do not forecast the "future" but generate possible alternative "futures" (King 1975).

7.1.1 Expansion of Urban forecasting Studies:

The last four decades have witnessed a major expansion of forecasting studies in the United States, UK and Europe. The work of Herman Kahn and his colleagues at the Hudson Institute; the 'Futuribles' group in Paris; the Social Science Research Council in London, the De Jouvenel, E. masterpiece 'The Art of Conjecture', and the overwhelming contribution of Armstrong, J. S. since 1982 are only a few of the many now forecasting various aspects of life during the near and distant future.

Urbanization was the major theme of many of these forecasts, for it seems that more and more of the world's population will live in a culture dominated by urban values even if they remain on a remote farm. But not many groups have taken the notion of urbanization as their main focus. Of course, everyone concerned with urban studies in the broadest sense, has his own views for the future, and quite specific forecasts have been made for particular cities or regions. But, such forecasts are, by definition, partial and limited (Cowan 1970).

7.2 FORECASTING SURVEY METHODOLOGY

Through the previous chapters, the thesis has thoroughly examined the theoretical bases and justifications of the proposed urban approaches and the future role of technology in applying them in developing countries. The proposed approaches are: (1) urban decentralisation; (2) small-size settlements; and (3) the incremental planning and implementation of urban programs. The main objective of this future research exercise is to examine the importance and applicability of these approaches for managing the urban future in developing countries and the future role of technology in applying them. Also, it is the purpose of this exercise to conceptualise the main consequences, recommendations, and guidelines for the application of such approaches in these countries. However, it is not the propose of this exercise to define certain future impacts of technology at certain times, but rather to develop a verified and more accurate idea about the role of technology in shaping the urban future in developing countries.

7.2.1 Selection of Forecasting Method

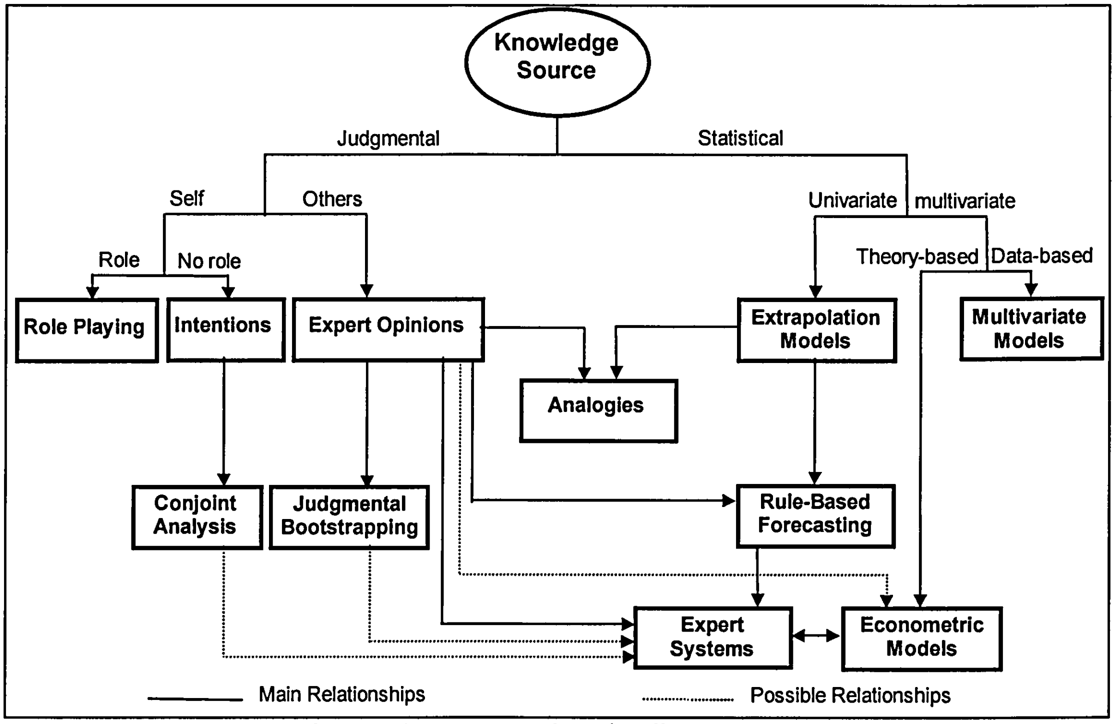
Forecasting methods, as defined by Armstrong in 1983, are explicit procedures for attaining and analyzing data to get a realistic idea about the future of a given phenomenon. Futures research methods are appropriate techniques for social forecasting. Their fundamental assumption postulates that society is not predestined or otherwise constrained to a particular long-run end state. Their procedures are based on two concepts: *robustness* and *cybernetics.* Robustness works with fundamental causes of change as the basis for designing new strategic options consistent with anticipated future environments (Nanus 1982). A robust concept can withstand large environmental changes. It provides effective performance under all likely future environments to enable flexible adjustment to these changes. Cybernetics is based on the perception that a single present situation will induce a set of alternative futures via a cybernetic process, and the future should only be viewed within a wide range of expectations. Futures research methods require more than observation; they require judgmental interpretation to relate past to future to prepare for action (Fathy 1991, 50). At present, there are a number of schemes for classifying forecasting methods. These schemes are based upon the type of data used, the type of people doing the forecasting, and the degree of sophistication of the methods used to analyse data.

7.2.1.1 Anticipatory and Exploratory Approaches

Peter Hall (1977) classified forecasting approaches as either of two types: anticipatory or exploratory. This classification is also termed by Jones, H. and Twiss, G. (1978) as 'top down' and 'bottom up'. In the anticipatory approach, the objective is to establish whether a specific normative goal or objective might be achieved. The objective set for or by the planner may result from a national policy, theoretical analysis, or vision. Initially, it should be merely a desirable target without having any clear idea of how it could be achieved and which of the alternative routes to be followed. For the exploratory approach, it highly meets the needs of urban planners concerned with management of complex urban systems, the evolution of which is the outcome of the joint operation of numerous factors which are located in the present (and the past) but which may evolve in a variety of ways in the future. For these situations, this approach provides a range of methods have been devised to assist in forecasting. These methods include: trend extrapolation, cyclic analysis, consensus methodologies such as Delphi, scenario construction, analogy, model-building and simulation (Newton and Taylor 1985, 314). For the purpose of this research, and as it was for similar studies exploring the probable urban futures, exploratory approach and its suite of techniques seems highly suitable.

7.2.1.2 Judgmental and Statistical Approaches

In 2001, Armstrong and Collopy classified forecasting methods as either subjective or objective. Subjective, or judgmental, forecasts are perhaps the most widely used for important forecasts. Subjective or judgmental methods are those in which the available data are insufficient and not highly accurate or formal; a matter that is common in social studies. They may use objective data or subjective data as inputs but it is usually relative and depends on personal experience. Subjective methods may be based on simple or complex processes. Objective, or statistical, forecasts include extrapolation (such as moving averages, linear regression against time, or exponential smoothing) and econometric methods (typically using regression techniques to estimate the effects of causal variables). Objective or statistical methods are those that use well-specified processes to analyse the data. Ideally, they have been specified so well that other analysts can replicate them and obtain identical forecasts (Armstrong and Collopy 2001). Figure 7.1 depicts the main characteristics of forecasting methods and their inter-relationships.



Source: Armstrong, J. S. and Collopy, F. 2001.

Figure 7.1: Characteristics of Forecasting Methods and Their Relationships.

The choice between the two methods depends mainly on the purpose of forecasting, the sufficiency of the available data, and on the analysis technique adopted. In Urban studies, especially when the future is concerned, judgmental method is usually applied for long-term forecasting, while the statistical method is used for 5-10 years forecasting where enough data could be found. Most of recent urban forecasts are made using subjective methods. It also seems that the more important the forecast, the greater is the likelihood that subjective methods will be used (Armstrong and Collopy 2001). For the purpose of this study, judgmental or qualitative method seems to be the most appropriate as it proved effective in long range forecasting where technological, political, etc. factors play a significant role (Owenb 1999). In judgmental or qualitative approach two main techniques are usually used: (1) subjective, based on a hunch, intuition; or (2) experience based: jury of executive opinion and Delphi techniques (Owen 1999). Delphi Technique is widely used in urban studies as the most developed form of urban forecasting according to the judgmental/qualitative approach.

7.2.1.3 Delphi technique:

The Delphi method, pioneered by Olaf Helmer and his associates at the Rand Corporation in the late 1960's, is a widely used polling technique that systematically and collectively solicits expert subjective or judgmental opinions in quantified form.

The main objective of Delphi technique is to generate reliable consensus among people with exceptional knowledge about a particular subject. This technique is a group process which utilizes written responses as opposed to bringing individuals together (Michael 1994). This is mainly to avoid some of the bias that might result were they all brought together, e.g. domination by a strong willed individual, divergent (but valid) views not being expressed for fear of humiliation (Beasley 2001). At the same time, it maintains the heterogeneity of the participants to assure validity of the results and avoid the dominance of aggregating results by quantity. While some individual responses may be more informative and accurate, the aggregation process assimilates this expertise (Fathy 1991).

Fabiana Scapolo (1997) defined three quintessential attributes that distinguish Delphi technique from conventional face-to-face group interaction: anonymity, iteration with controlled feedback, and statistical response handling. Delphi does permit an effective interaction between members of the panel, even though this interaction is highly filtered by the moderators' summarising of the arguments (Martino 1993). In 2002, Linstone and Turoff presented a detailed comparison of the main characteristics of the different group communication techniques (see Table 7.1).

Usually, Delphi technique is a series of two or more questionnaires. The first questionnaire asks individuals to respond to a broad question (questions might focus on emerging issues and forecasts for your community). Each subsequent questionnaire (one or more additional) is built upon responses to the preceding questionnaire (Michael 1994). However, the nature and the objective of the survey may limit the number of questionnaires required. In many cases where it is not required to define certain future impacts of technology at certain times, and because of the difficulty in getting response from the selected experts group for two or three times, many studies such as those of Newton and Taylor (1985), and Fathy (1991) have used a single-round questionnaire.

In this research, the Delphi Technique is used to verify the conceptual analysis of the effects of technological achievements on the proposed approaches for the future of urban development in developing countries. In addition, Delphi method is used in this study to forecast the impacts of such approaches and to generate hypotheses about how to deal with these impacts.

Table 7.1: Main Characteristics of Different Group Communication Techniques

	Conference Telephone Call	Committee Meeting	Formal Conference or Seminar	Delphi
Effective Group Size	Small	Small to Medium	Small to Large	Small to Large
Occurrence of Interaction by Individual	Coincident with group	Coincident with group	Coincident with group	Random
Length of Interaction	Short	Medium to Long	Long	Short to Medium
Number of Interactions	Multiple, as required by group	Multiple, necessary time delays between	Single	Multiple, necessary time delays between
Normal Mode Range	Equality to chairman control (flexible)	Equality to chairman control (flexible)	Presentation (directed)	Equality to monitor control (structured)
Principal Costs	Communications	Travel Individual's Time	Travel Individual's Time Fees	Monitor Time Clerical Secretarial
	Time –urgent considerations	Forced delays		Forced delays
Other Characteristics	Equal flow of information to and from all Can maximize psychological effects		Efficient flow of information from few to many	Equal flow of information to and from all Can minimize psychological effects Can minimize time demanded of respondents or conferees

Source: adapted from: Linstone, H.A. and Turoff, M. 2002, 8,9.

7.2.2 Setting the forecasting time-horizon

Defining the suitable forecasting time-horizon is crucial to ensure the validity and reliability of forecasting exercise results. In this regard, it is clear that the further ahead we look the more uncertain the future will be. But on the other hand if horizons are too close forecasting work will lose much of its value. There are many arguments in this regard, some favouring short time-horizons while others prefer longer time horizons. However, both recommend to avoid choosing specific dates, especially dramatic dates such as 'Towards 2000' or similar dates, because it seem rather fictitious as one year is very much like another, and not much will separate 2000 from 1999 or 2001 (Cowan 1970).

As urban development is the main subject of this study, it is recommended to review the time horizons adopted in previous urban studies. In this regard, it is worth noting that the earlier town and country development plans in the UK, since 1951 onwards in accordance with the Town and Country Planning Act 1947, are based on a twenty-year planning period. Some studies in late sixties and early seventies have extended this time-period to about thirty-five years. They are not considered as 'leaps into the future', but as progress by reasoned stages. Jackson (1972) argues that the overall time span cannot be extended further with any degree of statistical accuracy as beyond thirty years there can be no reasonable limits of confidence about precise future conditions.

However, some experts recommend that the length of the planning period should be extended. Their main argument is that the twenty or thirty-five years are shorter than the life expectancy of many existing structures and of all major works to be constructed. Infrastructure and other development projects above and below ground will certainly outlive this period, and will continue thereafter to influence the form and direction of subsequent urban growth. Therefore, they argue that an average life expectancy of about seventy-five to a hundred years is reasonable time horizon (Jackson 1972). Another supporting argument, and from the social perspective, Cowan (1970) claimed that it is more useful that time horizon be couched in terms of generations. For instance, there may have been a genuine 'change of outlook' among the current generation of young people, and it is possible to suggest the kind of futures which the next generation will encounter. Thinking in terms of generations will be more helpful in tracing the consequences of current or just-emerging patterns (Cowan 1970). The main drawback of this argument is that a century ahead is far beyond the capacity of economic, social and technological prediction (Jackson 1972), particularly in developing countries.

For the purpose of this study about urban future in developing countries, and in view of all previous arguments, time-horizon should not be too long for many reasons. First, the rapid pace of technological achievements and their socio-economic impacts as well as the rapid rate of change in developing countries make it risky and difficult to look for a century ahead. Second, there is a considerable level of political and economic instability in these countries that makes it hard to reasonably forecast the socio-economic conditions in the next fifty years. This is aggravated by the lack of a systematic reliable data in these countries. Therefore, a time horizon of about 30-40 years seems to be more appropriate for the purpose of this study. Taking into account the history of socio-economic change, the proposed 30-40 years time-horizon goes well with both the short- and the long-wave economic cycles of Kuznets and Kondratieff. It is the double of Kuznets short-wave cycle (15-20 years) and slightly less than one long-wave Kondratieff cycle (50 years). Meanwhile, this time horizon can be regarded as the first phase in a continuous forecasting process to ensure the continuous evaluation and revision of the planning process.

7.3 SURVEY DESIGN, SAMPLE SELECTION AND DATA COLLECTION

The main purpose of this future research exercise is to survey the expectations of technology and urban development experts about the role future technology achievements in the adoption of the proposed approaches in developing countries. Also, it aims to survey the expectations of those experts on the consequences of the adoption of the proposed approaches on the future size and function of existing settlements. Therefore, and based on Delphi Technique requirements, the survey is conducted in three questionnaires in two consecutive stages.

Questionnaire I is designed for, and sent to, science and technology experts. Responses to Questionnaire I are then analysed and used as a basis for the next stage of the survey. Based on the results of Questionnaire I, Questionnaire II is designed for, and sent to, science and technology experts, while Questionnaire III is designed for, and sent to, urban development experts. Moreover, and to get a higher degree of consensus, results of Questionnaire I have been sent to all experts who are invited to take part in both Questionnaire II and Questionnaire III. To stick to the principles of Delphi Technique, results of Questionnaire III have been sent to urban experts for the second round. A summary of these stages is presented in Figure 7.2. In the following sub-sections, an analysis of the main objectives, structure, methods of sample selection and data collection for each questionnaire is presented.

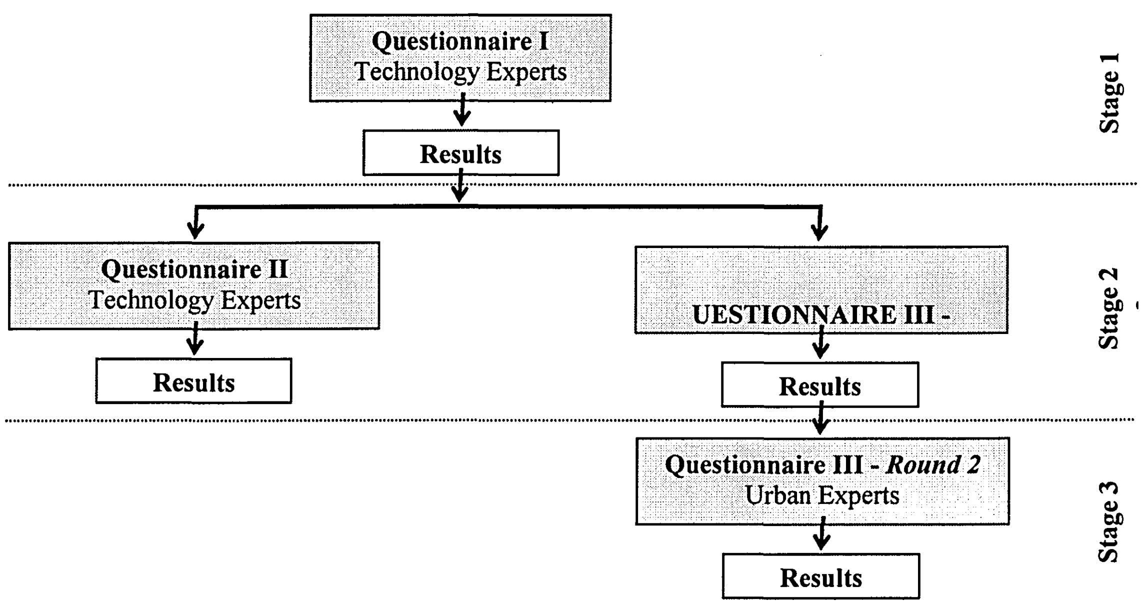


Figure 7.2: Stages of conducting the forecasting Survey

7.3.1 Questionnaire I – to Science & Technology Experts:

7.3.1.1 Questionnaire Design:

This questionnaire is of preliminary and exploratory nature. It asks broad questions about the nature and characteristics of emerging technologies and their future impacts. It consists of three parts. The first part aims to get information about the area of expertise of the interviewed expert (i.e. information technology, transportation, energy, utilities, etc.) and about his role in that field (i.e. R&D, design, production, management, etc.). The second part aims to survey the expectations of the interviewed expert about future changes in his field of expertise. It also asks experts about their expectations about the main technological achievements expected to influence the future of urban development in the next 30-40 years. It also asks them to rank these achievements according to their expected degree of influence. Finally, the questionnaire asks experts about any comments they may have in the area of this research.

This questionnaire is presented in full in Appendix 1. Also, it is posted online at: http://www.shu.ac.uk/schools/research/cbe/feedback/korin/

7.3.1.2 Sample Selection and Data Collection:

Concerning sample selection, the initial goal of this questionnaire was to recruit between thirty to forty science and technology experts in industry and research institutions. Transportation, telecommunications, information technology, energy, and urban utilities were the main technology sectors for selection of targeted experts. Web search was the main way for getting the contact details of these experts. Using Google search engine, a list of 200 experts in both industry and research institutions, mainly from England and the United States, was developed. In this list, the affiliation and the direct contact details of each expert were compiled. This list consists of equal numbers of experts in all technology sectors mentioned before.

On Monday, 4 March 2002, selected experts were contacted by e-mail and invited to fill in the online-posted questionnaire. In the invitation letter, experts were asked to invite other interested experts to participate in this survey. Responses automatically saved in a data file which is compatible with almost all statistical packages such as Microsoft Excel and SPSS. After two weeks, the first reminder has been sent to experts who did not fill in the questionnaire. Two weeks later, the second reminder had been sent. On Monday, 15 April 2002, response data had been harvested. All returned responses that dose not have the respondents name were discarded. Thirty-five successfully returned responses were received, at a response rate of 19.5 percent.

The invitation letter and a full list of participants' names and their affiliations appear in Appendix 1.

Because expectations about the scope of future changes are determined by expertise and judgemental knowledge, there is no way to define the best judgement accurately. Consequently, all predictions are treated on the basis of having equal importance. Therefore, the maximum and minimum values of variables have significance in determining the scope of future possibilities, while the mean and standard deviation provide confidence in "the most possible" cases.

Responses have been loaded on Microsoft Excel and SPSS spreadsheet files and a statistical analysis for each question had been run. The main analysis produced standard deviations, means, medians, minimum and maximum values, and frequency distributions. Results of this analysis have been used as a basis for the design of the second round of the survey. Also, these results have been presented in graphs and tables and made ready to be sent to experts in the second round.

7.3.2 Questionnaire II – to Science & Technology Experts:

7.3.2.1 Questionnaire Design:

Based on the results of Questionnaire I and its associated comments, Questionnaire II was designed to get a more detailed survey of science and technology experts' expectations about the role of technology in shaping the urban future. This questionnaire is divided into four main parts. The first part aims to get information about the area of expertise of the interviewed expert and about his role in that field. It also aims to survey the expectations of the interviewed expert about future changes expected in his field of expertise in the next 30 to 40 years. The second part is about how much the future technological achievements are expected to influence the urban life in the next 30-40 years. The third part is about the expected role of future achievements of major technology sectors (transportation, IT & telecommunications, renewable energy, urban utilities) on the adoption of the proposed approaches: urban decentralisation and the small-size settlement. For each of these technology sectors, questions about the main points expected to be influence the application of the proposed approaches have been asked. The fourth part is about the expectations of technology experts regarding the rate of technology transfer to developing countries. Questionnaire II is presented in full in Appendix 2 and posted online at: http://homepages.shu.ac.uk/~aaboukor/Questionnaire%202.htm

7.3.2.2 Sample Selection and Data Collection:

To get more responses than that of Questionnaire I, Questionnaire II is sent to a larger sample of science and technology experts than that of Questionnaire I. The initial goal was to recruit of between forty to fifty experts in industry and research institutions. Transportation, telecommunications, information technology, energy, and urban utilities were the main technology sectors for selection of targeted experts. Again, web search was the main way for getting the contact details of these experts. In addition to the contact details for respondents to Questionnaire I, and using Google search engine, a new list of 200 experts, in both industry and research institutions, was developed. In this list, the affiliation and the direct contact details of each expert were compiled. This list consists of equal numbers of experts in all technology sectors mentioned before.

On Monday, 24 June 2002, selected experts were contacted by e-mail and invited to fill in the online-posted questionnaire. The overall results of Questionnaire I have been attached to the invitation letter. In the invitation letter, experts were asked to invite other interested experts to participate in this survey. Responses automatically saved in a data file which is compatible with almost all statistical packages such as Microsoft Excel and SPSS. After two weeks, the first reminder has been sent to experts who did not fill in the questionnaire. But this time, and to overcome the low response rate experienced in Questionnaire I, thirty-five technology experts in the UK were contact by post. Two weeks later, the second reminder had been sent to those who did not respond yet. On Monday, 5 August 2002, response data had been harvested. Fifty successfully returned responses were received, fifteen of which were received by post. The overall response rate was about 25.5 percent and 42.8 percent for postal contacts. The invitation letter and a full list of participants' names and affiliations appear in Appendix 2.

Responses have been loaded on Microsoft Excel and SPSS spreadsheet files and statistical analysis for each question has been run. The main analysis produced standard deviations, means, medians, minimum and maximum values, and frequency distributions.

7.3.3 Questionnaire III – to Urban Development Experts:

7.3.3.1 Questionnaire Design:

Again, based on the results of Questionnaire I and its associated comments, Questionnaire III is designed to get a more detailed survey of the expectations and visions of urban development experts in developing countries about the importance of the proposed approaches and the role of technology in the adoption of these approaches in developing countries.

Questionnaire III consists of four parts, each of which is designed to fulfil a certain objective. The first part aims to get information about the area of expertise of the interviewed expert and his expectations about the extent to which future technological advancements are expected to affect urban development in developing countries in the next 30-40 years. The second part is designed to survey the expectations about the nature of the main technological advancements expected to influence the shaping of future urban development policies. It also asks about how future technological advancements are expected to influence some important urban life aspects. The third part asks questions about the expected role of future achievements of major technology sectors (transportation, IT & telecommunications, renewable energy, urban utilities) on the adoption of the proposed approaches: urban decentralisation, the small-size settlement, and incremental implementation of these approaches. In the fourth parts explicit questions have been asked regarding urban development experts' expectation about the future function, location and size of new urban settlement in developing countries. Also, it asks some questions about the expected impacts of these approaches on the future size and function of existing settlements. Questionnaire III is presented in full in Appendix 3 and posted online at:

http://homepages.shu.ac.uk/~aaboukor/Questionnaire%203-E.html (in English), and

http://homepages.shu.ac.uk/~aaboukor/Questionnaire%203-A.html (in Arabic)

7.2.3.2 Sample Selection and Data Collection:

This questionnaire is sent to urban development experts in developing countries, mainly Egypt and South Africa. However, some experts in the UK, USA, and Australia who are of considerable knowledge about technology and urban change in developing countries have been invited to participate in this questionnaire.

Questionnaire III is sent to a sample of urban development experts larger than that of Questionnaire I and Questionnaire II. The initial goal was to recruit of between fifty to sixty urban development experts. Urban academics, city planners, city planning officials, and architects were the main targeted groups. As the thesis is focusing on urban development in developing countries, urban experts in Egypt and South Africa were the targeted experts. However, urban experts of high experience in that subjected in the UK and the United States have been invited to participate in that questionnaire.

The sample had been selected through three main venues. First, the contact details of the participants in two important conferences were collected: (1) the 37th International ISoCaRP Congress "Planning in the Information Age", 16-20 September 2001, Utrecht, The Netherlands; (2) the "Future Cities" symposium, 10-12 November 2001, Riyadh, Saudi Arabia, 2001, organised by the Arab Urban Development Institute. This significantly helped reaching participants from Egypt and Europe. Second, the contact details for experts from South Africa were collected through the web search using Google search engine. Third, in the invitation letter experts were asked to invite other interested experts to participate in this survey, a matter that significantly helped in gaining new participants from Egypt and South Africa.

On Monday, 24 June 2002, selected experts were contacted by e-mail and invited to fill in the online-posted questionnaire. The overall results of Questionnaire I has been attached to the invitation letter. This time, the majority of experts contacted in South Africa were first contacted by telephone and invited to complete the online questionnaire. Responses automatically saved in a data file which is compatible with almost all statistical packages such as Microsoft Excel and SPSS. After two weeks, the first reminder has been sent to experts who did not fill in the questionnaire. Two weeks later, the second reminder had been sent to those who did not respond yet. On Monday, 5 August 2002, response data had been harvested. Sixty-four successfully returned responses were received. The overall response rate was about 32 percent. The invitation letter and a full list of participants' names and affiliations appear in Appendix 3. Responses have been loaded on Microsoft Excel and SPSS spreadsheet files and statistical analysis for each question has been run. The main analysis produced standard deviations, means, medians, minimum and maximum values, and frequency distributions.

In order to adhere to the principles of Delphi Technique, urban experts who participated in the first round of this questionnaire were invited on Monday, 16 June 2003 to participate in the second round. Urban experts from South Africa were first invited by telephone. The over all results of the first round were attached to the invitation letter. In this round, experts were asked to reassess their responses in the light of first round results. Two weeks later, the first reminder was sent to experts who did not reply yet. Again, urban experts from South Africa were contacted by telephone. On Monday, 14 July 2003, the last reminder was sent out. On Monday, 28 July 2003, response data had been harvested. Responses came in three ways: 17 experts have refilled the questionnaire, 3 experts send their comments by e-mail, and 4 have expressed their comments through the telephone. The overall response rate to this round is about 43 percent. The old responses of these experts have been replaced the new ones, while responses of experts who did not participate in this second round are left the same as they were in the first round.

Again, responses have been loaded on Microsoft Excel and SPSS spreadsheet files and statistical analysis for each question has been run. The main analysis produced standard deviations, means, medians, minimum and maximum values, and frequency distributions.

7.4 SURVEY SCORING AND DATA EVALUATION

In designing the survey scoring method, the research tried to apply a numeric measurement, or scale variable, that enables the respondent to easily choose the direction and magnitude of expected change. In such measurement, the differences ("distances") between possible responses are uniform. Therefore, and using this Likert-type scale, the scoring scale in the three questionnaires is divided into 7 points: 3 positive (+1, +2, +3) for the expected increase, 3 negative (-1, -2, -3) for the expected decrease, and 1 neutral (0) for no change. As indicated in each questionnaire; 1 or -1 is equivalent to less than 20% of change, 2 or -2 is equivalent to 21-50% of change, and 3 or -3 equivalent to more than 50% of change. Also, for those who may have no opinion or do not know a (No Op.) selection is provided.

In the statistical analysis of the received data, the research has mainly employed the descriptive statistics for two main reasons. First, questions in each questionnaire are unrelated to each other, as each of these questions covers a different point. Second, the majority of these questions are closed questions where respondents are asked to choose the answer among given alternatives. Therefore, the research depended on descriptive statistics in measuring the data position (or central tendency), variability (or dispersion – spread of the data set), and skewness (data asymmetry). Also, the research uses the frequency distribution in measuring the distribution of responses among the scale points.

For measuring the position (or central tendency), which describes where the data are concentrated, there are three main measures: Mean, Median, and Mode. The research applied the "Mean" in measuring the data central tendency for two main reasons. First, the "mean" is more representative for the whole data set while the "median" just looks at the middle observation of such set, and the "mode" looks at the value around which the greatest number of observation are concentrated, which is similar to the frequency distribution. Second, while the "median" overcomes the problems of outlying data, all the questionnaires are using equal-interval scales with no outlying points (Arsham, H. 1996). Therefore, the mean is seen as the most appropriate measure of central tendency in all of the three questionnaires.

In measuring data variability (or dispersion – spread), there are three main measures: Range, Variance, and Standard Deviation. The "range" is the difference between the largest and the smallest observations in the data set. Therefore, the "range" is a limited measure because it depends on only two of the numbers in the data set. Unlike range, "variance" takes into consideration all the data points in the data set. If all the observations are the same, the variance would be zero. The more spread out the observation are, the larger the variance. Standard deviation is the positive square root of the variance, and is the most common measure of variability. Standard deviation indicates how close to the mean the observations are. The larger the standard deviation, the more variation there is in the data set (Pearson NCS 1995). Therefore, the research applies the standard deviation as the measure variability in all the three questionnaires.

Skewness is the degree of asymmetry of a distribution. If the data are not distributed symmetrically, the distribution is said to be skewed. One way of determining skewness is by looking at the frequency distribution of the data. Another way of determining skewness is by comparing the values of the mean, median and mode. If the three are equal, then the data are symmetrical. If the mean is to the left of the median and mode, the distribution is said to be negatively skewed (skewed left). If the mean is to right of the median and mode, the distribution is said to be positively skewed (skewed right) (Pearson NCS 1995). Because of the purpose of this exercise to produce guidelines for the future trends and because of the direct nature of almost all questions, the research applied the skewness measure to some questions of the questionnaires.

Conclusion:

This chapter presents the survey design process including forecasting survey methodology, questionnaires design, sample selection and data collection, and survey scoring and data evaluation.

Regarding the forecasting survey methodology, and after reviewing the relevant methods, the Delphi Technique is selected because it is a widely used to generate reliable consensus among people with exceptional knowledge about a particular subject. In addition, it systematically and collectively solicits expert subjective or judgmental opinions in quantified form.

Regarding the questionnaires' design, the survey is conducted in three questionnaires. Questionnaire I is designed for, and sent to, science and technology experts. Based on the results of Questionnaire I, Questionnaire II is designed for, and sent to, science and technology experts, while Questionnaire III is designed for, and sent to, urban development experts. To get a higher degree of consensus, results of Questionnaire I have been sent to all experts who are invited to take part in both Questionnaire II and

Questionnaire III. To stick to the principles of Delphi Technique, results of Questionnaire III have been sent to urban experts for the second round (Figure 7.2).

Questionnaire I is of preliminary and exploratory nature. It asks broad questions about the nature and characteristics of emerging technologies and their future impacts. Questionnaire II is designed to survey the expectations of science and technology experts' about the role of technology in shaping the urban future. Questionnaire III is designed to get a more detailed survey of the expectations and visions of urban development experts in developing countries about the importance of the proposed approaches and the role of technology in the adoption of these approaches in developing countries.

Regarding the forecasting time-horizon, and for the purpose of this study about urban future in developing countries, and in view of related arguments, time-horizon should not be too short as it will be unable to notice medium and long term changes. In this regard, it is worth noting that the earlier town and country development plans in the UK, since 1951 onwards in accordance with the Town and Country Planning Act 1947, are based on a twenty-year planning period. Some studies in late sixties and early seventies have extended this time-period to about thirty-five years. However, time-horizon should not be too long because of the rapid pace of technological achievements and their socio-economic impacts and because of political and economic instability in these countries. Therefore, a time horizon of about 30-40 years seems to be more appropriate for the purpose of this study. The proposed 30-40 years time-horizon goes well with both the short- and the long-wave economic cycles of Kuznets and Kondratieff. It is the double of Kuznets short-wave cycle (15-20 years) and slightly less than one long-wave Kondratieff cycle (50 years).

In designing the survey scoring method, the research applies a numeric measurement, or scale variable, that enables the respondent to easily choose the direction and magnitude of expected change. In such measurement, the differences ("distances") between possible responses are uniform. Therefore, and using this Likert-type scale, the scoring scale in the three questionnaires is divided into 7 points: 3 positive (+1, +2, +3) for the expected increase, 3 negative (-1, -2, -3) for the expected decrease, 1 neutral (0) for no change, and (No Op.) for no opinion or do not know. As indicated in each questionnaire; 1 or -1 is equivalent to less than 20% of change, 2 or -2 is equivalent to 21-50% of change, and 3 or -3 equivalent to more than 50% of change.

The next chapter presents an analysis and discussion of the forecasting survey results.

Chapter Eight

FORECASTING SURVEY: RESULTS ANALYSIS AND DISCUSSION

Introduction:

This chapter presents the statistical analysis of the main results of each of the three questionnaires. In the statistical analysis of the received data for each questionnaire, the research uses the descriptive statistics in measuring the data position (or central tendency), variability (or dispersion – spread of the data set), and skewness (data asymmetry). Also, the research uses the frequency distribution in measuring the distribution of responses among the scale points. More details about survey scoring and data evaluation are presented in section 7.4.

In the statistical analysis, all responses are treated on the basis of equal value, and frequency distribution is used as the main criterion for measuring experts' consensus. To do so, in weighting the relative values of responses among the different variables of a question, the highest number of responses received to a single variable is taken as a 100 percent and other variable are measured in relation to it. For example, if variable A received the highest number of responses among all variable, i.e. 100 responses, and variable B received 25 responses, then variable B is assessed as of having 25 percent of the responses. SPSS applies this method in measuring the frequency distribution among different variables.

In data analysis, the different levels of change are referred to as of *some, considerable,* or *impressive* (increase or decrease) for change of (1 or –1), (2 or –2), (3 or –3) respectively. When data represents a probability level, these levels are referred to as: *somewhat (likely* or *less likely)* for change of (1 or –1), *Likely* or *less likely* for change of (2 or –2), and *Most* or *Least Likely* for change of (3 or –3). In expressing the frequency distribution, the percentage of responses received for any variable are expressed as "percentage of total responses" or as "percentage of responses per variable". "Percentage of total responses" refers to the percentage of responses received for each variable in a given question to the total responses received for that question, while "percentage of responses per variable" refers to the percentage of responses for each level of change in that variable to the total responses received for that variable.

To provide a clearer idea about the frequency distribution of responses to each question, frequency data is graphically presented in this chapter while the detailed frequency tables for Questionnaire II and III are presented in Appendix 4.

8.1 QUESTIONNAIRE I: RESULTS ANALYSIS AND DISCUSSION

Responses to this questionnaire give a general idea about technology experts' visions of the future impacts of technology on urban development in developing countries during the next 30-40 years. The main findings of this questionnaire are used as a base for developing the next questionnaires and sent with them to both technology and urban experts.

In this chapter, the received valid responses of technology experts for the different questions are statistically analysed. In doing so, the statistical software SPSS had been used in conjunction with Microsoft Excel Software. The data file generated by the online questionnaire replies had been loaded to SPSS and Microsoft Excel spreadsheet files and statistical analysis for each question has been run.

8.1.1 Characteristics of Experts Group: Area of Interest and Degree of Relevance

Question 1:

1. *From your wide interests and experience, please indicate all areas of expertise starting by the closest to your field of specialization = 1*

Table 8.1: Frequency distribution of technology experts' areas of expertise

	High Relevance	Medium Relevance	Low Relevance	% Per Sector
	%RT	%RT	%RT	
Information Technology	14.74	11.58	5.26	31.58
Transportation	4.21	5.26	10.53	20.00
Energy	12.63	3.16	7.37	23.16
Utilities (water, sewer, gas)	5.26	2.11	5.26	12.63
Other: Indicated below	11.58	1.05	0.00	12.63
% Responses	48.42	23.16	28.42	100.00
Total Responses	95			

Notes: % RT= Percentage of subgroup to total number of responses

Other areas of Interest include:

Architecture and Building Construction	6	Environmental technologies	3
Engineering	2	Biotechnology	1

Concerning experts' experience relevance to the main areas of technology expertise, 48 percent of the experts interviewed are highly relevant to their areas of expertise, while 23 and 28 percent of them are of medium and low relevance respectively. About 15 percent of total valid responses state that information technology is their highly relevant area of expertise, followed by 13, 5, and 4 percent for energy, utilities and transportation respectively. Other areas of expertise, including housing and building construction; environmental technologies and engineering; represent about 12 percent. Table 8.1 and Figure 8.1 present the whole situation for all experts' degrees of relevance to the main areas of technology. This analysis clearly shows that chosen sample of experts are of high relevance to the technology issues studied.

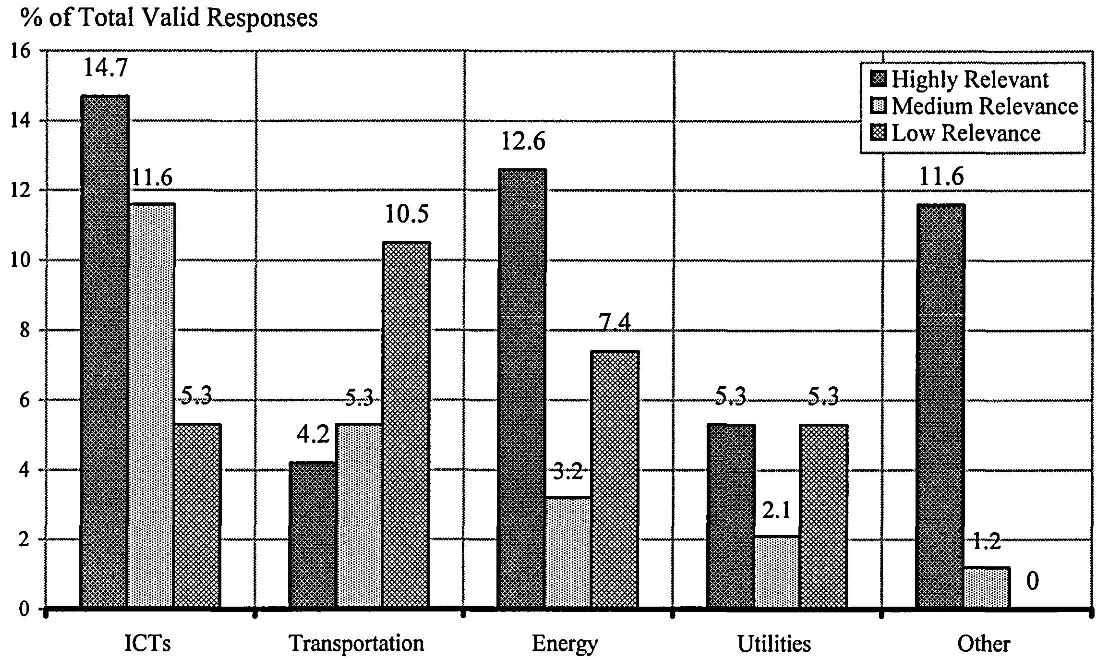


Figure 8.1: Frequency distribution of technology experts' areas of expertise

Question 2:

2. Please indicate all areas of expertise starting by the closest to your field of specialization = 1

Table 8.2: Frequency distribution of technology experts' field of specialisation

	Highly Relevant	Medium Relevance	Low Relevance	% Per Sector
	%RT	%RT	%RT	
a. Research & Development	17.39	11.96	2.17	31.52
b. Design	7.61	9.78	7.61	25.00
c. Production	4.35	5.43	8.70	18.48
d. Management	6.52	8.70	5.43	20.65
e. Other: indicated below	3.26	1.09	0.00	4.35
% Responses	39.13	36.96	23.91	100.00
Total No. of Responses	92			

% RT= Percentage of subgroup to total number of responses
Other: Consultancy in: environment, planning, engineering, and marketing

Concerning experts' fields of specialisation, Table 8.2 shows that about 32 percent of experts work in research and development; while 25, 21, and 18 percent of the experts work in design, management, and production respectively. About 17 percent of experts were highly relevant to research and development; followed by 8, 7, and 4 percent for design, management, and production respectively.

This analysis demonstrates that the chosen sample of experts consists mainly of R&D and design experts, whom usually are of wider vision and more concerned about the future impacts of technology.

8.1.2 Extent and Nature of Expected Technological Change

Question 3:

4. To what extent do you think current operation and production systems in your field will be changed in the next forty years?

The importance of this question is that it gives a general idea about how technology experts view the future impact of technological change on current operation and production systems. Statistical analysis of technology experts' responses to this question revealed some important points (see Table 8.3 and Figure 8.2). First, none of the experts expect that there would be no change. Second, more than 50 percent of the responses expect that future technological achievements will have an impressive effect, and 37 percent of the responses expect a considerable change in current operation and production systems.

This analysis explicitly reveals the high expectancy level among technology experts about the future impact of technological achievements on current operation and production systems during the next 30-40 years.

Table 8.3: Frequency distribution of technology experts' areas of expertise

Level of Change	%
a) No change	0
b) Some change	12.5
c) Considerable change	37.5
d) Impressive change	50.0

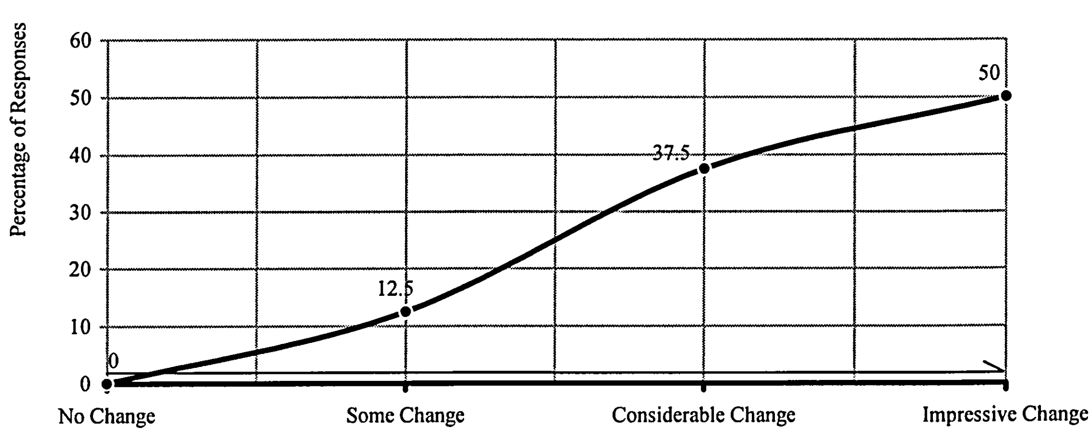


Figure 8.2: Frequency distribution of technology experts' areas of expertise

Question 4:

4. To the best of your knowledge and in your area of expertise, what are the main technological achievements expected to influence the future of urban development in the next 30-40 years? Please start by the most influential achievement and briefly clarify each of your choices.

Table 8.4: Frequency distribution and descriptive statistics of technology experts' responses about the main technological achievements expected to influence the future of urban development in the next 30-40 years?

Area of Achievement	Expected Influence (% responses)				% Per Sector	Mean	STDEV
	A-Very High	B-High	C-Moderate	D-Low			
	% RT	% RT	% RT	% RT			
ICTs	16	11	8	6	40	10.25	4.35
Energy, renewable energy	8	7	5	4	23	6.00	1.83
Transportation	5	4	4	2	15	3.75	1.26
Utilities	3	3	2	1	9	2.25	0.96
Environment	3	2	1	0	6	1.50	1.29
Manufacturing & New materials	1	1	1	1	4	1.00	0.00
Building, Construction, smart Homes	0	2	1	1	4	1.00	0.82
Responses Subtotal %	35	29	21	15	100		
Total No of Responses	103						

% RT Percent sector to total responses

The statistical analysis of technology experts' responses to this question clearly shows that information and telecommunications technologies are expected to be of very high influence on the future of urban development. About 16 percent of the responses expect that ICTs will be of very high influence on urban development followed by transportation and energy sectors. About 8 percent of the responses expect that energy technologies would be of very high influence. Also, about 9 and 6 percent of the responses expect that transportation and utilities technologies will be high influence (Table 8.4 and Figure 8.3). This analysis proves that ICTs, energy, transportation, and utilities are the main technologies expected to influence the urban future in developing countries.

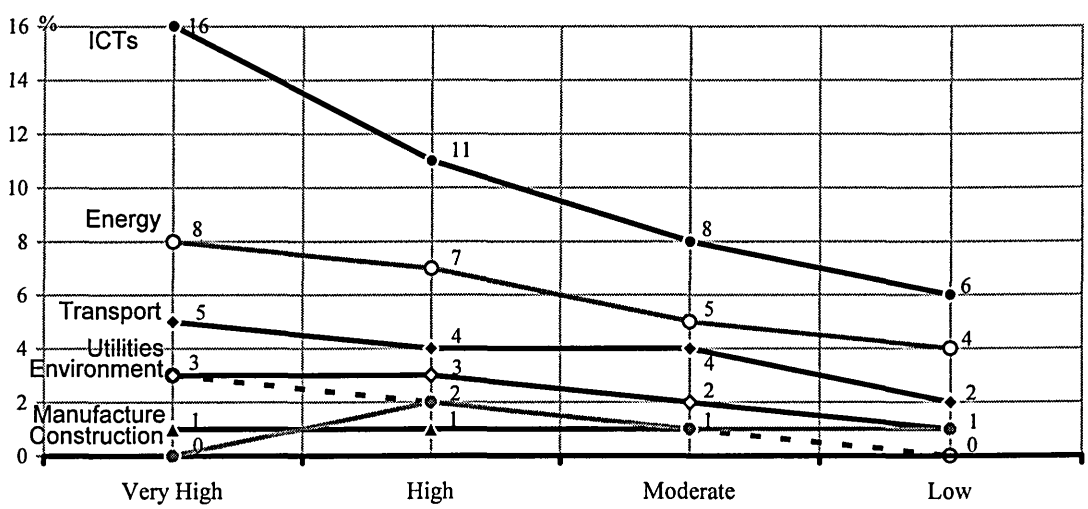


Figure 8.3: Expected influence of different technological sectors on the future of urban development in the next 30-40 years

8.2 QUESTIONNAIRE II: RESULTS ANALYSIS AND DISCUSSION

In this chapter, the received valid responses for the different questions will be thoroughly statistically analysed. In doing so, the statistical software SPSS (Statistical Package for the Social Sciences) had been used in conjunction with Microsoft Excel Software. The data file generated by the online questionnaire replies, after incorporating the postal replies, was loaded to SPSS and Microsoft Excel spreadsheet files and statistical analysis for each question has been run. Descriptive statistics and frequency distribution were the main statistical analyses applied. In order to avoid repetition, the discussion of results implications has directly followed the statistical analysis.

8.2.1 Experts Relevance to Main Areas of Technology

Question 1:

1. *<u>From your wide interests and experience, please indicate all areas of expertise starting by the closest to your field of specialization = 1</u>*

Table 8.5: Frequency distribution of technology experts' relevance to main areas of technology

	Highly Relevant	Medium Relevance	Low Relevance	% Per Sector
	% RT	% RT	% RT	
Information Technology ICT	10.40	7.20	9.60	27.20
Transportation	4.80	6.40	4.80	16.00
Energy	16.80	3.20	4.80	24.80
Utilities (water, sewer, gas)	7.20	8.00	2.40	17.60
Other	10.40	4.00	0.00	14.40
% Responses	49.60	28.80	21.60	100.00
Total number of Valid Responses	125			

Notes: % RT= Percentage of subgroup to total number of responses
Other areas of interest include:
Environment and Sustainable Development 6 Engineering 4

Regarding experts' interests and experience relevance to technology sectors studied in this research, 50 percent of the participating experts are highly relevant to these technologies, while 28 and 22 percent stated they are of medium and low relevance respectively. For about 17 percent of total valid responses, energy is their highly relevant area of expertise, followed by 10, 7, and 5 percent for ICTs, utilities and transportation respectively. Other areas of expertise, including environmental management; sustainable development and engineering; represent about 10 percent of the sample. Table 8.5 and Figure 8.4 present the whole situation for all experts' interests and experience relevance to the main areas of technology.

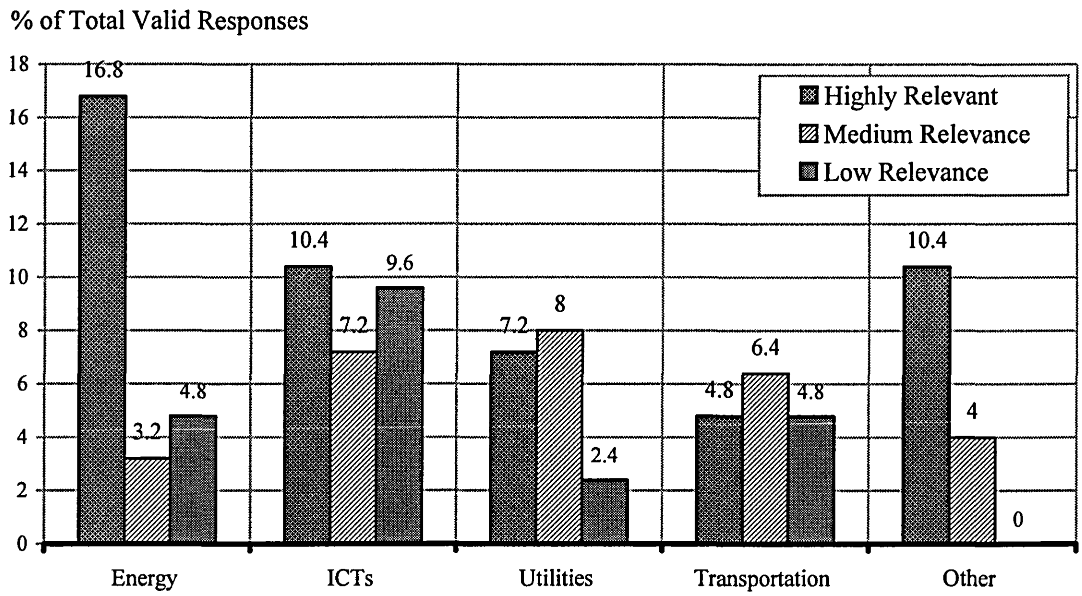


Figure 8.4: Frequency distribution of technology experts' relevance to main areas of technology

This statistical analysis clearly demonstrates that the chosen sample of experts is of high relevance to the technology sectors studied. It also shows that the distribution of experts in this sample is significantly balanced among all technology sectors.

Question 2:

2. Please indicate all areas of work starting by the closest to your field of specialization = 1

Table 8.6: Frequency distribution of technology experts' work relevance

	Highly Relevant	Medium Relevance	Low Relevance	% Per Sector
	% RT	% RT	% RT	
R&D	15.82	5.06	4.43	25.32
Design	5.06	5.70	5.06	15.82
Production	0.63	1.90	3.16	5.70
Management	4.43	7.59	6.96	18.99
Consultancy	8.86	13.29	1.90	24.05
Other	5.70	1.90	2.53	10.13
% Responses	40.51	35.44	24.05	100.00
Total Responses		158		

Notes: % RT= Percentage of subgroup to total number of responses
Other areas of work include: Policy Analysis and Assessment 6 Education 3

Regarding experts' work relevance to technology fields studied in this thesis, about 41 percent of the experts stated they are highly relevant, while 35 and 24 percent of them were of medium and low relevance respectively (Table 8.6 and Figure 8.5). R&D is the sector of highest relevance to participating experts, of about 16 percent of the total experts. It is followed by design and management sectors, at 5 and 4 percent respectively.

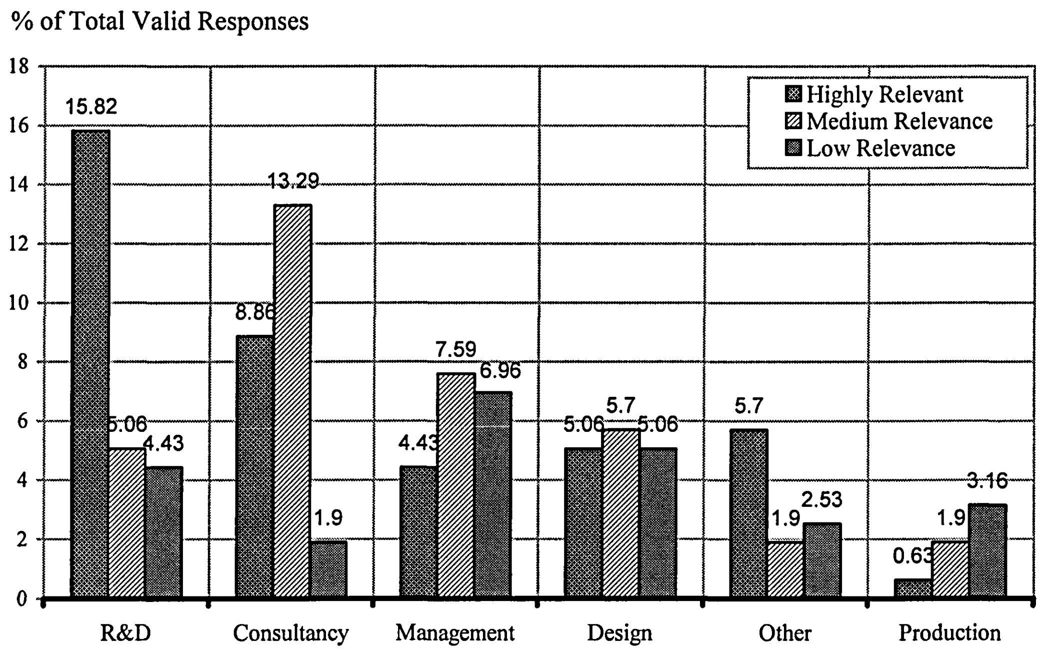


Figure 8.5: Frequency distribution of technology experts' work relevance

This analysis demonstrates that the chosen sample of experts consists mainly of R&D, consultancy, design, and management experts, whom usually are of wider and leading vision and more concerned about the future impacts of technology.

8.2.2 Expected Impacts of Technology

Question 3:

1. *To what extent do you think current operation and production systems in your field will be changed in the next thirty to forty years?*

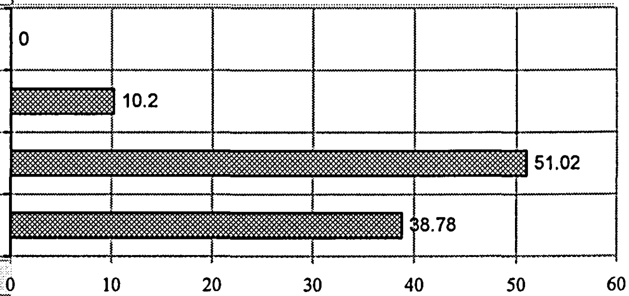
The importance of this question is that it gives a comprehensive idea about the expected technological change in all fields of technology under consideration in this thesis. The statistical analysis of technology experts' responses to this question revealed some important points: (Table 8.7).

1. None of the experts expect that there will be no change in their different fields of expertise.
2. More than half of the valid responses expect that current operation and production systems in all fields of expertise will experience a considerable change in the next 30-40 years.
3. About 39 percent of responses expect an impressive change to occur during this period.

Table 8.7: Descriptive statistics of responses to the extent to which current operation and production systems expected to changed in the next Thirty to forty years

	N	% V
No change = 0	0	0.00
Some change = 1	5	10.20
Considerable change = 2	25	51.02
Impressive change = 3	19	38.78
Total	49	100.00
Minimum Value	0	
Maximum Value	3	
Mean	2.29	
Skew	-0.35	
STDEV	0.65	

Illustration



N= Number of valid responses %V= percent of valid responses to total responses

This statistical analysis explicitly reveals the high expectancy level among technology experts about the future high rate of change in operation and production systems. Such change could impose considerable impacts on the socio-economic and urban conditions of societies during the next 30-40 years.

Question 4:

4. How much do you expect technological achievements to influence the urban life in the next 30-40 years?

Concerning the expected influence of technology on different urban life aspects, technology experts' responses to this question give a comprehensive idea about the over all impacts of all technology sectors. The statistical analysis of these responses, presented in Table 8.8, Figure 8.6, and Table A4.1 in Appendix 4, came to the following important results:

1. Regarding the relation between home and work, about 50 percent of responses state that the total amount of time needed for travelling to work & other daily activities is expected to decline at an average of -0.18 (mean). Moreover, about 60 percent of responses state that the usual interdependence between place of residence and work location is also expected to decline (-0.51). Also, about 65 percent of technology experts expect that the commuting distance between home and work will increase significantly. This could be attributed to the advancements and spread of telecommunications or transportation technologies; either private or public transportation.

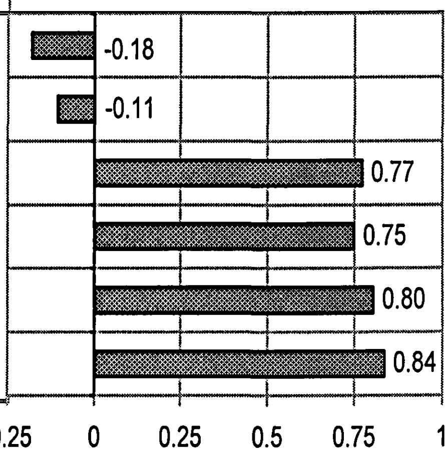
2. Population mobility, through both public and private transportation modes, is expected to increase. For public transportation, about 63 percent of responses to this category expected an increase in the use of public transportation. About 60 percent of the responses expected the same for the use of private transportation. Moreover, these responses reveal that both the public and the private transportation will experience the highest level of increase among all other urban life aspects examined, with an expected average increase (mean) of about 0.80 and 0.84 respectively.

3. Settling in remote and uninhabited areas is expected by 65 percent of the responses to increase significantly at an average of 0.77 (mean), with the lowest STDEV among all other variables (1.452).

Table 8.8: Descriptive statistics of responses to the expected influence of technological achievements on urban life during the next 30-40 years

Variables	N	Mean	STDEV	Skew
a) Total amount of time spent travelling to work & other daily activities	55	-0.18	1.668	0.40
b) Interdependence between place of residence and work location	56	-0.51	1.970	-0.05
c) Settling in remote or uninhabited areas	57	0.77	1.452	-0.93
d) Commuting distance between home and work	56	0.75	1.564	-0.54
e) The Use of public transportation	56	0.80	1.507	-0.45
f) Private transportation ownership	55	0.84	1.512	-0.54

Mean value illustration



N= Number of valid responses
STDEV= Standard Deviation

The statistical analysis of technology experts' responses reflects the high expectancy level among technology experts about the importance of the future role of technology. It also demonstrates that the long-established close relationship between work location and place of residence will start loosening. Advancements and spread of transport technologies, public and private, is expected to significantly increase population mobility. This means that people will be more able than before to select their place of residence with lower influence of work location as determining factor. Therefore, it is expected that remote and uninhabited areas will experience more urban activities as they are of considerable environmental qualities and of cheap land prices.

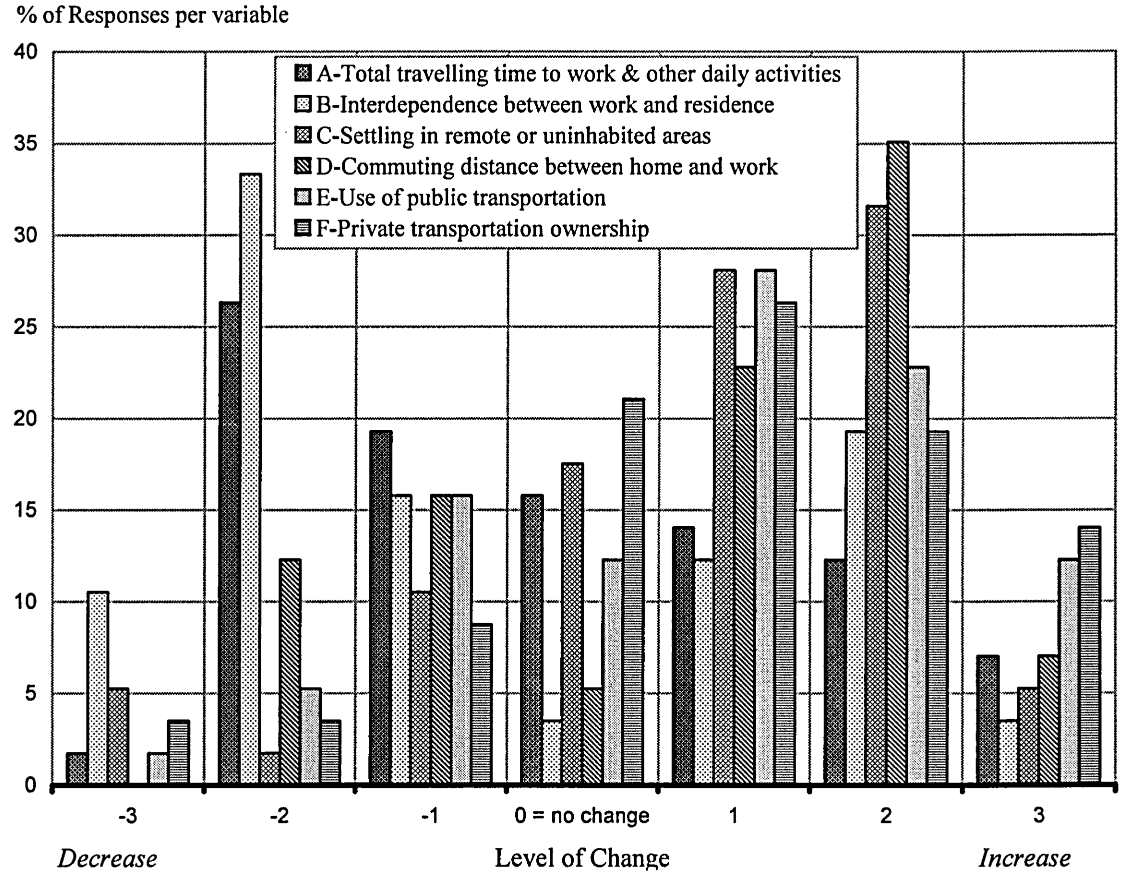


Figure 8.6: Frequency distribution of responses to the expected influence of technological achievements on urban life during the next 30-40 years

Question 5:

5. In the area of urban transportation, how much do you expect technological advancements to affect the following aspects?

Concerning the expected impacts of the future technological advancements in urban transportation, the statistical analysis of valid responses shows that:

1. All examined transport categories are expected to increase in the next 30-40 years. The highest expected increase is in vehicle capabilities and safety with an average increase of about 2.05 (mean), and followed by both the role public transportation on regional level and the role of public air transport with an average increase of 1.32 and 1.26 respectively. About 75 percent of the responses expect an increase in role of public transportation at both the regional and local levels during the next 30-40 years at an average of 1.32 and 1.09 respectively. This confirms the results reached in Question 4 reflects that public transport is highly expected to play the leading role among other transport modes in the expected increase of population mobility discussed earlier. Table 8.9 presents the descriptive statistics of the responses to all transport variables studied.

2. Regarding vehicle capabilities and safety, 95 per of the responses expect that vehicle capabilities and safety will experience the highest increase among all other variables (2.05), with the lowest STDEV (0.85).

3. For the expected role of private transportation, 65 percent of responses expect an increase in the future role of private transportation at an average of 0.737.

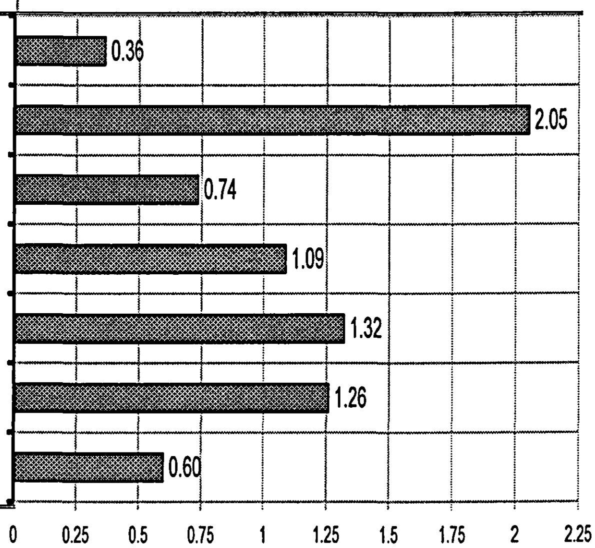
4. For the future role of air transportation, about 72 percent of the responses expect a considerable increase in public air transportation. The expected increase in the role of public air transportation is more than that of private transport and public transport at local level. Also, about 47 percent of the responses expect an increase in the future role of private air transportation. Thus, air transportation, is expected to play a more influential role in urban development, especially at the regional level.

Figure 8.7 and Table A4.2 (in Appendix 4) presents the frequency distribution of technology experts' responses to all transport variables examined.

Table 8.9: Descriptive statistics of technology experts' responses to the expected impacts of advancements in urban transport technologies

Variables	N	Mean	STDEV
a) Vehicle speed	55	0.364	1.338
b) Vehicle capabilities & safety (Navigation systems, etc.)	57	2.053	0.854
c) Role of private transportation	57	0.737	1.383
d) Role of public transportation at local level	57	1.088	1.366
e) Role of Public transportation at regional level	56	1.321	1.295
f) Role of public air transportation	54	1.259	1.291
g) Role of private air transportation	50	0.600	1.161

Mean value illustration



N= Number of valid responses

The statistical analysis of technology experts' responses to this question demonstrates that transportation technology is highly expected to affect the future of urbanisation. Public transportation, at both the regional and local levels, as well as the increasing use of private transportation will considerably increase population mobility in the next 30-40 years. The expected increasing in vehicle's capabilities and safety and in the role of public and private transportation, including the expected increase in the role of air transportation, clearly demonstrate that transport technologies will induce considerable changes in the existing urban patterns and will open up new opportunities for urbanisation in rural and remote regions.

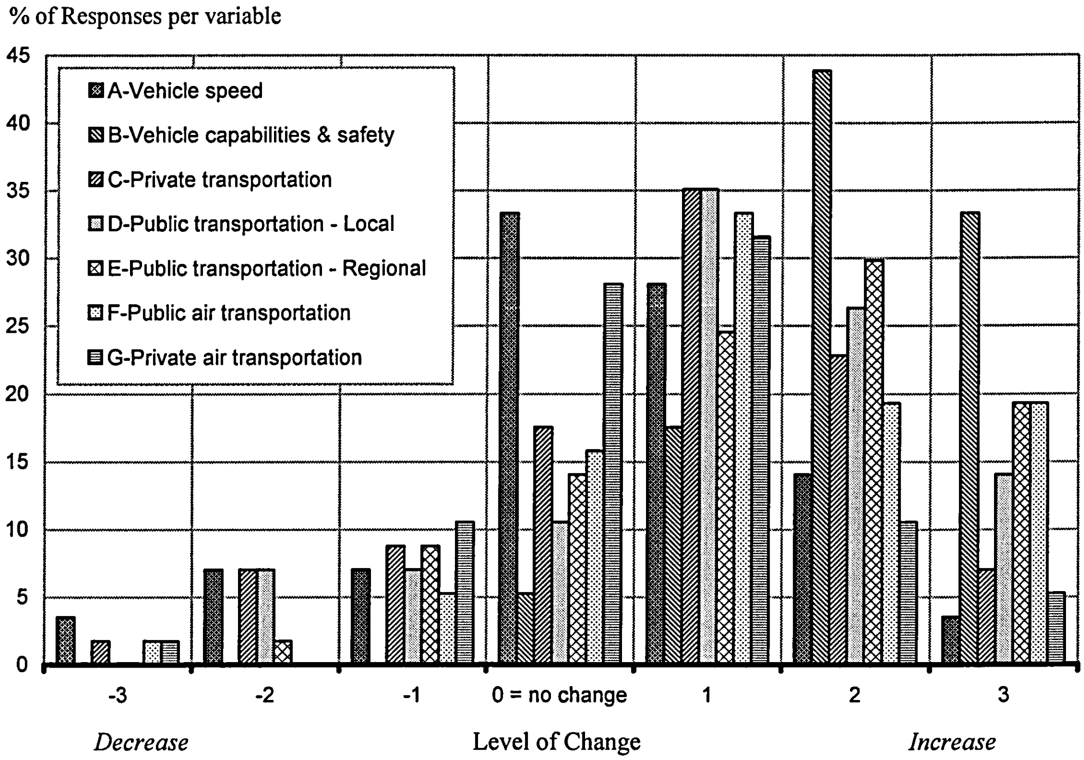


Figure 8.7: Frequency distribution of responses to the expected impacts of advancements in urban transport technologies

Question 6:

6. To the best of your knowledge, how much do you expect renewable energy sources (solar, wind,. etc) to affect the following aspects?

The statistical analysis of technology experts' responses to this question reveals that:

1. Dependence on fossil fuels is expected, by 82 percent of the responses, to considerably decline in the next 30-40 years with an average of -1.16 (mean). This means that an increase the use of renewable energies is highly expected.

2. About 84 percent of the responses expect that the cost of renewable energy production will considerably decline at an average of -1.33. About 63 percent of responses expect that the cost of energy supply networks (solar, wind) will decline at an average of -0.62. This reflects the high expectancy that the use of renewable energy will be economically feasible.

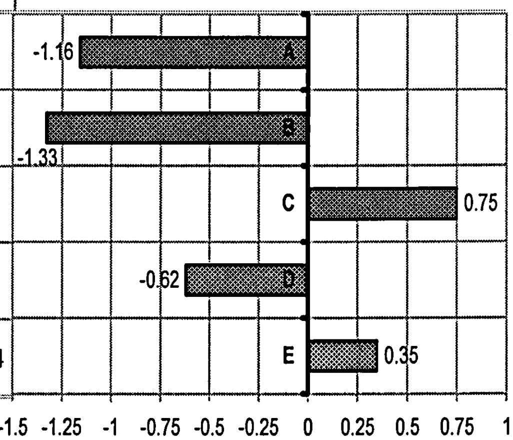
3. Regarding the future urban impacts of renewable energy, about 47 percent of technology experts' responses expect that energy technologies will increase the ability of settling out of congested areas at an average of 0.75. Also, about 44

percent of the responses expect that the freedom of locating new urban communities will increase at an average of 0.35. However, about 33 and 32 percent of the responses expect that there will be no change in these two variables. Although these ratios are high, they are lower than that of those who expect that there will be an increase in these two variables. Also, this is may be because technology experts are not highly aware of the spatial impacts of technology.

Table 8.10, Figure 8.8, and Table A4.3 (in Appendix 4) present the descriptive and the frequency distribution statistics of technology experts' responses to the expected impacts of renewable energy technologies.

Table 8.10: Descriptive statistics of technology experts' responses to the expected impacts of renewable energy technologies (solar, wind,. etc) on some urban aspects

	N	Mean	STDEV	Skew	Mean value illustration
a) Dependence on fossil fuels	57	-1.16	1.37	0.94	
b) The cost of renewable-energy production (solar, wind)	57	-1.33	1.21	1.17	
c) Settling out of congested areas	51	0.75	1.13	0.09	
d) The cost of energy supply networks (solar, wind ...)	55	-0.62	1.33	0.73	
e) The freedom of locating new urban communities	54	0.35	1.39	-0.54	



The statistical analysis of technology experts' responses reveals experts' consensus that renewable energy is growing rapidly and is considerably challenging the traditional role of fossil fuels. It is expected that renewable energy technologies will free people from the necessity of being gathered in large urban centres, which is needed to ensure the economic operation of large fossil fuel stations. Future energy technologies are expected to open up new opportunities for the development of remote and uninhabited areas and to facilitate the start of new urbanisation activities in these areas.

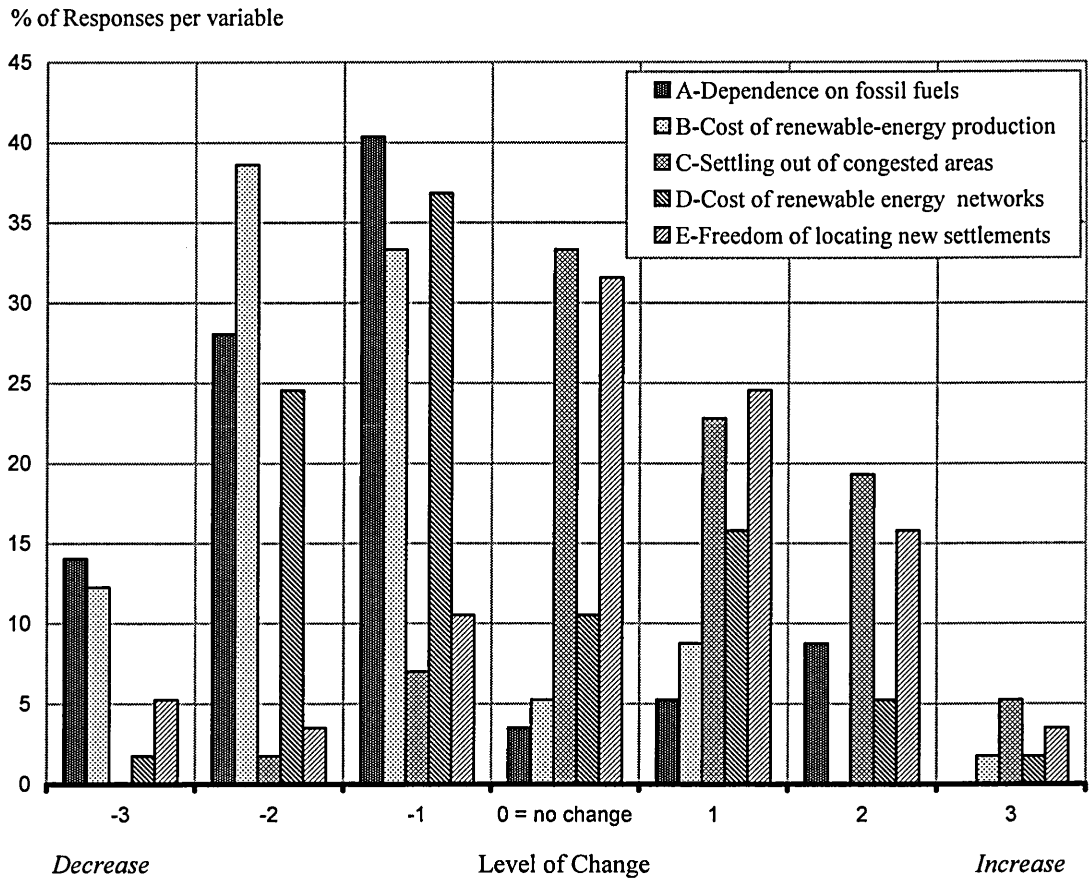


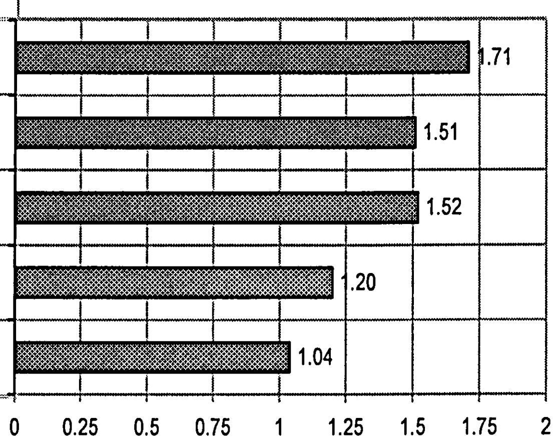
Figure 8.8: Frequency distribution of technology experts' responses to the expected impacts of renewable energy technologies (solar, wind,. etc)

Question 7:

<u>*7. In the area of utilities, to what extent do you expect technological advancements to affect the following aspects?*</u>

Table 8.11: Descriptive statistics of technology experts' responses to the expected change in urban utilities technologies

	N	Mean	STDEV	Mean value illustration
a) Introduction of new techniques for water purification	42	1.71	0.89	
b) Introduction of new techniques for sanitary treatment	43	1.51	0.77	
c) Introduction of small water & sanitary treatment units	42	1.52	0.94	
d) Facilitation of settling remote areas	46	1.20	1.17	
e) Environmental improvement of rural communities	46	1.04	1.07	



STDEV= Standard Deviation

The statistical analysis of technology experts' responses to this question reveals the following important results:

1. Regarding the introduction of new water purification techniques, about 83 percent of the responses expect that it will experience the highest increase among all other variables examined, at an average of 1.71.

2. For water and sanitary treatment, about 87 percent of the responses expect that the introduction of new techniques for sanitary treatment will increase at an average of 1.51. Also, about 80 percent of the responses expect that the introduction of small water & sanitary treatment units will increase at an average of 1.52.

3. Regarding the regional impacts of these technologies, about 78 percent of responses expect that utilities technologies will help improve the environment of rural areas at an average of 1.04. Also, about 74 percent of these responses expect that these technologies will facilitate settling remote areas at an average of 1.20.

Table 8.11, Figure 8.9, and Table A4.4 (in Appendix 4) present the descriptive and frequency distribution statistics of technology experts' responses about the expected impacts of urban utilities technologies.

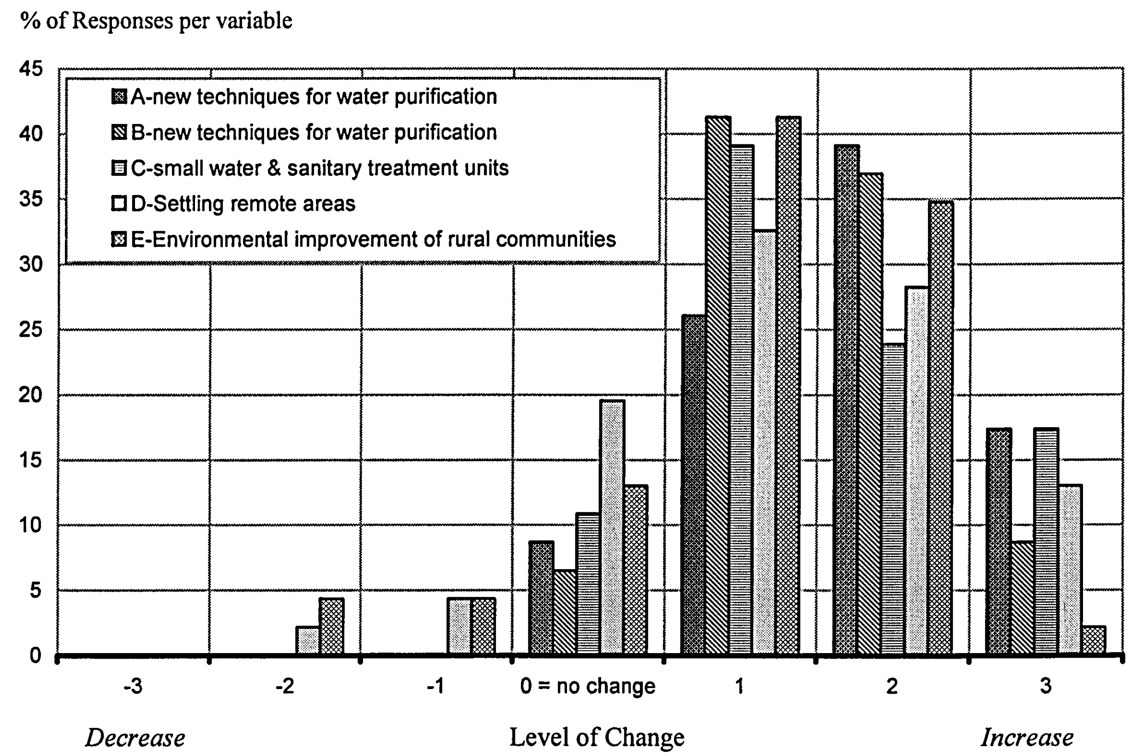


Figure 8.9: Frequency distribution of technology experts' responses to the expected change in urban utilities technologies

This high level of expectancy about the future impacts of urban utilities technologies clearly shows that these technologies could play a significant role in shaping the urban future. The expected increase in the introduction of new techniques for water purification and sanitary treatment as well as the increase in the introduction of small-scale water and sanitary treatment units will help overcome one of the main obstacles in inhabiting remote or rural areas, especially for small-size settlements and will considerably facilitate the process of urban decentralisation.

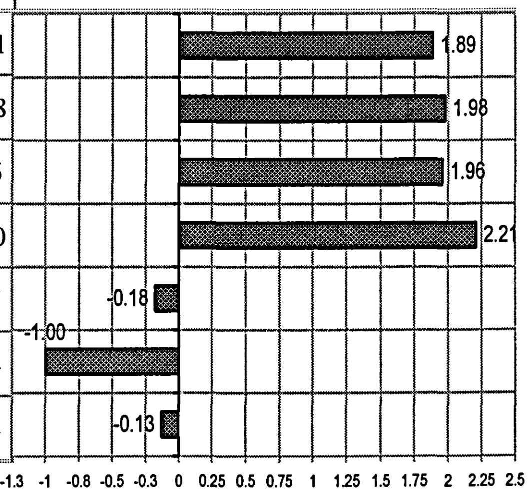
Question 8:

8. In the area of telecommunication and information technology, to what extent do you expect technological advancements in the next 30-40 years to affect the following aspects?

Table 8.12: Descriptive statistics of technology experts' responses to the expected impacts of telecommunication and information technologies

	N	Mean	STDEV	Skew
a) Home-based work	57	1.89	0.82	-0.41
b) Remote education	57	1.98	0.81	-0.38
c) Online shopping	56	1.96	0.76	0.06
d) Home entertainment	57	2.21	0.80	-0.40
e) Concentration of business in CBD of existing cities	51	-0.18	1.60	0.05
f) Preserve current working conditions	53	-1.00	1.11	0.44
g) Congestion of existing urban centres	54	-0.13	1.36	0.24

Mean value illustration



STDEV= Standard Deviation

According to the statistical analysis of technology experts' responses, information and telecommunication technologies are expected to have impressive impacts on various urban life aspects. Table 8.12 presents the descriptive statistics, while Figure 8.10 and Table A4.5 (in Appendix 4) present the frequency distribution of these responses. The main results of this analysis are:

1. Regarding the expected impacts of ICTs on work and living conditions, about 95 percent of the responses expect that ICTs will considerably increase the home-based work at an average of 1.89 (mean). More important, about 70 percent of the responses expect a considerable decline in preserving current working condition at an average of 1.11. Also, about 98 and 96 percent of the responses expect that ICTs will considerably increase online shopping and remote education at an average of 1.96 and 1.98 respectively. All technology experts (100%) expect that home entertainment will experience the highest level of increase among all other categories, at an average of 2.21.

   The main implication of these results is that new functions will be added to the house. Work and education are the most prominent of these functions. Also, house is expected to be more enjoyable and that more time could be spent in the house. This reflects that houses could move further away of large urban concentrations.

2. Regarding the expected urban impacts of ICTs, about 47 percent of the responses expect that the concentration of business activities in CBDs of existing cities will experience some decline. For the congestion of existing urban centres, about 44 percent of the responses expect similar attitude of decline.

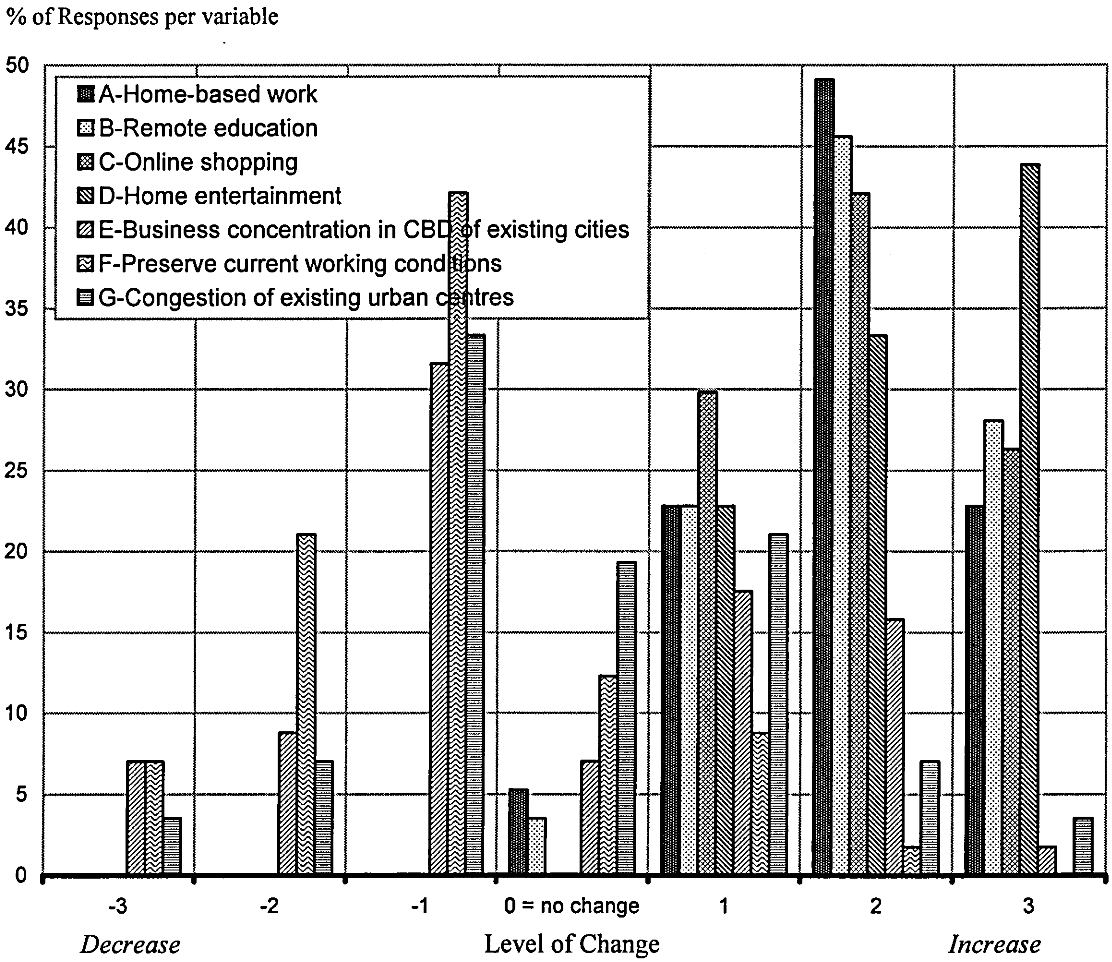


Figure 8.10: Frequency distribution of technology experts' responses to the expected impacts of telecommunication and information technologies

The high expectancy level of technology experts about the future impacts of ICTs on different urban life aspects suggests some important implications. First, the expected high increase in tele-work, distance education, and online shopping shows that large cities will lose -to some extent- its role as centre for work, education, and commerce. Second, the need to settle in these large cities will considerably decline. Third, these impacts will increase the attractiveness of the small urban communities and will significantly facilitate the implementation of the proposed small-size settlements and urban decentralisation approaches. Fourth, the expected decline in both the concentration of business activities in CBDs of existing cities and in the congestion of existing urban centres necessitates the adoption of new policies for the future development of these cities taking into account the expected change in their size and function.

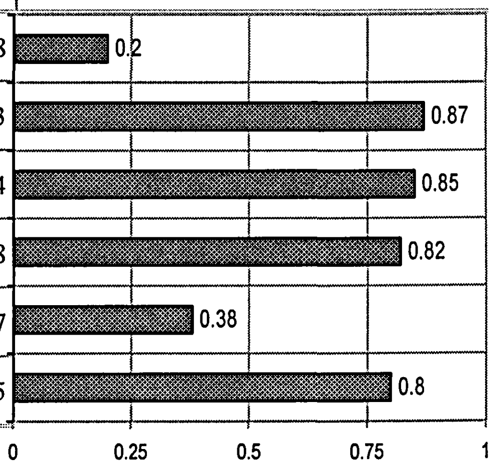
Question 9:

<u>9. To the best of your knowledge, how much do you expect future impacts of technological achievements to alter the urban pattern?</u>

Responses of the technology experts about the expected urban impacts of technology are important as they reflect the overall perception of technology experts about the urban impacts of all and interrelated technologies. Although technology experts may be of limited knowledge about spatial and urban impacts of technological change, their responses could be used a guide about the possible urban changes.

Table 8.13: Descriptive statistics of technology experts' responses to the expected impacts of overall technological achievements on urban patterns

Variables	N	Mean	STDEV	Skew	Mean value illustration
a) Concentration of population in few urban centres	55	0.20	1.37	-0.38	
b) Dispersion of urban population to the suburbs	55	0.87	1.19	-0.43	
c) Dispersion of urban population to rural settlements	54	0.85	1.21	-0.04	
d) Emergence of remote isolated urban communities	49	0.82	1.36	-0.58	
e) The size of future new urban settlements	50	0.38	1.41	-0.27	
f) The future size of existing cities	54	0.80	1.34	-0.25	



N= Number of Responses STDEV= Standard Deviation

The statistical analysis of technology experts' responses shows that:

1. Regarding the expected impact of future technology achievements on the dispersion of urban population, about 65 percent of the responses expect some increase in population dispersion to the suburbs at an average of 0.87 (mean), with lowest standard deviation (Table 8.13). Also, about 65 percent of the responses expect some increase in the dispersion of urban population to rural areas at an average of 0.85. On the other hand, about 56 percent of the responses expect some increase in the emergence of remote isolated urban communities at an average of 0.82. However, 49 percent of the responses expect a slight increase in the concentration of population in few urban centres.

   This reflects the high consensus among technology experts that future technological achievements will facilitate population dispersion. Although the expected increase in population concentration in few urban centres seems in contradiction of the expected population dispersion, it should be notes that such increase is less than the half of the expected increase either to the suburbs, rural areas, or to new settlements.

2. Regarding settlement size, about 45 percent of the responses expect some increase in the size of future new urban settlements at an average of 0.38. And about 64 percent of the responses expect some increase in the future size of existing cities at an average of 0.80 (Figure 8.11 and Table A4.6 in Appendix 4). However, such expected increase in the future size of existing cities contradicts with the expected increase of population dispersion and with expected decline in the congestion of existing urban centres (Question 8).

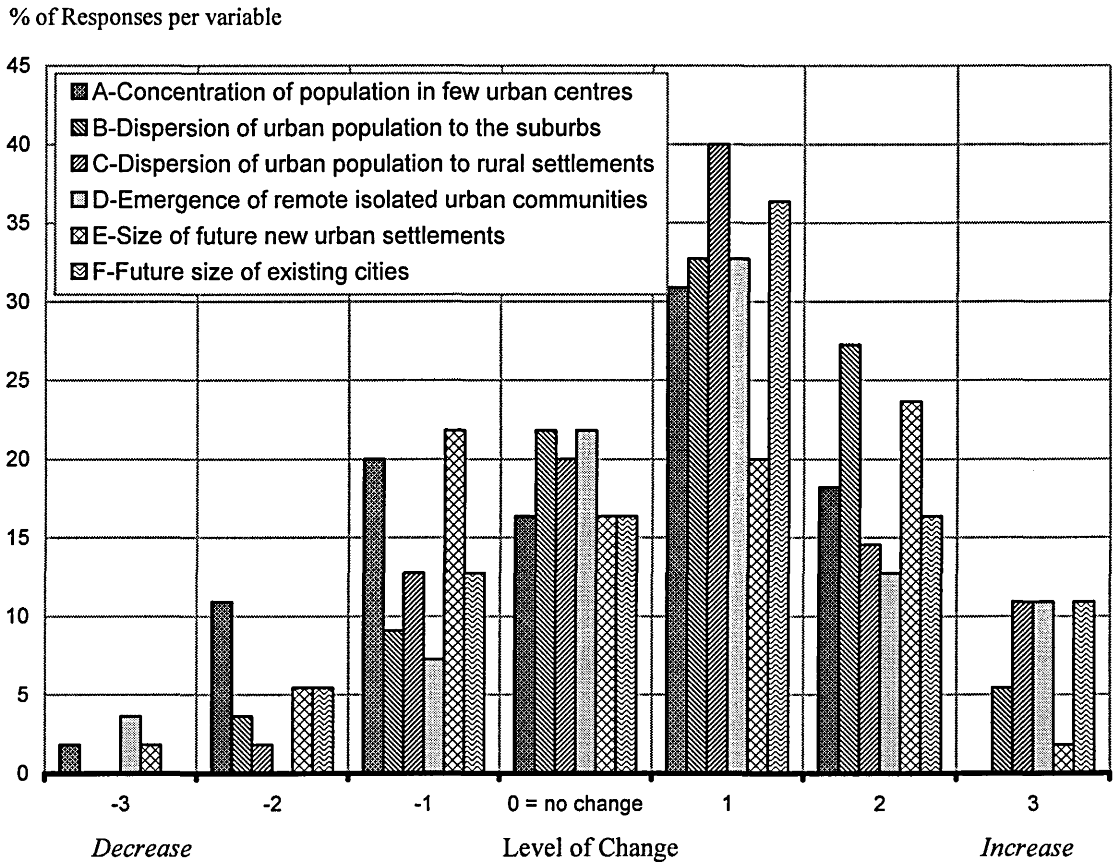


Figure 8.11: Frequency distribution of technology experts' responses to the expected impacts of overall technological achievements on urban patterns

The main conclusion that can be drawn out of the responses to this question is that population dispersion to the suburbs, rural areas and to the remote areas is highly expected.

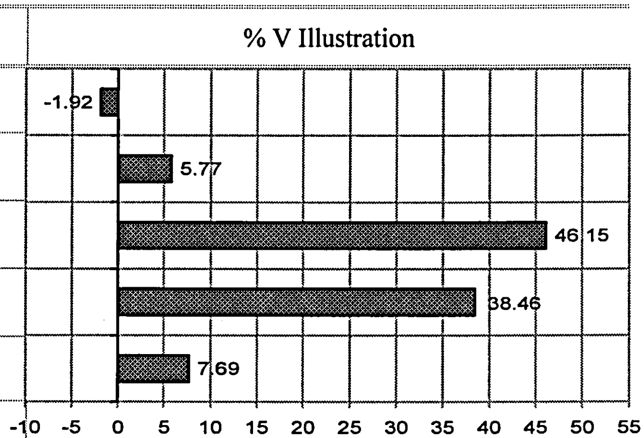
8.2.3 Technology Transfer and its Impacts in Developing Countries

Question 10:

10. How much do you expect the rate of transferring these technological achievements to affect urban life in progressive developing countries in the next 30-40 years?

Table 8.14: Frequency distribution of technology experts' responses about how the rate of technology transfer is expected to affect urban life in progressive developing countries in the next 30-40 years

	N	% V
a) Decrease	1	1.92
b) No change	3	5.77
c) Some increase	24	46.15
d) Considerable change	20	38.46
e) Impressive change	4	7.69
Total	52	100



N = Number of valid responses V. % = Valid percent

Regarding the impact of technology transfer on urban life in developing countries during the next 30-40 years, the statistical analysis of the technology experts' responses shows that about 92 percent of responses expect an increase, of different levels, in the impact of technology transfer on urban life in these countries (Table 8.14). Of this percentage, about 38 percent expect a considerable increase, and about 8 percent expect an impressive increase in the impact of technology transfer on urban life in developing countries. Also, about 46 percent expect that there will be some increase. This is while only 6 percent expect that there will be no change.

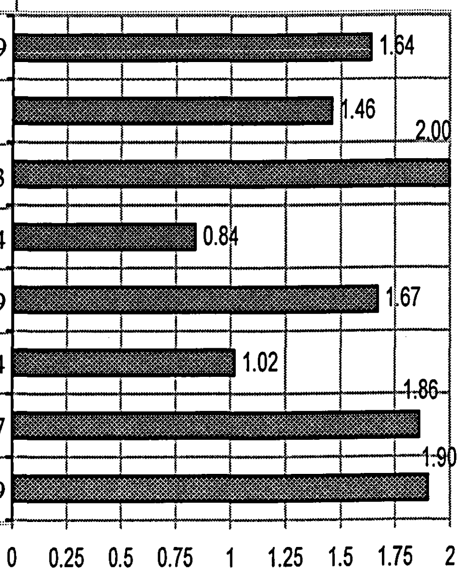
The statistical analysis of technology experts' responses to this question clearly demonstrates that technology transfer to developing countries is highly expected to have a considerable impact on urban change in these countries. This implies the need to investigate the possible and the best approaches for managing future urban change in developing countries to meet the expected impacts of technological change.

Question 11:

11. Regarding technology transfer to developing countries, how much do you think it had been in the past ten years and how much do you expect it will be in the next 30-40 years?

Table 8.15: Descriptive statistics of technology experts' responses about the past and the expected levels of technology transfer to developing countries.

	N	Mean	STDEV	Skew	Mean value illustration
a) The future importance of markets in developing countries	47	1.64	1.07	-0.99	
b) Transfer of telecommunication technologies in past ten years	46	1.46	0.81	0.01	
c) Transfer of telecommunication technologies in next 30-40 years	49	2.00	0.98	-0.83	
d) Transfer of transportation technologies in the past ten years	45	0.84	0.95	-0.34	
e) Transfer of transportation technologies in next 30-40 years	49	1.67	0.97	-0.59	
f) Transfer of utility technologies in the past ten years.	43	1.02	1.01	-0.34	
g) Transfer of utility technologies in the next 30-40 years.	44	1.86	0.93	-1.17	
h) Future importance of developing countries markets in technology transfer.	48	1.90	0.90	-0.69	



N= Number of Responses STDEV= Standard Deviation

The statistical analysis of the technology experts' responses to this question clearly shows that:

1. Regarding the last ten years, technology experts' responses confirm that technology transfer to developing countries was increasing in all technology sectors during that period. About 84 percent of the responses state that there was a considerable increase in the transfer of telecommunications technologies to developing countries at an average of 1.46. Also, about 65 percent of the responses stated that there were similar in the transfer of both transportation and utilities technologies at an average of 0.84 and 1.02 respectively. Figure 8.12 and Table A4.7 (in Appendix 4) present the frequency distribution of these responses.

2. Regarding the next 30-40 years, technology experts expect that technology transfer to developing countries will considerably increase during that period. About 94 percent of the responses expect that there will be a considerable increase in the transfer of both telecommunication and transport technologies at an average of 2.00 and 1.67 respectively. About 86 percent of the responses expect a considerable increase in the transfer of utilities technologies at an average of 1.86.

3. Regarding the future importance of developing countries markets in technology transfer, about 94 percent of the responses expect that the importance these market will significantly increase at an average of 1.90.

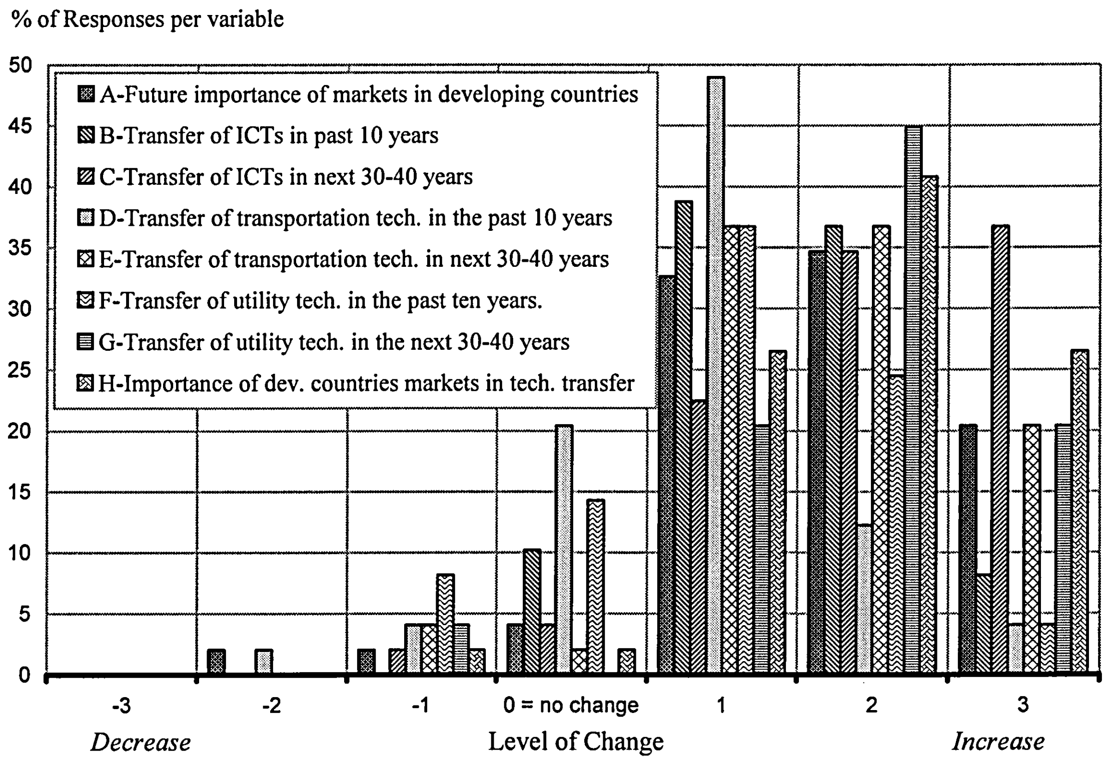


Figure 8.12: Frequency distribution of the technology experts' responses about technology transfer to developing countries

This statistical analysis clearly shows that the transfer of telecommunication, transportation, and utilities technologies to developing countries is highly expected to increase substantially during the next 30-40 years. This expected high increase in technology transfer to developing countries would certainly affect urban change patterns in these countries.

8.3 QUESTIONNAIRE III: RESULTS ANALYSIS AND DISCUSSION

In this chapter, the received valid responses of urban experts for each question are statistically analysed. In doing so, the data file was first developed using the urban experts responses in the two rounds. The old responses of experts who participated in the second round have been replaced by the new ones, while responses of experts who did not participate in that round are left the same as they were in the first round. Then, the developed data file was loaded on SPSS and Microsoft Excel and the statistical analysis for each question had been run. Descriptive statistics (mean, standard deviation, and skewness) and frequency distribution were the main statistical analyses applied. In this analysis, all responses are treated on the basis of equal value and frequency distribution is used as the main criterion for measuring experts' consensus. In order to avoid repetition, the discussion of results implications has directly followed the statistical analysis.

In the analysis of this questionnaire, related questions are grouped according to their main objective under the title of their objective.

8.3.1 Experts Relevance to Main Areas of Urban Development

Question 1:

2. *From your wide interests and experience, please indicate all areas of expertise starting by the closest to your field of specialization = 1*

Table 8.16: Frequency distribution of urban experts' relevance to main areas of expertise

	Highly Relevant	Medium Relevance	Low Relevance	% Per Sector
	% T	% T	% T	
Urban Academics	26.09	4.35	2.90	33.33
City Planners	10.14	11.59	5.07	26.81
City Planning Officials	2.90	2.90	4.35	10.14
Architects	11.59	4.35	2.17	18.12
Other	6.52	4.35	0.72	11.59
% Responses	57.25	27.54	15.22	100.00
Total Valid Responses		138		

Notes: % T= Percentage of subgroup to total number of responses
Other areas of interest include:

Housing and Building Services	4	Transportation Planning	3
GIS urban applications	2		

Concerning experts' experience relevance to the main areas of urban expertise, 57 percent of the participating experts are highly relevant to their areas of expertise, while

28 and 15 percent are of medium and low relevance respectively. Urban academic is the highly relevant area of expertise for about 26 percent of participating experts, followed by 11, 10, and 3 percent for architects, city planners and city planning officials respectively. Other areas of expertise, including housing and building services, transportation planning and GIS urban applications are the highly relevant areas of expertise for about 7 percent of the participating experts. Table 8.16 and Figure 8.13 present the frequency distribution of responses regarding experts' degrees of relevance to the main areas of urban expertise. This analysis clearly shows that the selected sample of experts is of high relevance to the urban issues studied.

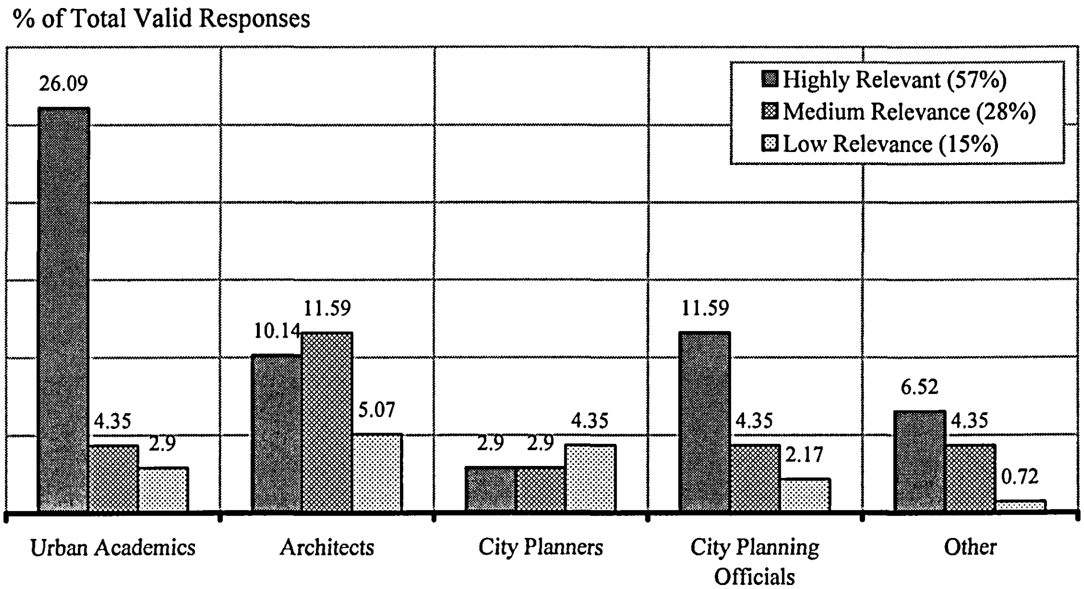


Figure 8.13: Frequency distribution of responses about experts' relevance to the main areas of expertise

This statistical analysis clearly demonstrates that the chosen sample of urban experts is of high relevance to the subject of this study.

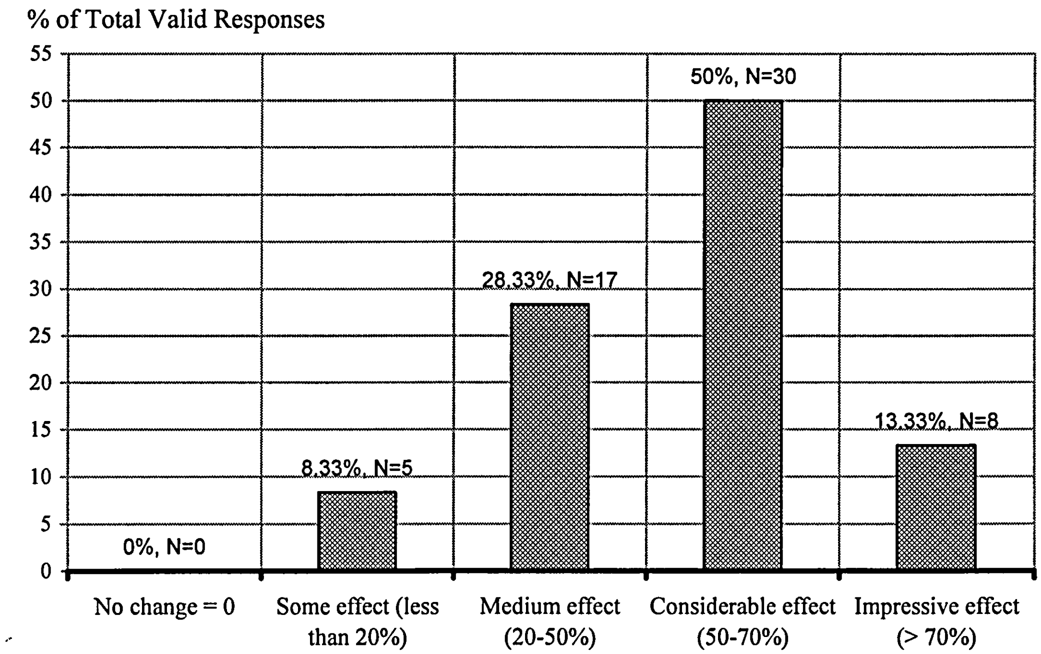
8.3.2 Expected Urban Impacts of Main Technological Forces

Question 2:

2. To what extent do you think future technological advancements will affect urban development in developing countries in the next 30-40 years?

The importance of this question is that it gives a comprehensive idea about how urban experts view the future impacts of technological change on urban development in developing countries. Statistical analysis of urban experts' responses to this question reveals the following important points (Figure 8.14):

1. None of urban experts expects that there would be no change.
2. Half of them expect that future technological achievements will be of considerable effect on urban development in developing countries in the next 30-40 years.
3. About 28 and 13 percent of them expect that technological achievements will be of medium and impressive effects respectively.



N= Number of valid responses

Figure 8.14: Frequency distribution of responses about the expected technology impacts on urban development in developing countries

This analysis explicitly demonstrates the high expectancy level among urban experts that future technological achievements will have a considerable impact on urban development in developing countries during the next 30-40 years.

Question 3:

3. To the best of your knowledge, what are the main technological advancements you expect to influence the future urban development policies? Please start by what you think the most influential.

The statistical analysis of urban experts' responses to this question shows that ICTs are expected to be of very high influence on the future of urban development (Figure 8.15). About 24 percent of responses expect that ICTs will be the most influential, followed by transportation (13%), energy (9%) and urban utilities technologies (8%).

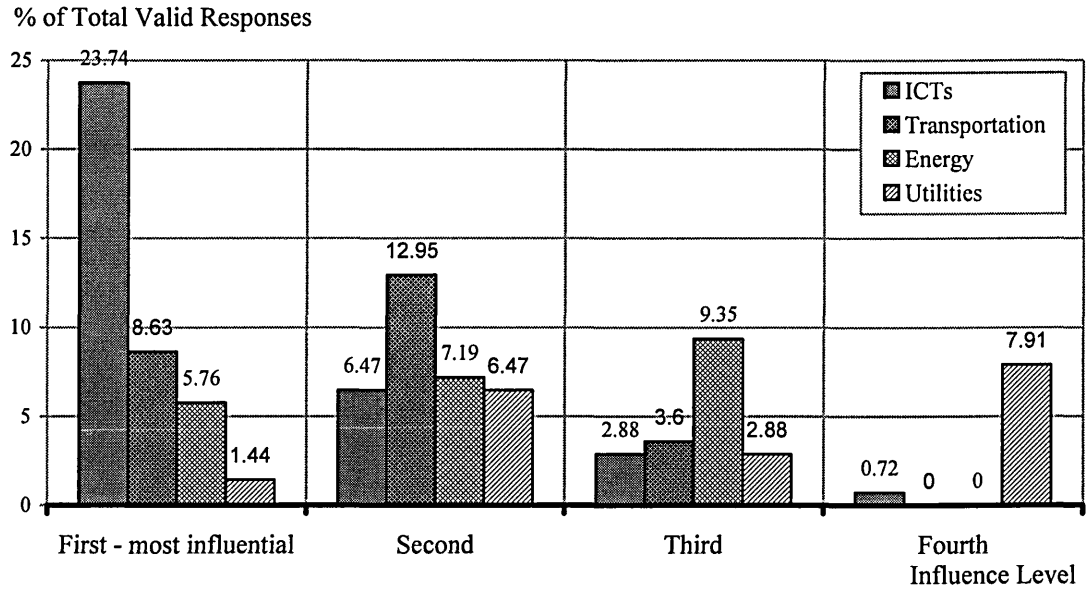


Figure 8.15: Frequency distribution of urban experts' responses about the expected influence of different technology sectors on urban development future

The main implication of theses results, and as ICTs are expected to be of the highest high influence on the future of urban development in developing countries, and because of the rapid and impressive advancement of these technologies, there will be a considerable degree of uncertainty in defining its urban impacts.

Question 4:

4. How do you expect future technological advancements to influence the following urban life aspects in the next forty years?

Concerning the expected influence of technology on different urban life aspects, urban experts' responses to this question reflect experts' perception of the impacts of all technologies together. Table 8.17 presents the descriptive statistics of the valid responses received.

The statistical analysis of responses to this question (presented in Table 8.17, Figure 8.16, and Table A4.8 in Appendix 4) reveals that:

1. Regarding the relationship between home and work, about 64 percent of the responses state that the total amount of time needed for travelling to work & other daily activities is expected to decline (mean = -0.72). Also, 49 percent of the valid responses expect that the usual interdependence between place of residence and work location will decline (mean = -0.29). Moreover, about 67 percent of the responses expect that the commuting distance between home and work will increase significantly. These expectations confirm with those of technology experts (Question 4 in Questionnaire II) and demonstrate the high confidence that

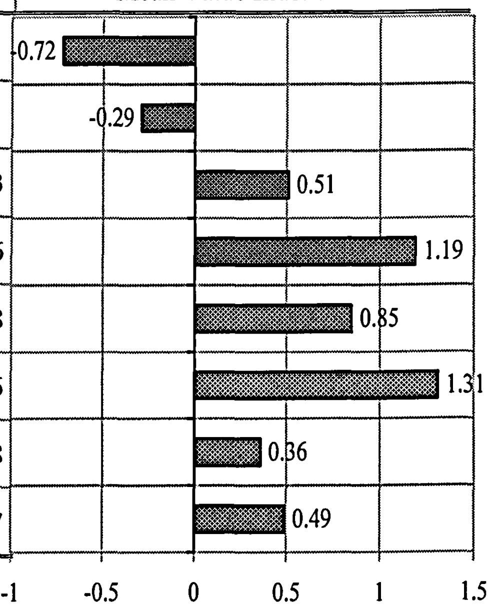
the relationship between work location and place of residence will start loosening. The main implication of these results is that these technologies will facilitate population dispersion in developing countries.

2. Regarding the expected change in transportation patterns, private transportation is expected to increase at a rate higher than that of public transportation. About 74 percent of responses expect that private transportation will considerably increase at an average of 1.31 (with lowest STDEV of 1.38), while 65 percent of responses expect that the use of public transportation will increase at an average of 0.85. Technology experts' responses to Question 4 and Question 5 show different attitude stressing that public transport will play the leading role among other transport modes in increasing population mobility. However, both urban and technology experts expect that population mobility will significantly increase.

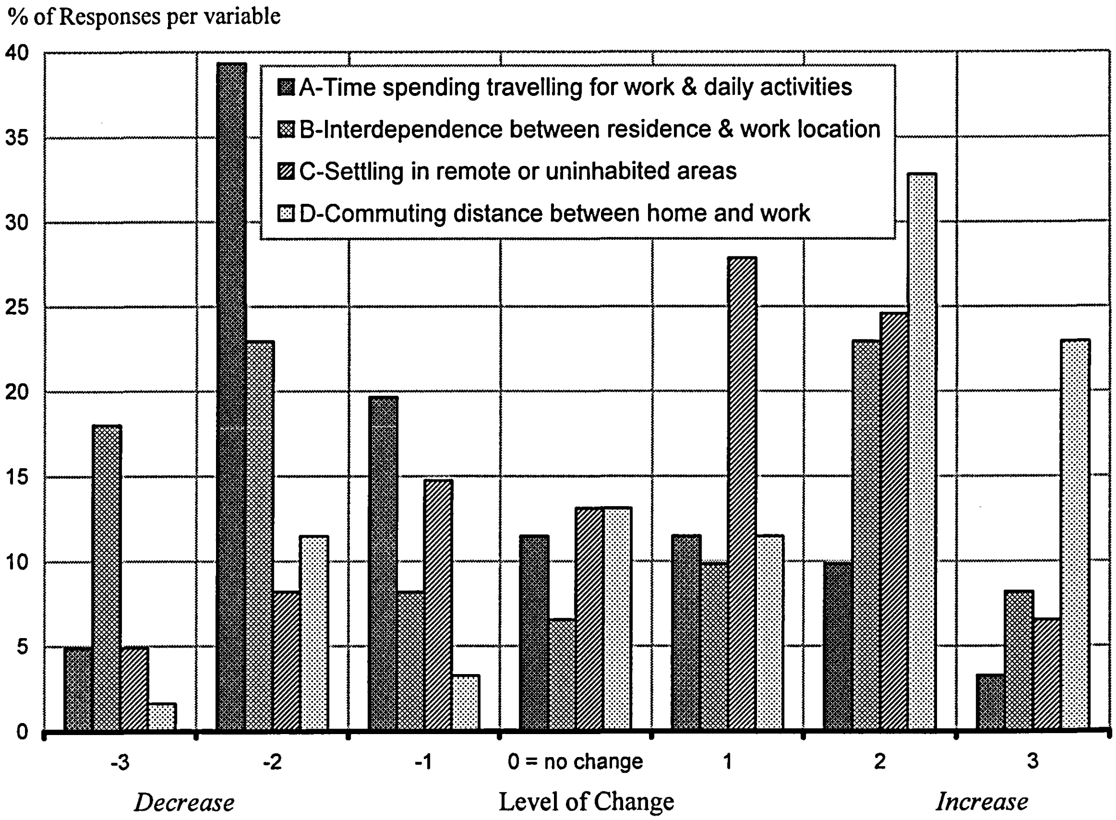
3. Regarding the expected changes in factors affecting the urban environment, urban experts expect that technological achievements will increase the attractiveness of rural settlements more than that of urban ones. About 51 percents of the responses indicate that the attractiveness of rural centres to urban population is expected to increase at an average of 0.49, while 49 percent of the responses show that attractiveness of urban centres will increase at an average of 0.36 only. Also, about 59 percent of valid responses expect that settling remote and uninhabited areas will increase at an average of 0.51. This result confirms with technology experts' expectations (Question 4 in Questionnaire II).

Table 8.17: Descriptive statistics of urban experts' responses to the expected influence of technological achievements on urban life aspects during the next 30-40 years.

Variables	N	Mean	STDEV	Skew	Mean Value Illustration
A) Time spent travelling for work & daily activities	61	-0.72	1.59	0.75	
B) Interdependence between residence & work location	59	-0.29	2.13	0.12	
C) Settling in remote or uninhabited areas	61	0.51	1.60	-0.53	
D) Commuting distance between home and work	59	1.19	1.71	-0.86	
E) The use of public transportation	60	0.85	1.59	-0.48	
F) Private transportation ownership	59	1.31	1.38	-0.86	
G) Attractiveness of urban centres to rural population	58	0.36	2.06	-0.28	
H) Attractiveness of rural centres to urban population	61	0.49	1.62	-0.17	



N= Number of valid responses STDEV= Standard Deviation



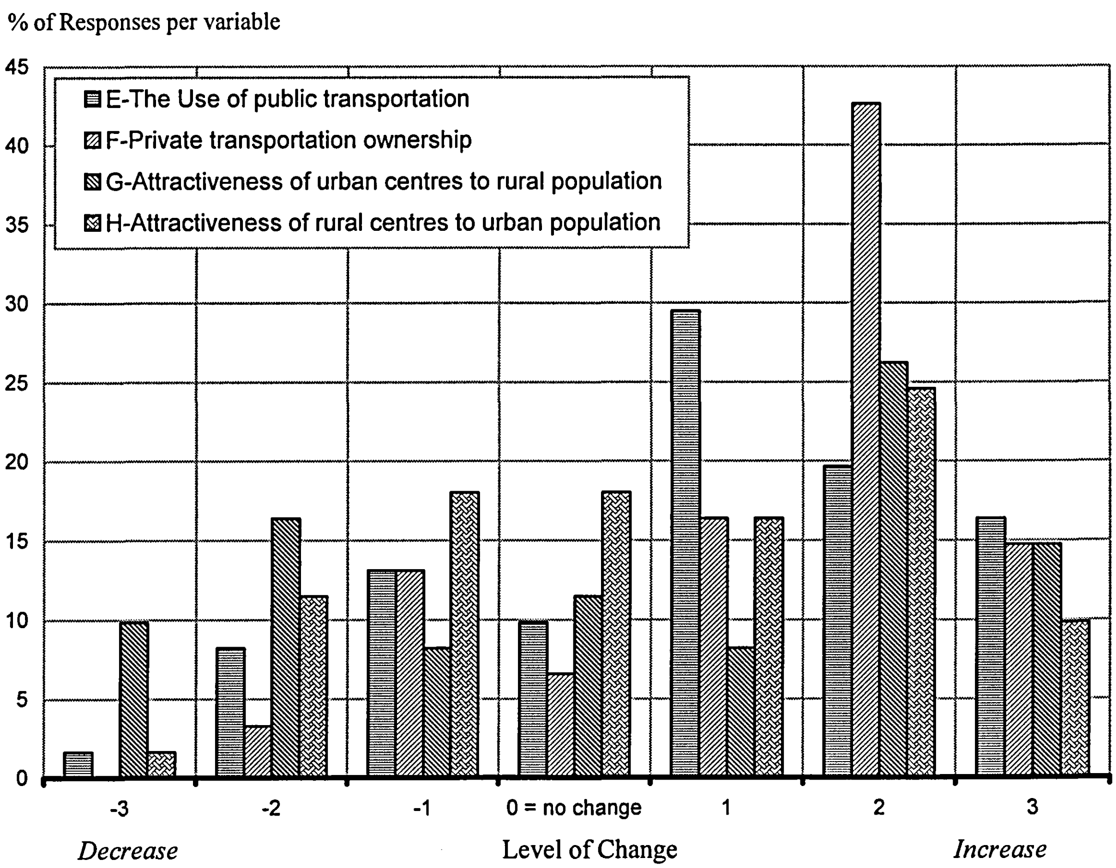


Figure 8.16: Frequency distribution of urban experts' responses to the expected influence of technological achievements on urban life during the next 30-40 years

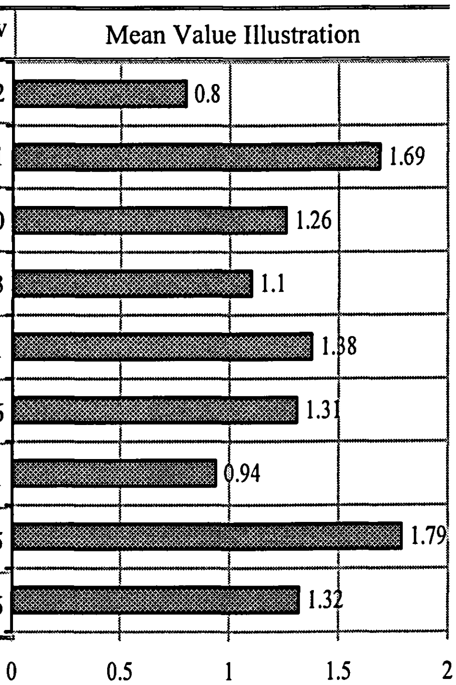
The statistical analysis of urban experts' responses to this question, and in confirmation with technology experts' expectations (Question 4 in Questionnaire II) reflects the high consensus among urban experts about the importance of future role of technology. These technologies, especially the ICTs, are expected to loosen the long-established close relationship between work location and place of residence. Also, the advancements and spread of transportation technologies are expected to significantly increase population mobility. Therefore, it is expected that people will be more able than before to select their place of residence with lower influence of work location as determining factor. Also, it is expected that rural and remote areas will attract more urban activities.

Question 5:

5. In the area of urban transportation, how do you expect technological advancements to affect the following aspects in developing countries?

Table 8.18: Descriptive statistics of urban experts' responses to the expected impacts of urban transport technologies in developing countries.

Variables	N	Mean	STDEV	Skew
a) Vehicle speed	59	0.80	1.23	-0.52
b) Vehicle capabilities and safety	58	1.69	1.06	-0.61
c) The role of private transportation.	61	1.26	1.37	-0.70
d) The role of public transport at local level	60	1.10	1.26	-0.93
e) The role of public transport at regional level	58	1.38	1.28	-0.91
f) The role of public air transportation	54	1.31	0.97	-0.16
g) The role of private air transportation	51	0.94	0.99	-0.91
h) Population Mobility	58	1.79	1.24	-1.25
i) The ability to settle in remote areas	60	1.32	1.37	-0.56



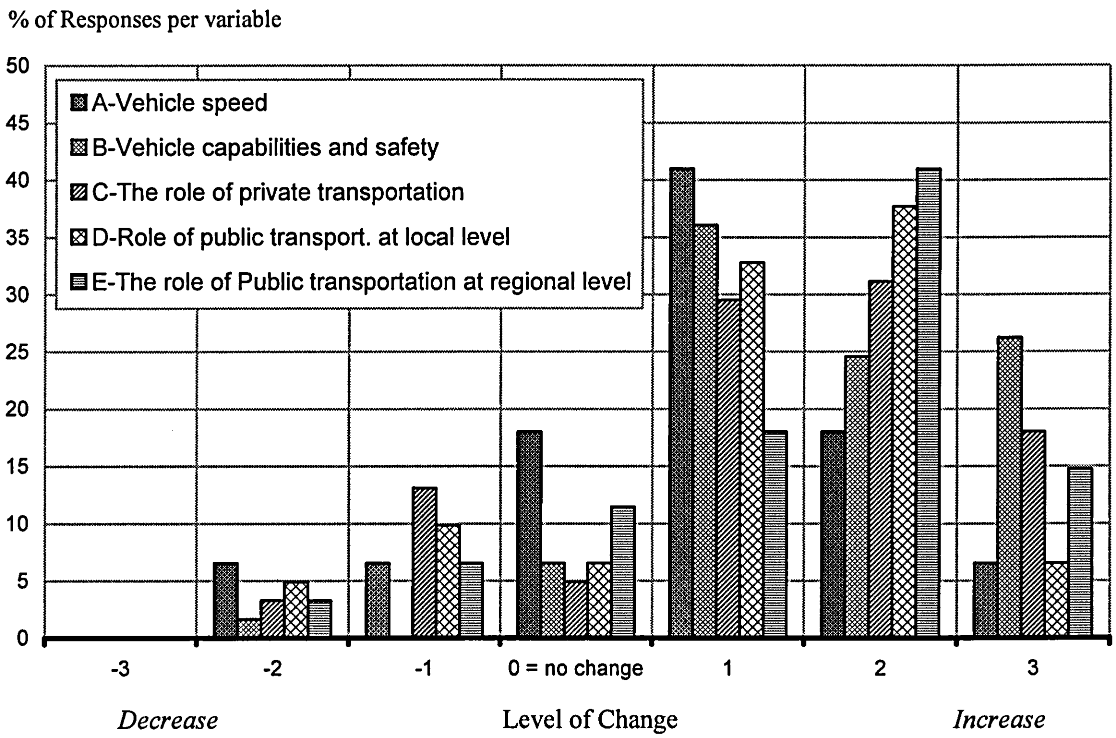
N= Number of valid responses   STDEV= Standard Deviation

Concerning the expected impacts of the future advancements in urban transportation technologies, the statistical analysis of valid responses shows that:

1. All examined categories are expected to increase in developing countries during the next 30-40 years. Table 8.18 presents the descriptive statistics of urban experts' responses for all transport categories studied. Figure 8.17 and Table A4.9 (in Appendix 4) present the frequency distribution of these responses.

2. Regarding population mobility, which gives a general idea about the over all impact of transport technologies, about 87 percent of the responses expect a considerable increase in this category with the highest mean of 1.79.
3. Regarding vehicle design, about 87 percent of the responses expect a considerable increase in vehicle capabilities and safety with the second highest mean of 1.69 and the lowest standard deviation of 1.01. Also, about 66 percent of the responses expect that vehicle speed will increase at an average of 0.8.
4. For the expected role of different transport modes, the role of public transport at regional level is expected to grow higher that of all other modes. About 87 percent of the responses expect an average increase of 1.38 (mean) in the future role of public transport at regional level, while about 79 and 77 percent of the responses expect an increase of 1.26 and 1.10 (mean) in the roles of private transport and public transport at local level respectively. This coincides with technology experts' expectation (Question 5 in Questionnaire II) and reflects the importance of the future role of public transportation. For the future role of air transport, about 69 and 64 percent of the responses expect a considerable increase of 1.26 and 1.10 (mean) in the roles of public and private air transport respectively. This expected increase reflects that air transportation is expected to influence urban change in developing countries, especially on the regional level.
5. Regarding the expected urban impacts of transport technologies, urban experts expect that technological achievements will increase the attractiveness of About 74 percent of urban experts expect that transport technology will considerably increase the ability to settle in remote areas at an average of 1.32.

The statistical analysis of the urban experts' responses to this question clearly demonstrates that transportation technologies will considerably increase population mobility and will influence the urban future in developing countries. The role of public and private transportation, including air transportation, is also expected to increase. The expected increase in population mobility is expected to increase their ability to reside in areas further away from the city. Also, the expected increase in the role of public transportation and public air transport is that it will introduce serious urban changes, mainly at the regional level. In this regard, it is highly expected that transport technology will considerably increase the ability to settle in remote areas.



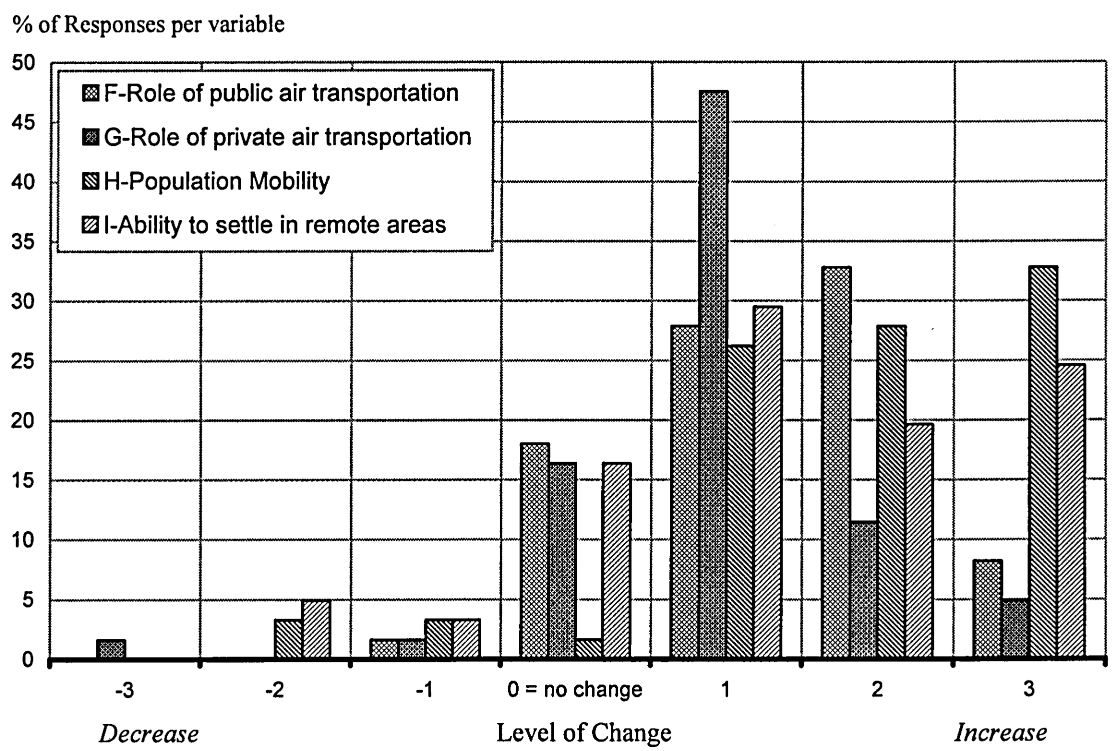
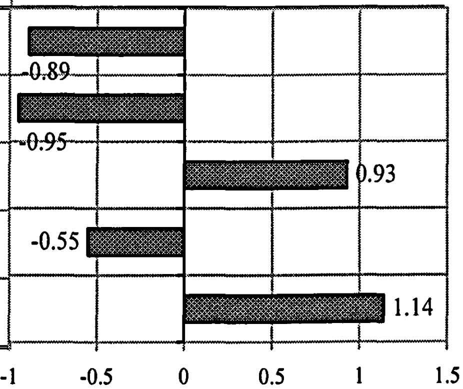


Figure 8.17: Frequency distribution of urban experts' responses to the expected impacts of transport technologies in developing countries

Question 6:

6. To the best of your knowledge, to what extent do you expect renewable energy sources (solar, wind,. etc) to affect the following aspects in developing countries?

Table 8.19: Descriptive statistics of urban experts' responses to the expected impacts of advancements in renewable energy sources in developing countries.

Variables	N	Mean	STDEV	Skew	Mean Value Illustration
a) Dependence on fossil fuels	56	-0.89	1.50	0.72	
b) The cost of renewable-energy production	55	-0.95	1.60	0.61	
c) Settling out of congested urban areas	57	0.93	1.29	-0.22	
d) The cost of energy supply networks (solar, wind)	58	-0.55	1.60	0.42	
e) The ability to settle in remote areas	59	1.14	1.36	-0.85	

The statistical analysis of urban experts' responses about the future impacts of energy technologies in developing countries reveals that:

1. For the future dependence on fossil fuels, about 66 percent of these responses expect that such dependence will decline at an average of -0.89 (mean). This could be attributed to the declining cost of renewable energies in addition to their environmental advantages.

2. Regarding the costs of renewable-energy, about, 64 percent of the responses expect that it will decline at an average of -0.95 (mean). Also, about 58 percent of the responses expect some decline in the cost of energy supply networks (solar, wind) (-0.55). These results highly confirms with technology experts' expectations.

3. Regarding the ability of relocation, about 58 percent of urban experts' responses expect that the future advancements of renewable energy technologies will increase the ability to settle out of congested areas, mainly around existing large cities, at an average of 0.93, with lowest standard deviation (1.29). Although the ratio of those who expect that there will be no change is relatively high (27 percent), the ratio of those who expect an increase is more than the double (58 percent). Moreover, 71 percent of these responses expect an increase in the ability to settle in remote areas, mainly in independent settlements, at an average of 1.14. Again this could be attributed to the fact that renewable energies offer economic alternatives for energy supply in these areas in developing countries.

Table 8.19 presents the descriptive statistics of urban experts' responses to this question. Figure 8.18 and Table A4.10 (in Appendix 4) present the frequency distribution of these responses.

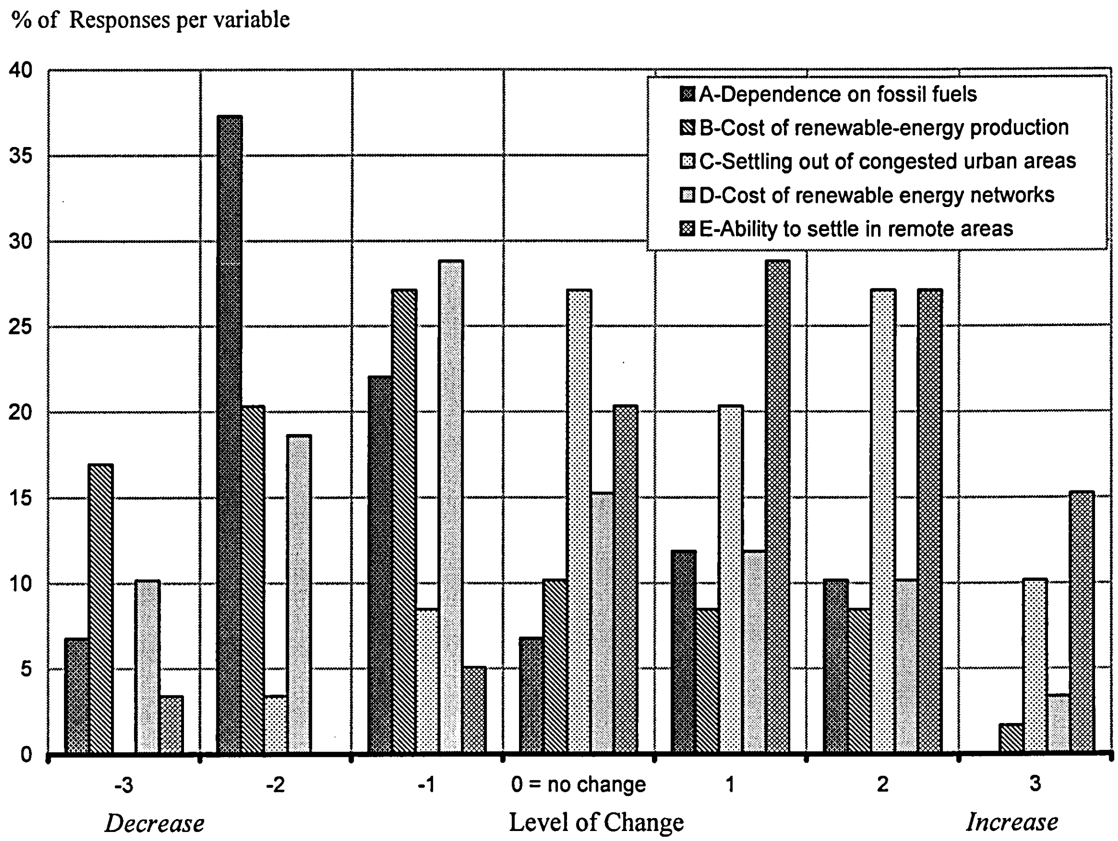


Figure 8.18: Frequency distribution of urban experts' responses to the expected impacts of advancements in renewable energy sources in developing countries.

This analysis demonstrates the high expectancy level among urban experts that advancements of renewable energy technologies will decrease the dependence on fossil fuels. In addition, they expect that these technologies will facilitate the dispersion of urban population out of congested urban areas towards the rural and remote areas. These technologies is expected to free people from the necessity of being gathered in large urban centres, which is needed to ensure the economic operation of large fossil fuel stations.

Question 7:

7. In the area of utilities, to what extent do you expect technological achievements to affect the following aspects?

In area of urban utilities, the statistical analysis of urban experts' responses reveals the high expectancy level about the future impacts of urban utilities technological achievements (Table 8.20, Figure 8.19 and Table A4.11 in Appendix 4). Through this analysis, the following results have been reached:

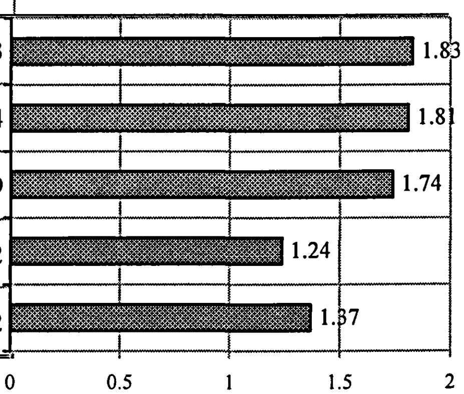
1. About 91 percent of the responses expect a considerable increase in the introduction of new techniques for water purification at an average of 1.80. Also, about 90 percent of these responses expect a considerable increase in the introduction of both new techniques for sanitary treatment and small water & sanitary treatment units at an average of 1.81 and 1.74 respectively. These results confirm with technology experts responses to Question 7 in Questionnaire II.

2. Regarding ability to relocate, about 80 percent of these responses expect that technological achievements in area of urban utilities will considerably facilitate settling in remote area and will considerably improve the environment of rural communities at an average of 1.24 and 1.37 respectively.

Table 8.20: Descriptive statistics of urban experts' responses to the expected impacts of technological advancements in urban utilities in developing countries.

Variables	N	Mean	STDEV	Skew
a) Introduction of new techniques for water purification	58	1.83	0.96	-0.63
b) Introduction of new techniques for sanitary treatment	58	1.81	0.98	-0.64
c) Introduction of small water & sanitary treatment units	58	1.74	1.10	-0.69
d) Facilitation of settling remote areas	54	1.24	1.01	-0.62
e) Environmental improvement of rural communities	54	1.37	1.14	-1.42

Mean Value Illustration



N= Number of valid responses STDEV= Standard Deviation

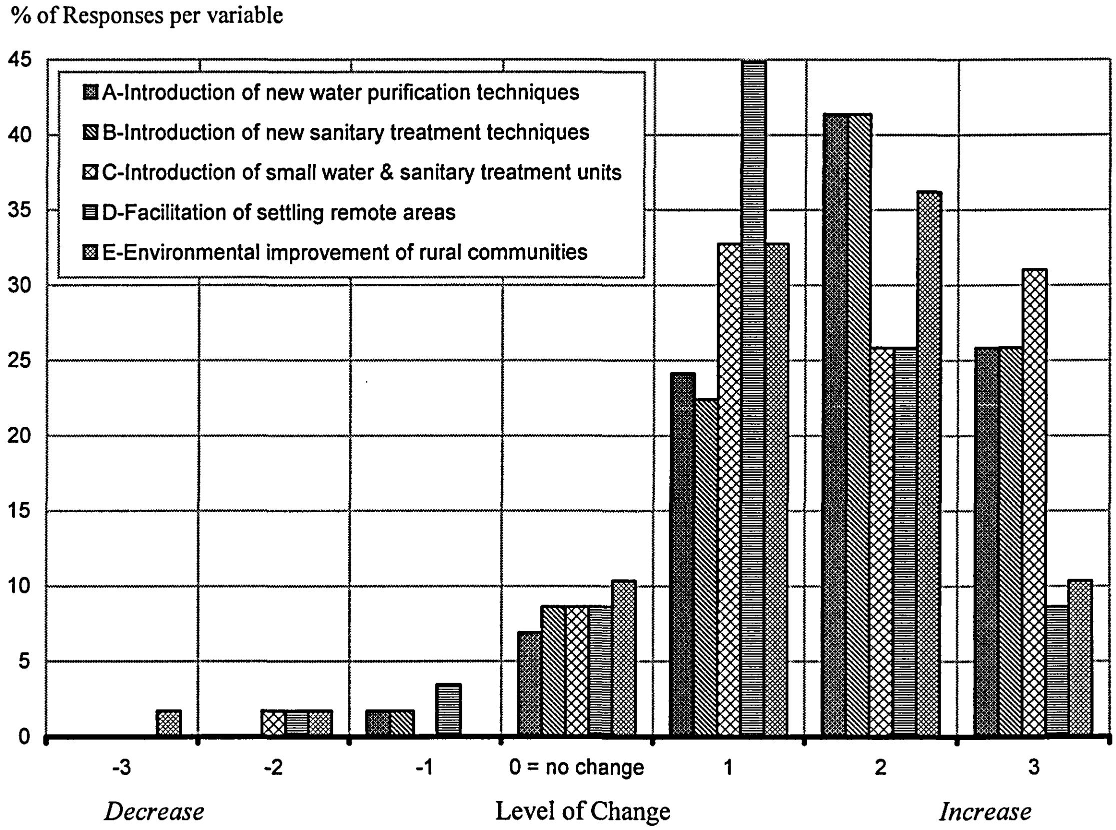


Figure 8.19: Frequency distribution of urban experts' responses to the expected impacts of technological advancements in urban utilities in developing countries

This analysis clearly demonstrates that technological advancements in urban utilities, especially in the introduction of small water and sanitary treatment units, are highly expected to overcome one of the main problems that confronted the dispersion of urban population to rural and remote areas and that these technologies would support the development of small-size settlements. This will be of considerable importance for the future of urban development in developing countries.

Question 8:

8. *In the area of telecommunication and information technology, to what extent do you expect technological achievements in the next 30-40 years to affect the following aspects in developing countries?*

Urban experts expect that ICTs will be of considerable impact on urban development in developing countries during the next 30-40 years. The statistical analysis of their responses, (Table 8.21, Figure 8.20 and Table A4.12 in Appendix 4), reveals that:

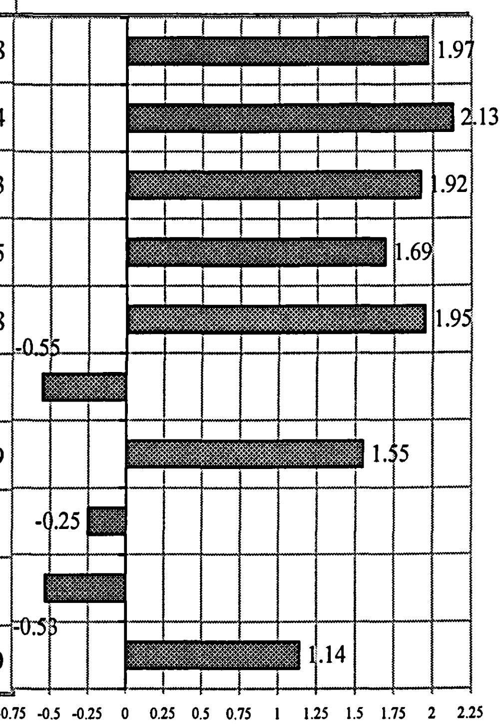
1. Regarding the expected changes in work and living conditions, about 98 percent of the responses expect that ICTs will considerably increase the home-based work, remote education, and home entertainment at an average (mean) of 1.97,

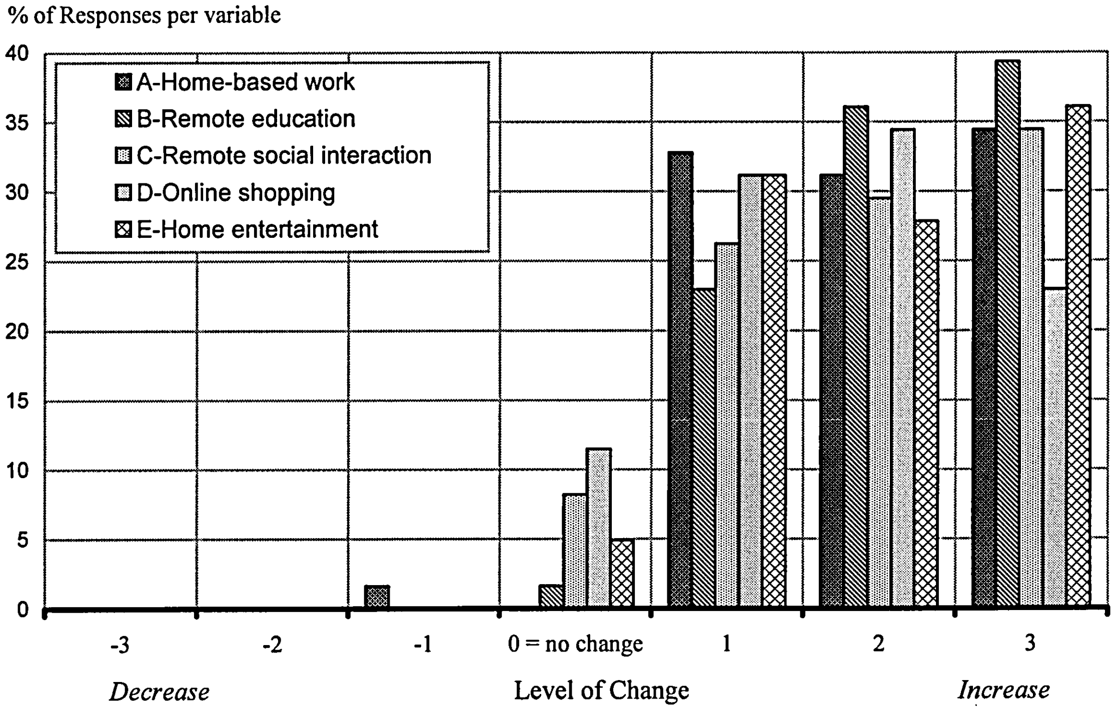
2.13, and 1.95 respectively. Also, about 90 percent of the responses expect a considerable increase in remote social interaction and online shopping at an average of 1.92 and 1.69 respectively. About 83 percent of the responses expect a considerable change in the prevailing working condition (1.55).

2. Regarding the expected urban impacts of ICTs, about 63 percent of the responses expect some decline in the concentration of business activities in CBDs of existing cities (-0.55), and about 46 percent of the responses expect a slight decline in the congestion of existing urban centres (-0.25). Moreover, about 70 percent of the responses expect a considerable increase in the ability to settle in remote regions (1.14).

Table 8.21: Descriptive statistics of urban experts' responses about impacts of telecommunication & information technology in developing countries during the next 30-40 years.

Variables	N	Mean	STDEV	Skew	Mean Value Illustration
a) Home-based work	61	1.97	0.91	-0.48	
b) Remote education (open universities, teleconferencing)	61	2.13	0.83	-0.44	
c) Remote social interaction (video phones, internet, ...)	60	1.92	0.98	-0.53	
d) Online shopping	61	1.69	0.96	-0.15	
e) Home entertainment	61	1.95	0.94	-0.28	
f) Concentration of businesses in CBD of existing cities	60	-0.55	1.57	0.52	
g) Change in current work conditions.	58	1.55	1.11	-0.69	
h) Congestion of existing urban centres	56	-0.25	1.58	0.26	
i) The cost of telephone and energy networks	59	-0.53	1.92	0.52	
j) The ability to settle in remote areas	59	1.14	1.38	-0.90	





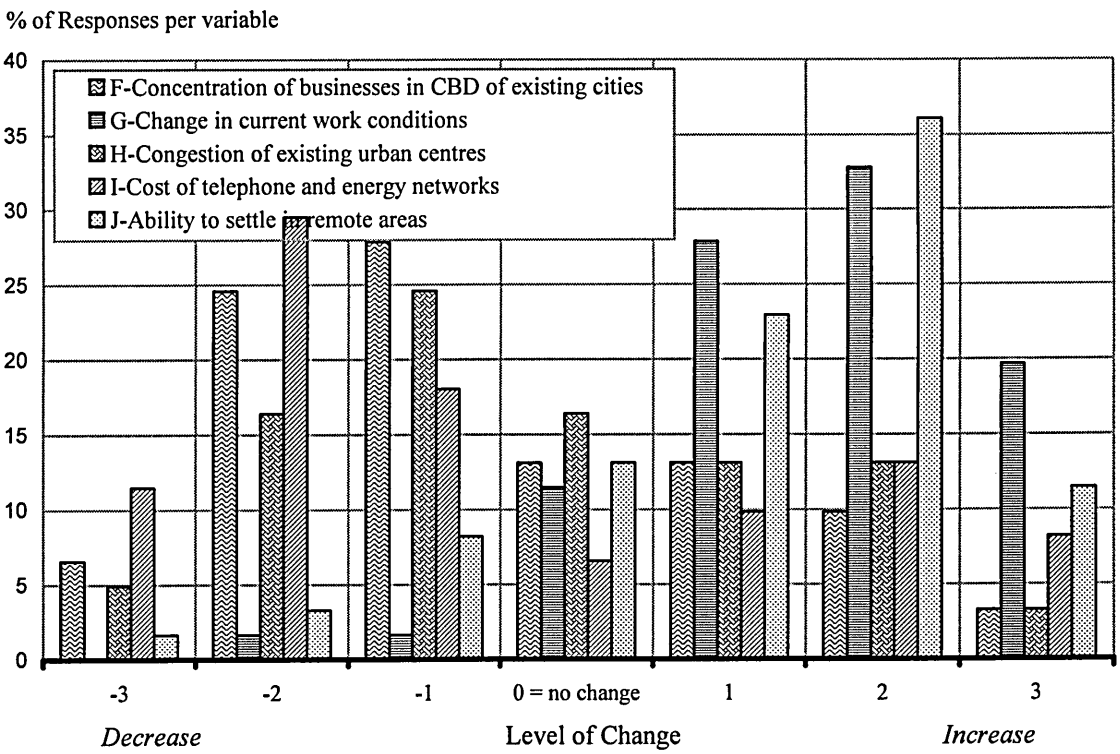


Figure 8.20: Frequency distribution of urban experts' responses about the expected impacts of telecommunication & information technology in developing countries

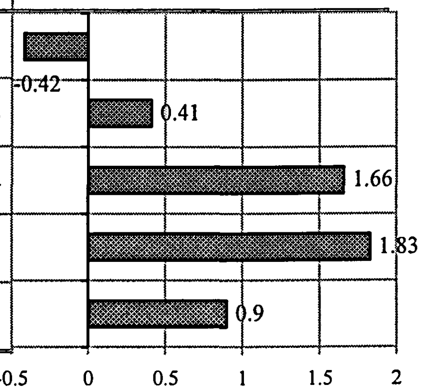
This analysis clearly demonstrates that ICTs are expected to have considerable impacts on the urban future in developing countries. Urban experts highly expect that ICTs will facilitate home-based work and many other tele-activities. This expected increase in tele-activities will decrease the importance of large cities as centre for work, education, and commerce. Also, these technological advancements will increase the attractiveness of the small urban communities and will significantly facilitate the implementation of the proposed small-size settlements and urban decentralisation approaches. Also it is expected that ICTs will facilitate the dispersion of urban population out of congested areas to rural and remote areas, as these technologies will help overcome many of the problems that previously obstructed such process.

Question 9:

<u>*9. To the best of your knowledge, how much do you expect future technological achievements to alter the movement of urban population in developing countries?*</u>

Table 8.22: Descriptive statistics of urban experts' responses about the expected impacts of technology on the movement of urban population in developing countries.

Variables	N	Mean	STDEV	Skew	Mean Value Illustration
g) Concentration of population in few urban centres	59	-0.42	1.80	0.21	
h) Dispersion of urban population to rural settlements	59	0.41	1.50	-0.13	
i) Dispersion of urban population to the suburbs	59	1.66	0.98	-0.64	
j) Dispersion of urban population to new urban centres around existing large cities	60	1.83	0.94	-0.41	
k) Dispersion of urban population to new remote urban centres	60	0.90	1.35	-0.33	



N= Number of valid responses STDEV= Standard Deviation

Urban experts' responses to this question are of considerable importance as they provide clear idea about the future patterns of urban population dispersion in the light of the expected technological achievements. The statistical analysis of these responses, presented in Table 8.22, Figure 8.21 and Table A4.13 (in Appendix 4), reveals that:

1. Regarding the future impacts of technology achievements on concentration of urban population in few urban centres, about 51 percent of these responses expect that such concentration will decline at an average of –0.42.

2. Regarding the future patterns of urban population dispersion, 90 percent of these responses expect a considerable increase in the dispersion of urban population to new urban centres around existing large cities at an average of 1.83, with lowest standard deviation of 0.94; this is while 83 percent of responses expect a considerable increase in the dispersion to the suburbs (+1.66). Also, 67 percent of the responses expect some increase in the dispersion of urban population to new remote urban communities (+0.90), and about 50 percent of the responses expect some increase in the dispersion of urban population to rural settlements (+0.41).

3. These results confirms with the results of the previous questions, regarding the ability of settling in rural and remote areas and the concentrations of urban population in existing urban centres (Questions 8, 7, 6, and 5 in Questionnaire III).

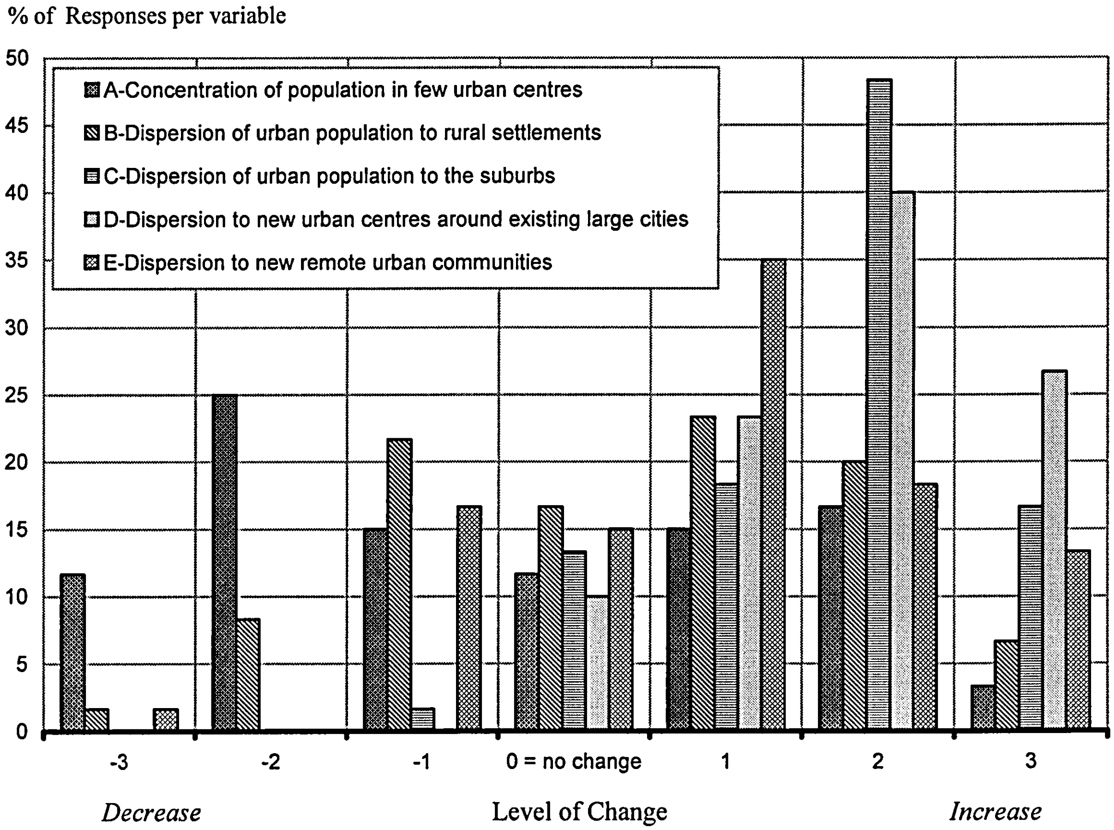


Figure 8.21: Frequency distribution of urban experts' responses about the expected impacts of technology on the movement of urban population in developing countries

This statistical analysis proves that technological achievements are highly expected to facilitate the dispersion of urban population towards new urban centres around existing large cities - followed by the dispersion towards the suburbs, new remote urban communities and rural settlements.

8.3.3 Technology and Future New Settlements

Question 10:

<u>10. To the best of your knowledge, how do you expect the function of future urban settlement to be?</u>

Concerning the function of future urban settlements, the statistical analysis presented in Table 8.23, Figure 8.22 and Table A4.14 (in Appendix 4) reveal that:

1. About 84 percent of urban experts' responses expect that future urban settlements are likely to be of multiple related functions (IT & education, etc) with the highest average of 1.56. Only 6 percent of the responses expect that future settlements are less likely to be of multiple related functions.

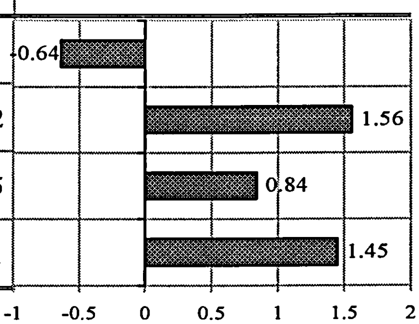
2. The second expected function for these settlements is to work as centres for location-bound activities (tourism, mining). This is expected by about 84 percent of urban experts' responses at an average of 1.45.

3. About 66 percent of the responses expect that the function of future urban settlements is somewhat likely to be a combination of multiple unrelated functions (0.84).

4. On the other side, about 54 percent of the responses expect that future urban settlements in developing countries are somewhat less likely to be of a single specialised function (IT, commercial, health, education, industrial, etc.) (-0.64).

Table 8.23: Descriptive statistics of urban experts' responses about the expected function of future urban settlement.

Variables	N	Mean	STDEV	Skew	Mean Value Illustration
a) Single specialised function (IT, commercial, education, industrial)	58	-0.64	1.64	0.20	
b) Multiple related functions (IT & education, etc)	61	1.56	1.31	-1.42	
c) Multiple unrelated functions	58	0.84	1.64	-0.65	
d) Centre for location-bound activities (tourism, mining, etc)	58	1.45	1.03	-1.31	



N= Number of valid responses STDEV= Standard Deviation

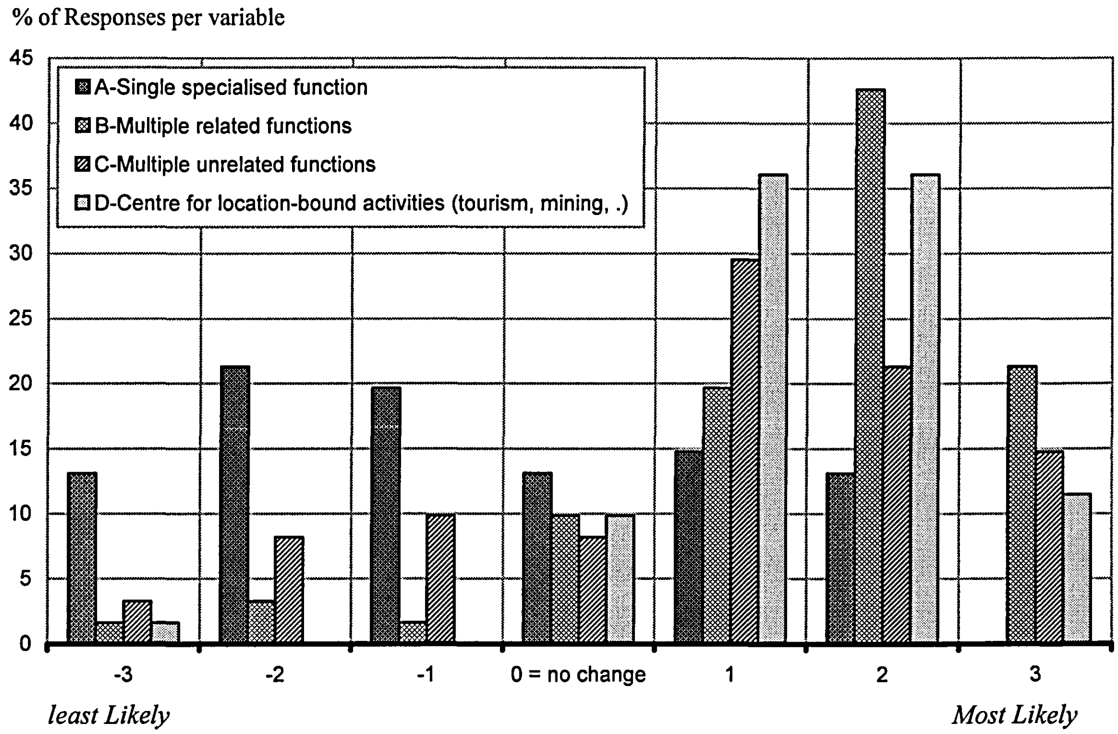


Figure 8.22: Frequency distribution of urban experts' responses about the expected function of future urban settlement

According to this analysis and on the frequency distribution of responses, it is highly expected that future urban settlements in developing countries will be of multiple related functions such as IT, education, and other related activities. Also, it is expected that these settlements could work as centres for location bound activities such as tourism or mining. The least expected function for future settlements is to work as centres for multiple unrelated activities.

Question 11:

11. To the best of your knowledge, what are the probable ways for the provision of services (education, health, shopping, etc.) in future new urban settlements?

The statistical analysis of urban experts' responses regarding the probable ways for the provision of services in future new urban settlements, which is presented in Table 8.24, Figure 8.23 and Table A4.15 (in Appendix 4), reveals some important findings:

1. About 84 percent of the urban experts' responses expect that introduction of specialised service centres between a group of cities is most likely at an average of 1.38 (mean). This implies that service delivery will affect the regional distribution of new settlements.

2. About 82 percent of the responses expect that incorporation of primary services in every settlement is most likely at an average of 1.48 (mean). This reflects experts'

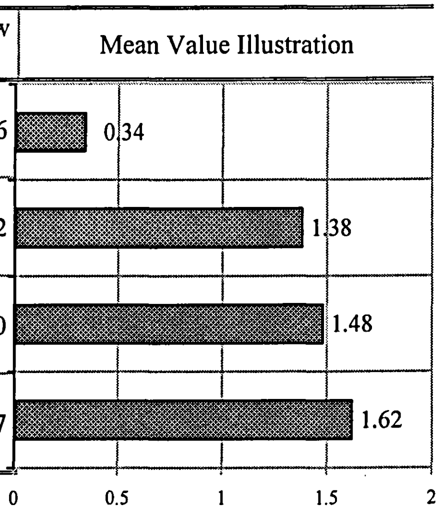
high consensus that these settlements should be self-sufficient regarding basic services while specialised services could be gathered in large service centre between a group of cities.

3. About 66 percent of the responses expect that emergence of new forms for provision of some services (Education, health, police) is most likely at an average of 1.62 (mean), with lowest standard deviation (1.03). Urban experts suggest incentive-based / service-based service delivery, multi-function mixed-use centres, and community-based policing as the possible new forms of service provision in new settlements.

4. Only 54 percent of the responses view the introduction of specialised service centres in every settlement as likely to happen at an average of 0.34. Although this view has the lowest number of responses and the lowest average among other variables of this question, it is important to define the implications of this choice. This reflects that these experts expect that future settlements either will be of very large size or located at far distances from each other. However, these two possibilities are not consistent either with the literature review presented in Chapter Six, or with experts' responses to other questions regarding the location and the size of future settlements (Questions 12 & 13).

Table 8.24: Descriptive statistics of urban experts' responses about the probable ways for the provision of services in future new urban settlements.

Variables	N	Mean	STDEV	Skew
a) Introduction of specialised service centres in every settlement	53	0.34	1.67	-0.36
b) Introduction of specialised service centres between a group of cities	55	1.38	1.06	-1.02
c) Incorporation of primary services in every settlement	56	1.48	1.21	-0.50
d) Emergence of new forms for the provision of some services (Education, health, police)	42	1.62	1.03	-0.27



N= Number of valid responses STDEV= Standard Deviation

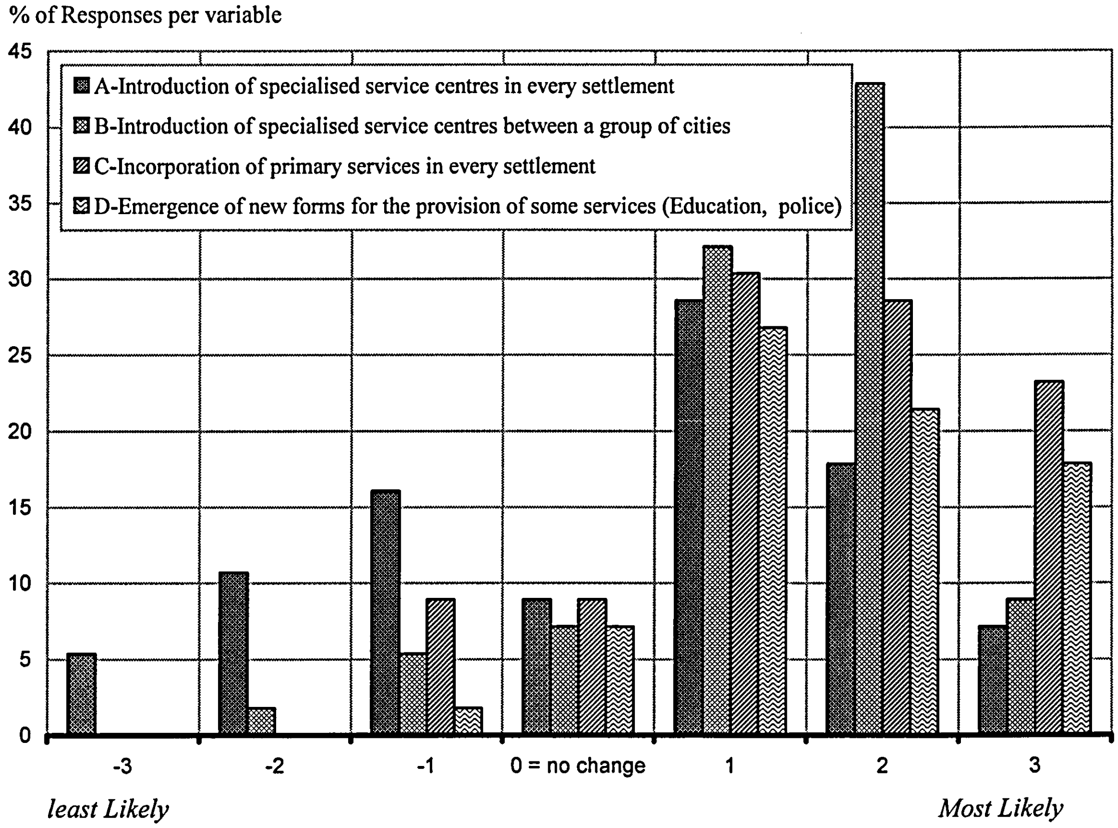


Figure 8.23: Frequency distribution of urban experts' responses about the probable ways for the provision of services in future new urban settlements

The statistical analysis of urban experts' responses to this question demonstrates that introduction of specialised service centres between a group of cities is most likely way for the provision of services in future urban settlements in developing countries. Incorporation of primary services in every settlement is second most likely way for the provision of services in these settlements. The third most likely way is the emergence of new forms for provision of some services (education, health, police).

Question 12:

12. Regarding location of future new urban settlements, to what extent do you expect they would be more likely located?

The statistical analysis of urban experts' responses to this question reveals that:

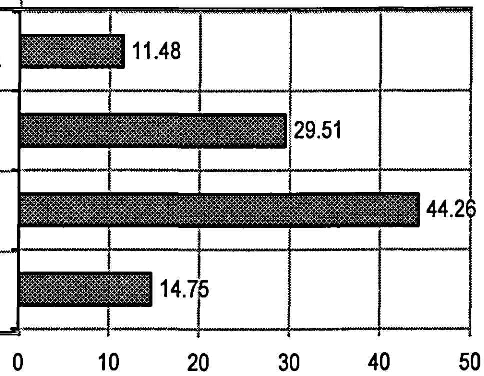
1. About 44 percent of these responses expect that future new urban settlements would be located on more than 20 km away of large urban centres (Table 8.25).
2. About 30 percent of the responses expect that these settlements would be located on 10-20 km away of large urban centres.
3. Only 15 percent expect that these settlements could be freely located.

4. Only 11 percent of the responses expect that these settlements could be located on less than 10 km away from a large urban centre.

Table 8.25: Frequency distribution of urban experts' responses about the location of future new urban settlements.

Variables	N	V. %
a) Less than 10 km away from a large urban centre	7	11.48
b) 10 – 20 km away from a large urban centre	18	29.51
c) More the 20 km away from a large urban centre	27	44.26
d) Freely located	9	14.75

V. % Illustration



N= Number of valid responses V. % = Valid percent

This analysis demonstrates that large urban centres will continue to have some impact on locating future urban settlements, as the majority of people moving to the new settlements will be coming from these large urban centres. Also, this analysis shows that future technological achievements will facilitate locating these new settlements further away from existing large urban centres.

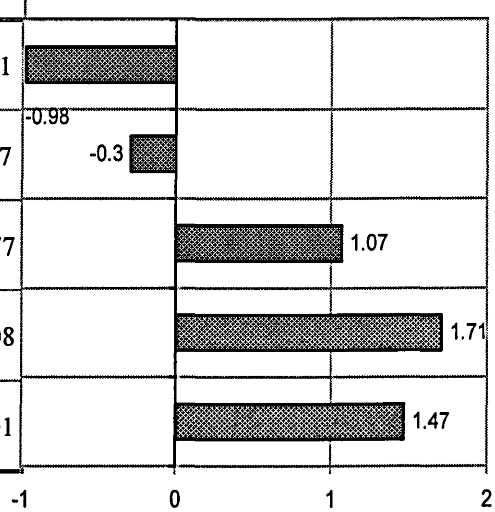
Question 13:

<u>*13. The future new urban settlement could be of different sizes, which of the following you consider to be the most appropriate in the next 30-40 years?*</u>

Table 8.26: Frequency distribution of urban experts' responses about the size of the future new urban settlements.

Variables	N	Mean	STDEV	Skew
a) Very small (<1,000 inhabitants, Group of families, environmental considerations)	54	-0.98	1.72	0.71
b) Small settlements (1,000-5,000 inhabitants, support the economic provision of primary services)	54	-0.30	1.54	0.17
c) Medium urban centres (5,000-10,000 inhabitants)	54	1.07	1.34	-0.77
d) Large urban centres (10,000-20,000 inhabitants)	51	1.71	1.12	-1.08
e) Very Large Urban Centres (20,000-50,000 inhabitants)	55	1.47	1.62	-1.01

Mean value illustration



The statistical analysis of urban experts' responses about the size of future new settlements are of considerable importance as they reflect the experts' overall assessment of future technological achievements impacts in developing countries (see Table 8.26, Figure 8.24, and Table A4.16 in Appendix 4). This analysis shows the following important results:

1. For the very small settlement size category (less than 1,000 inhabitants), about 60 percent of these responses expect that this size category is less likely to be appropriate at an average of -0.98. About 20 percent of these responses expect that this size category is least likely to be appropriate (-3.0). Only 15 percent of these responses view it as appropriate.

2. For the small size category of 1,000-5,000 inhabitants, 55 percent of the responses expect that it is less likely to be appropriate at an average of –0.30. However, about 35 percent of the responses expect that it is likely to be appropriate. This reflects that this size category is gaining more confidence among urban experts than the previous one, and that it could be appropriate for some settlements of special functions.

3. For the medium size category of 5,000-10,000 inhabitants, about 75 percent of the responses expect that this size category is likely to be appropriate, at an average of +1.07. This is while only 15 percent of these responses expect that it is less likely to be appropriate.

4. Regarding large size of 10,000-20,000 inhabitants, about 80 percent of the responses expect that this size category is more likely to be appropriate, at the highest average among all size categories of +1.71 (mean).

5. For settlement size category of 20,000-50,000 inhabitants, about 76 percent of the responses expect that this size category is more likely to be appropriate, at an average of +1.47.

6. Only 5 responses (out of 273 total responses) expect that some other sizes, ranging from 100,000 to 1 million inhabitants, as more likely to be appropriate.

According to this analysis, urban experts consider settlement size of 10,000-20,000 inhabitants as more likely to be appropriate for new settlements in developing countries. Settlement size of 20,000-50,000 inhabitants is considered as the second size category that is more likely to be appropriate. And settlement size of 5,000-10,000 inhabitants is ranked the third. This is while settlements sizes of less than 5,000 inhabitants are seen as less likely to be appropriate for new settlements in developing countries.

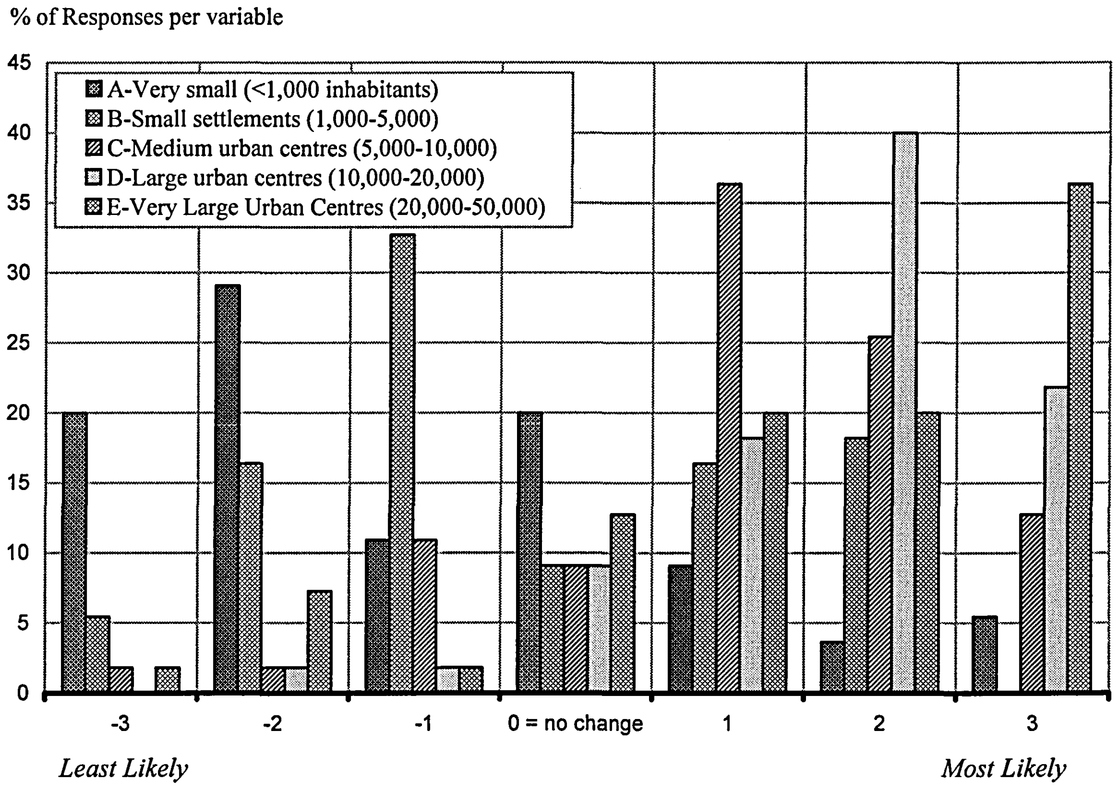


Figure 8.24: Frequency distribution of urban experts' responses about the size of the future new urban settlements

Question 14:

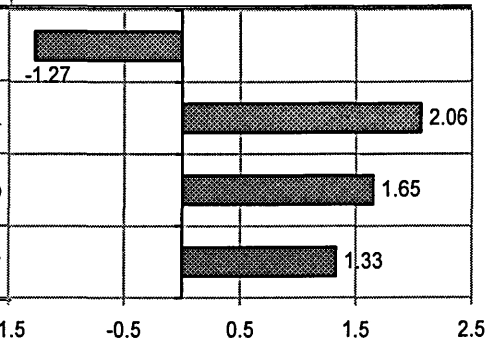
14. The development of future new urban settlement could take different approaches, which of the following do you consider to be the most appropriate in the next 30-40 years?

Concerning the appropriate approaches for the development of future cities, the statistical analysis of the urban experts' responses reveals that:

1. About 56 percent of urban experts' responses consider building the whole settlement at one time as less appropriate at an average of –1.27. Moreover, about 35 (out of this 56 percent) of the responses view this approach as least appropriate (Table 8.27, Figure 8.25, and Table A4.17 in Appendix 4).
2. About 93 percent of the responses consider the gradual development of future settlements as most appropriate, with highest average increase (mean) of +2.06, with lowest standard deviation of 1.13. Almost half of this percentage views this approach as most appropriate.
3. Regarding the possible ways for the development of future new urban settlements, about 86 percent of the responses view the expansion and growth of new urban settlements in the form of new suburbs as more appropriate at an average of 1.65. However, 71 percent of the responses view the expansion in the form of new independent urban units as more appropriate at an average of 1.33.

Table 8.27: Frequency distribution of urban experts' responses about the development of the future new urban settlements in the next 30-40 years

Variables	N	Mean	STDEV	Skew	Mean value illustration
a) Whole settlement built in one time	55	-1.27	1.79	0.63	
b) Gradually built	63	2.06	1.13	-1.64	
c) Expansion in the form of new suburbs.	60	1.65	1.20	-1.09	
d) Expansion in the form of new independent urban units	58	1.33	1.60	-1.27	



N= Number of valid responses
STDEV= Standard Deviation

This analysis reflects the high consensus among urban experts that the gradual development of new urban settlements is suitable for urban development in developing countries. To achieve this approach, urban experts highly recommend the growth of these settlements in the form of new suburbs or in the form of new independent urban units.

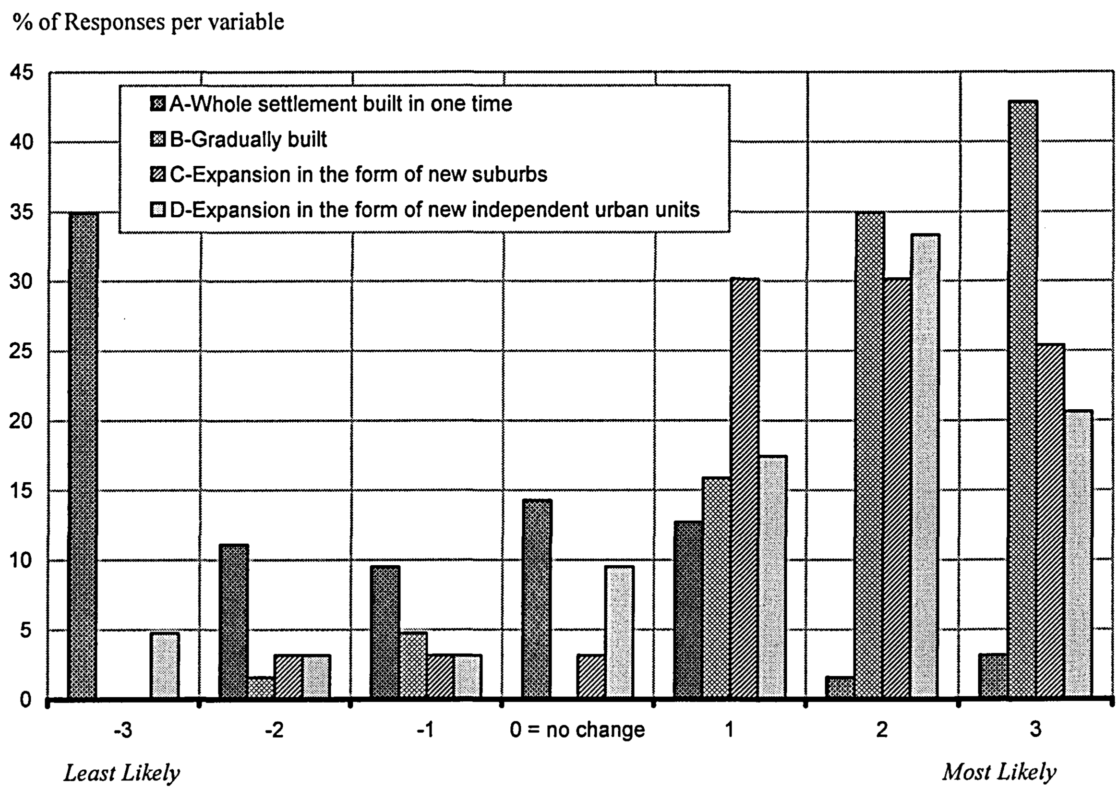


Figure 8.25: Frequency distribution of urban experts' responses about the development of the future new urban settlements in the next 30-40 years

8.3.4 Technology and Existing Settlements

Question 15:

15. In your opinion, and in the light of the rapid technological change, how will the size of existing urban settlements change in the next 30-40 years?

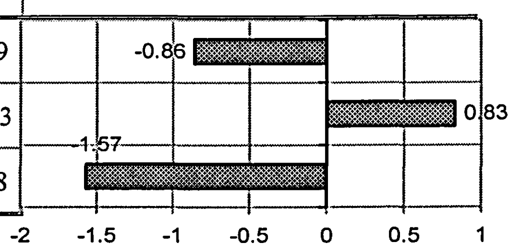
Concerning the future impacts of technology on the size of existing settlements, the statistical analysis of the urban experts' responses shows that:

1. About 60 percent of the responses expect that the increase in the size of existing settlements is less likely to continue (-0.61). Moreover, about 25 out of this 60 percent of the responses expect that the increase in the size of existing settlements is least likely to continue. However, about 39 percent of the responses expect that the increase in the size of existing settlements is somewhat likely to continue.
2. About 57 percent of the responses expect that the size of these settlements is likely to decrease at an average of 0.73 (mean), with lowest standard deviation (Table 8.28, Figure 8.26 and Table A4.18 in Appendix 4). However, About 31 out of this 57 percent of the responses expect that the size of these settlements is somewhat less likely to decrease.
3. Moreover, about 62 percent of the responses expect that it is less likely that size of existing urban settlements will not be affected.

This analysis reveals the high consensus among urban experts that the size of the existing cities is likely to decrease. Such decrease means that more people will move out of these settlements towards new urban settlements. These results confirm with results reach from responses to Questions 9 and 12 in this questionnaire. These results reflect that existing settlements will continue to determine the distribution of new settlements.

Table 8.28: Frequency distribution of urban experts' responses about the size of existing urban settlements in the next 30-40 years

Variables	N	Mean	STDEV	Skew	Mean value illustration
a) Continue to increase	63	-0.86	2.13	0.59	
b) Decrease	54	0.83	1.77	-0.53	
c) Will not be affected	47	-1.57	1.44	0.88	



N= Number of valid responses STDEV= Standard Deviation

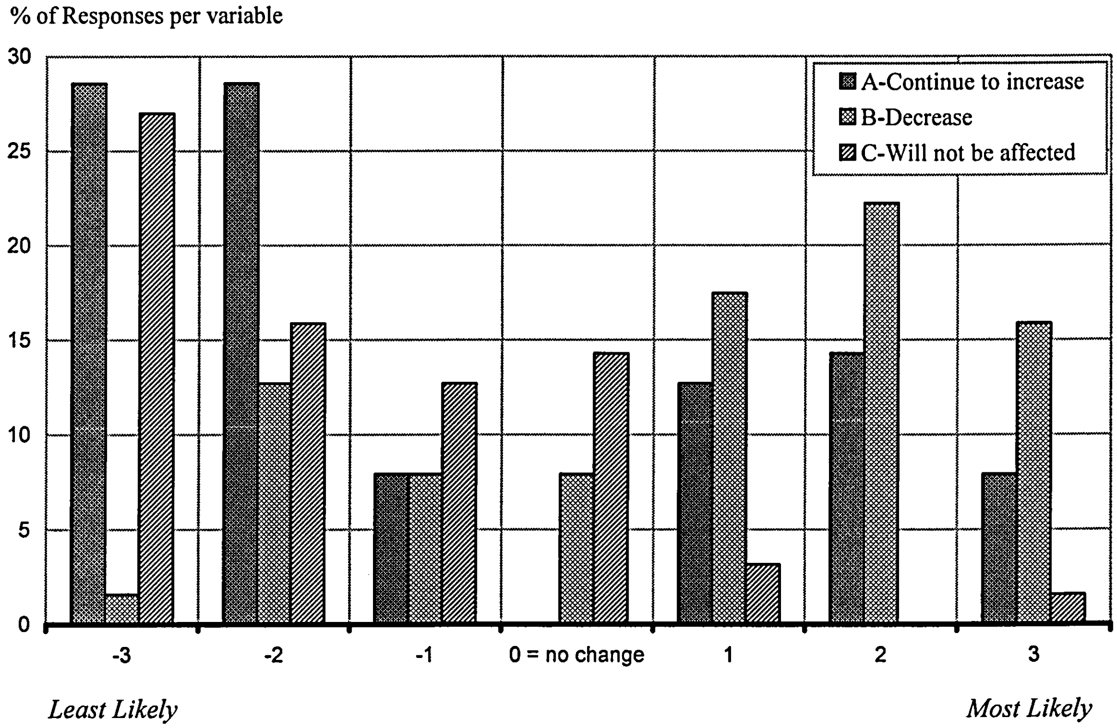


Figure 8.26: Frequency distribution of urban experts' responses about the size of existing urban settlements in the next 30-40 years

Question 16:

16. For developing countries, how do you expect the future function of existing urban settlements in the next 30-40 years?

Table 8.29: Frequency distribution of urban experts' responses about the future function of existing urban settlements in the next 30-40 years

Variables	N	Mean	STDEV	Skew	Mean value illustration
a) Regional service centres (education, commercial, entertainment)	56	2.09	1.01	-1.27	2.09
b) Continue performing the same functions	58	0.72	1.52	-0.10	0.72
c) New Functions (*please specify*)	29	1.14	1.25	-1.11	1.14
					0 0.5 1 1.5 2 2.5

N= Number of valid responses
STDEV= Standard Deviation

Regarding the future impacts of technology on the function of existing settlements in developing countries, the statistical analysis of urban experts' responses reveals that:

1. About 90 percent of urban experts' responses expect that these settlements are more likely to work as regional service centres (education, commercial, entertainment), with the highest average increase of =2.09 (mean) and lowest standard deviation (Table 8.29, Figure 8.27, and Table A4.19 in Appendix 4).

2. About 55 percent of these responses expect that these settlements are likely to continue performing the same functions.
3. About 41 percent of the responses expect that existing settlements are more likely to perform some new functions; i.e. recreation, distribution centres, health, education, communication, retail etc.

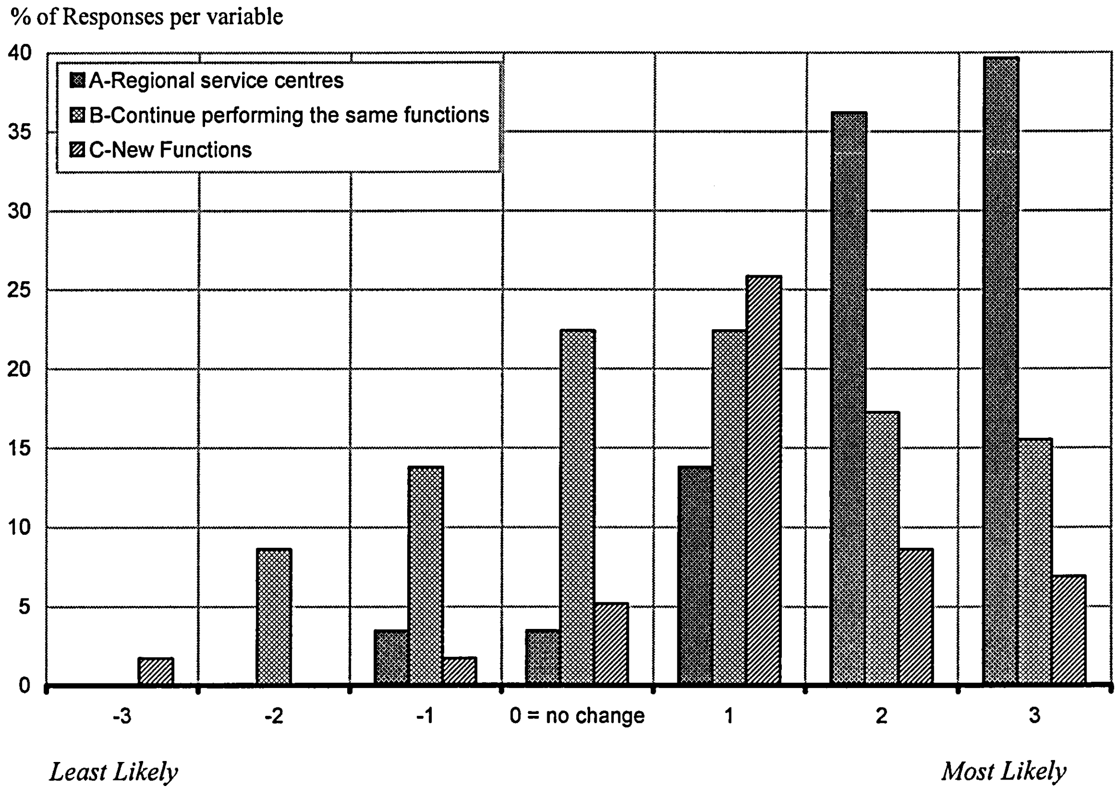


Figure 8.27: Frequency distribution of urban experts' responses about the future function of existing urban settlements in the next 30-40 years

Based on this analysis, it is highly expected that existing settlements could work as regional service centres. These settlements can efficiently work as specialised regional service centres, which are recommended in Question 1. Also, existing large urban centres could perform some new regional functions; i.e. recreation, distribution centres, health, education, communication, retail etc. In general, the future role of existing cities, within the national and regional levels, is expected to face a considerable change. Therefore, developing countries should take this expected change into consideration when developing their future regional and national urban plans.

8.4 RECEIVED COMMENTS

Generally, few comments have been received through the three questionnaires. The main comments received on this survey were mainly about the nature of technologies expected to be transferred to developing countries, stressing the difference between the use of technology (as products) and its invention (without the baggage of developed countries solutions). For this research, the use of technology is its main concern. Although most of technologies currently in use in developing countries are designed and manufactured outside these countries, their socio-economic and urban impacts in these countries are substantial.

Also, some of the received comments were stressing the variation of the development status and technological capabilities among developing countries. The research is mainly focusing on progressively developing countries experiencing increasing technological capabilities. However, the research results and recommendation are expected to be, to some extent, valid for less and least developing countries, as technology impacts in these countries are substantial, though at a lower scale compared to other developed and developing countries.

After sending the results of the first round of Questionnaire III (to urban experts), another important comment was received. It claims that these results are not surprising and expected. Although it is not the objective of this research to get surprising results and that extreme care had been taken to get the most possible reliable results, it should be kept in mind that these results are about developing countries, with lower technological capabilities compared to developed countries. This comment came mainly from an expert in developed countries, while some experts from developed countries viewed some of these results as being somewhat exaggerating. However, and even if these results are not surprising, they are still of confirmatory value, validating arguments otherwise will be regarded just as personal opinions.

Conclusion:

In this chapter, the statistical analysis of the results of each question in the three questionnaires is presented. Also, the thesis presents a brief explanation of the possible implications of results of each question. Because questions in each questionnaire are unrelated to each other, the thesis tries, in the next chapter, to formulate a synthetic evidence for the validity of each of the proposed approaches from the results of different questions in the three questionnaires.

FORECASTING SURVEY: AN APPRAISAL OF THE PROPOSED APPROACHES

Introduction:

Because each question covers a different point, the thesis tries in this chapter to formulate a synthetic evidence for the validity of each of the proposed approaches from the results of various questions in the three questionnaires. For each of these approaches, relevant data from the statistical analysis of both technology and urban development experts' responses is compiled and analysed. To avoid repetition, this chapter starts by presenting an analysis of the technological impacts expected to be of considerable importance for all the proposed approaches. Then, other expected impacts are considered in relation to each proposed approach.

9.1 EXTENT AND NATURE OF FUTURE TECHNOLOGICAL IMPACTS

The forecasting survey tried through a series of questions to both technology and urban development experts to assess, as accurately as possible, the expected impacts of technological achievements of the 21st century on shaping the urban future in developing countries during the next 30-40 years. The statistical analysis of the responses reveals the following broad results:

A. EXTENT OF THE EXPECTED CHANGE:

1. Through the three questionnaires, none of urban or technology experts expected that there will be no change in their different fields of expertise.
2. More than 90 percent of the technology experts' responses expect a considerable change in current operation and production systems (Question 3, Questionnaire II). Also, more than 67 percent of urban experts' responses expect that future technological achievement will be of considerable impact on urban development in developing countries (Question 2, Questionnaire III).
3. Regarding types of technologies expected to influence the urban future, information and telecommunications technologies are expected by both technology and urban experts to be of a very high influence on the future of urban development. About 16 percent of the total technology experts' responses expect that ICTs will be of a very high influence on urban development followed by energy, transportation, and utilities technologies (Question 4, Questionnaire I). Similar trends has been expected by urban experts where 24 percent of their responses expect that ICTs will be of a very

high influence on urban development followed by transportation (13%), energy (9%) and urban utilities technologies (8%) (Question 3, Questionnaire III).

B. NATURE OF THE EXPECTED CHANGE:

The overall impacts of technology: both technology and urban experts (Question 4 in Questionnaires II and III) expect that technology will affect the following aspects:

1. Regarding the relation between home and work, about 50 percent of technology experts' responses and 64 percent of urban experts' responses expect that the total amount of time needed for travelling to work and other daily activities will decline. Also, the long established interdependence between place of residence and work location are also expected to decline by about 60 percent of technology experts and 49 percent of urban experts. Based on these two points, it was logic that 65 percent of technology experts and 67 percent of urban experts expect that the commuting distance between home and work will increase significantly.

2. Regarding the changes to the factors affecting the urban environment, urban experts expect that technological achievements will increase the attractiveness of rural settlements more than that of urban ones. About 51 percent of the responses indicate that the attractiveness of rural centres to urban population is expected to increase at an average of 0.49, while 49 percent of the responses show that attractiveness of urban centres will increase at an average of 0.36 only. Also, about 59 percent of valid responses expect that settling remote and uninhabited areas will increase at an average of 0.51. Also, about 59 percent urban experts and 65 percent of technology experts expect that settling remote and uninhabited areas will increase.

3. Regarding the expected change in transportation patterns, private transportation is expected to increase at a rate higher than that of public transportation. About 74 percent of urban experts and 60 percent of technology experts expect that private transportation will considerably increase, while 65 and 63 percent of urban and technology experts expect that the use of public transportation will increase at a lower rate.

4. Regarding technology transfer to developing countries, technology experts' responses are of considerable importance (Question 11 in Questionnaire II). About 94 percent of the responses expect that transfer of ICTs and transportation technologies will significantly increase during the next 30-40 years. For the transfer of utilities technologies, 95 percent expect a

considerable increase in this category during the same period, of which 50 and 23 percent expect a considerable and impressive increase respectively.

<u>The impacts of different technology sectors</u>: both technology and urban experts highly expect that:

5. Regarding information and telecommunications technologies, there is a high consensus among technology and urban experts that ICTs will considerably affect the work and living conditions (Question 8 in Questionnaires II and III). About 98 and more than 95 percent of urban and technology experts expect that ICTs will considerably increase the home-based work, remote education, and home entertainment. Also, more than 90 percent of urban and technology experts expect a considerable increase in remote social interaction and online shopping. About 83 and 70 percent of urban and technology experts expect a considerable change in the prevailing working conditions. It is also expected that these technologies will have a considerable impact on the urban future in developing countries (Question 8 in Questionnaire III).

6. Regarding transportation technologies, also there is a high consensus among technology and urban experts that future transportation technologies will considerably affect population mobility and urban activities (Question 5 in Questionnaires II and III). Regarding population mobility, which gives a general idea about the over all impact of transport technologies, about 87 percent of urban experts expect a considerable increase in population mobility. For the expected role of different transport modes, about 87 and 75 percent of urban and technology expect that the role of public transport at regional level will grow higher that of all other modes. This is while about 77 and 75 percent of urban and technology experts expect an increase in the roles of public transport at local level. Also, 77 and 65 percent of urban and technology experts expect an increase in the future role of private transportation. Also, about 95 and 87 percent of technology and urban experts expect a considerable increase in vehicle capabilities and safety and about 45 and 66 percent of them expect that vehicle speed will increase. Regarding air transport, about 69 and 72 percent of urban and technology experts expect a considerable increase in the roles of public air transport, and about 64 and 47 percent of urban and technology experts an increase in private air transport.

7. Regarding renewable energy technologies, it is highly expected that these technologies will be of considerable impact on the future of urban change in developing countries (Question 6 in Questionnaires II and III). About 82 and 66 percent of technology and urban experts expect that such dependence will

decline. Also, about, 84 and 64 percent of technology and urban expect that the costs of renewable-energy will considerably decline.

8. Regarding urban utilities technologies, there is a high consensus among urban and technology experts that future utilities technologies will have a considerable impact on the urban future in developing countries (Question 7 in Questionnaires II and III). About 91 and 83 percent of urban and technology experts expect a considerable increase in the introduction of new techniques for water purification. About 90 and more than 80 percent of urban and technology experts expect a considerable increase in the introduction of both new techniques for sanitary treatment and small water & sanitary treatment units.

Findings:

The statistical analysis of both urban and technology experts' responses clearly demonstrates that future technological achievements of the 21st century will have profound impacts on shaping the urban future in many of the developing countries. It is highly expected that these technologies will considerably change operation and production systems and the home-work relationship. Also, it is highly expected that these technologies will increase population mobility and will help overcome energy and utilities problems that usually confront urban development activities in remote and rural areas.

9.2 URBAN DECENTRALISATION APPROACH

While the importance and effectiveness of urban decentralisation approach was comprehensively examined in Chapter Six, it is the purpose of this section to assess the role of future technology achievements in the application of such approach in developing countries. In doing so, the research will depend on the results of the related question in the forecasting survey. The statistical analysis of technology and urban experts' responses to these questions reveal that:

A. <u>There is a high level of expectancy among both technology and urban development experts that future technology achievements will highly facilitate the decentralisation of urban population in developing countries.</u>

1. Regarding future changes to the factors affecting the spatial distribution of urban population in developing countries, and as stated earlier, about 65 percent of technology experts and 67 percent of urban experts expect that the commuting distance between home and work will increase significantly. Also, about 60 percent of technology experts and 49 percent of urban experts expect that the long established interdependence between place of residence and work location is expected to decline (Question 4 in Questionnaires II and III). About 98 and more than 95 percent of urban and technology experts expect that ICTs will considerably increase the home-based work, remote education, and home entertainment (Question 8 in Questionnaires II and III). Also, about 87 percent of urban experts expect that transport technologies will considerable increase population mobility (Question 5, Questionnaires III). All these points demonstrate that population ability to move out of congested areas will considerable increase.

2. Regarding the spatial impacts of different technology sectors, it is highly expected that each of these technologies will significantly facilitate the dispersion of urban population in developing countries. For ICTs, about 70 percent of urban experts expect a considerable increase in the ability to settle in remote regions. Also, about 63 and 47 percent of urban and technology experts expect some decline in the concentration of business activities in CBDs of existing cities, and about 46 and 44 percent of them expect a slight decline in the congestion of existing urban centres (Question 8 in Questionnaires II and III). For transport technologies, and in addition to their expected role in increasing population mobility, about 74 of urban experts expect that transport technology will considerably increase the ability to settle in remote areas (Question 5, Questionnaires III). For renewable energy technologies, about 58

and 47 percent of urban and technology experts expect that the future advancements of renewable energy technologies will increase the ability to settle out of congested areas, mainly around existing large cities. Moreover, 71 percent of urban experts expect an increase in the ability to settle in remote areas, mainly in new independent settlements (Question 6 in Questionnaires II and III). For urban utilities technologies, about 80 and 74 percent of urban and technology experts expect that technological achievements in area of urban utilities will considerably facilitate settling in remote area and will considerably improve the environment of rural communities (Question 7 in Questionnaires II and III).

B. <u>Regarding the overall spatial impacts of future technology achievements, there is a high level of expectancy among urban and technology experts that urban population in developing countries will be more inclined to disperse out of congested urban centres</u>.

3. For the targeted areas of population movement, 90 percent of urban experts expect a considerable increase in the dispersion of urban population to new urban centres around existing large cities, while about 83 and 65 percent of urban and technology experts expect that there will be a considerable increase in population dispersion to the suburbs. Also, about 50 and 65 percent of urban and technology experts expect a considerable increase in the dispersion of urban population to rural areas. Moreover, about 67 and 56 percent of urban and technology experts expect some increase in the emergence of remote isolated urban communities. On the other hand, 51 and 49 percent of urban and technology experts expect that concentration of population in few urban centres will decline (Question 9 in Questionnaires II and III).

4. For the location of future new urban settlements in developing countries, is it highly expected to be located further away of large urban centres. About 44 percent of urban experts expect that future new urban settlements could be located on more than 20 km away of large urban centres. Also, while 30 percent of urban experts expect that these settlements could be located on 10-20 km away of large urban centres, only 15 percent expect that these settlements could be freely located and 11 percent of the responses expect that they could be located on less than 10 km away from a large urban centre (Question 12, Questionnaires III). Such movement out of large urban centres demonstrates that future technology advancements will facilitate the proposed urban decentralisation approach

C. Despite the high consensus about the expected role of technology in facilitating urban decentralisation, some of the received comments argue that the expected degree of change differs from country to country as the social-economic conditions and technical capabilities differ among these countries. Also, and emphasising the thesis argument that technology is just a tool that could be articulated to achieve certain targets; some of the received comments stress the role of prevailing political and socio-economic conditions and governmental regulations in this process. In the light of these comments, and to ensure the proper application of approach, technological achievements should be driven by a sincere political will and to be geared within the national policy to meet the socio-economic conditions prevailing in each country.

Findings:

Through the statistical analysis of both urban and technology experts' responses, the forecasting survey demonstrates that urban decentralisation is expected to be effective in managing the urban future in developing countries. Also, it shows that future technological achievements are highly expected to facilitate the adoption of the proposed urban decentralisation approach in developing countries during the next 30-40 years.

9.3 SMALL-SIZE URBAN SETTLEMENTS APPROACH

Although it has been evident through the theoretical analysis, presented in Chapter Six, that small-size settlements is an effective approach for urban development in developing countries, it is the purpose of this section to confirm its importance and to examine the role future technological achievements in the application of such approach. In doing so, again, the research depends on the results of the related question in the forecasting survey. In addition to responses about the size of future settlements, responses to questions regarding the function and the probable way for the provision of services in these settlements will be considered. The statistical analysis of the responses revealed the following important points:

A. Regarding the Size of New Urban Settlements:

1. About 80 out of the 92 percent of urban experts who responded to the question about this size category (Question 13 in Questionnaire III), expect that settlement size category of 10,000-20,000 inhabitants is more likely to be appropriate; at the highest average among all size categories of +1.71 (mean) and only 4 percent view it as somewhat less likely to be appropriate (Table 8.27, Figure 8.23, and Table A4.16 in Appendix 4).

2. About 76 percent of urban experts expect that settlement size category of 20,000-50,000 inhabitants is more likely to be appropriate. Only 11 percent view it as less likely to be appropriate.

3. For settlement size category of 5,000-10,000 inhabitants, about 75 percent of urban experts (out of 98 percent) expect that this size category is likely to be appropriate. This is while 15 percent of these responses expect that this size category is less likely to be appropriate. This reflects that this size category is gaining less confidence among urban experts than the previous ones.

4. For settlement size category of 1,000-5,000 inhabitants, 55 percent (out of 98 percent) of urban experts expect that it is less likely to be appropriate. However, about 35 percent of the responses expect that it is likely to be appropriate.

5. For settlement size category of less than 1,000 inhabitants, about 60 percent of these responses expect that this size category is less likely to be appropriate. About 20 percent of these responses expect that this size category is least likely to be appropriate (-3). Only 18 percent of these responses expect that it will be appropriate. This reflects that this size category is of the lowest confidence among urban experts than all other size categories.

6. Only 5 responses (out of 273 total responses) recommend that some other sizes, ranging from 100,000 to 1 million inhabitants, could be appropriate.

According to this analysis, settlement size of 10,000-20,000 inhabitants seem to be more appropriate for new settlements in developing countries, followed by settlements size of 20,000-50,000 inhabitants. This is while smaller settlements of 5,000-10,000 and larger settlements of 20,000-50,000 inhabitants could be suitable for settlements of special functions within their regional settings. Settlements of less than 5,000 inhabitants are not recommended.

B. **Regarding the Function of New Urban Settlements:** settlement's function is a decisive factor in determining its size. Therefore, and through the analysis of urban experts responses regarding the future functions appropriate for new settlements in the light of future technological impacts in developing countries, it is expected to draw a more comprehensive idea about the future size of these settlements. The statistical analysis presented in Table 8.24, Figure 8.21 and Table A4.14 (in Appendix 4) reveal that:

1. About 84 percent of urban experts' responses expect that future urban settlements are likely to be of multiple related functions (IT & education, etc). Only 6 percent of the responses expect that future settlements are less likely to be of multiple related functions.

2. The second expected function for these settlements is to be centres for location-bound activities (tourism, mining). This is expected by about 84 percent of urban experts' responses. Only 2 percent of the responses expect that this function is less likely to be appropriate.

3. About 66 percent of the responses expect that the function of future urban settlements is somewhat likely to be a combination of multiple unrelated functions. However, 21 percent of urban experts expect that such function is somewhat less likely. This reflects the low consensus among urban experts about the appropriateness of this function for new urban settlements in developing countries.

4. About 54 percent of the responses expect that future urban settlements in developing countries are somewhat less likely to be of a single specialised function (IT, commercial, health, education, industrial, etc.). However, about 28 percent of them expect that such function could be somewhat likely. Again, this reflects the low consensus about the appropriateness of this function for new urban settlements in developing countries.

According to this analysis, it is highly expect that future urban settlements are likely to be of multiple related functions (IT & education, etc) or as centres for location-bound activities (tourism, mining). These two functions could be efficiently performed in small settlements within the recommended size categories of 10,000-20,000 or 20,000-50,000 inhabitants.

C. **Regarding the Future ways for the provision of services in New Urban Settlements:** The statistical analysis of urban experts' responses to question 11 in Questionnaire III reveals that:

1. About 84 percent of the urban experts' responses expect that introduction of specialised service centres between a group of cities is most likely. Only 7 percent view this as somewhat less likely (Table 8.25, Figure 8.22 and Table A4.15 in Appendix 4).
2. About 82 percent of the responses expect that incorporation of primary services in every settlement is most likely. Only 9 percent view this as somewhat less likely.
3. About 66 percent of the responses expect that emergence of new forms for provision of some services (Education, health, police) is most likely. Only 2 percent view this as somewhat less likely.
4. Only 54 percent of the responses view the introduction of specialised service centres in every settlement as likely to happen. However, 32 percent of the responses view it as somewhat less likely. Which reflects the low consensus among experts about this alternative.
5. Only 9 responses (out of 206 total responses) recommend some other ways for the provision of services in new urban settlements. The most important of these ways are: incentive-based and performance based service delivery, business incubators, multi function mixed use centres.

The statistical analysis of urban experts' responses to this question reveals that the introduction of specialised service centres between a group of cities is the most likely way for the provision of services in future urban settlements in developing countries. Also, about 90 percent of urban experts' responses to question 16 in Questionnaire III expect that existing urban settlements are more likely to work as regional service centres (Table 8.30, Figure 8.26, and Table A4.19 in Appendix 4). This reflects the experts' belief that the majority of the proposed future settlements will not work as a regional service centres. This confirms the idea that the majority of these settlements will be of small size. This analysis also reveals that incorporation of primary services in every settlement is second most likely way for the provision of services in these settlements. This reflects experts' belief that that new settlements should be self-sufficient, which in turn, will support the viability of the proposed small-size settlements approach.

Findings:

The statistical analysis of urban experts' responses reveals the high consensus about appropriateness of the proposed small-size settlements approach for developing countries in the next 30-40 years. This analysis shows that settlement of 10,000-20,000 inhabitants seem to be more appropriate for new settlements in developing countries, followed by settlements of 20,000-50,000 inhabitants. This is while smaller settlement of 5,000-10,000 inhabitants and larger settlements of 20,000-50,000 inhabitants could be suitable for settlements of special functions within their regional settings. Settlements of less than 5,000 inhabitants are not recommended.

For the function of these settlements, it is highly expect that future urban settlements are likely to be of multiple related functions (IT & education, etc) or as centres for location-bound activities (tourism, mining). These two functions could be efficiently performed in small settlements within the recommended size categories of 10,000-20,000 or 20,000-50,000 inhabitants.

Regarding the possible ways for the provision of services in these settlements, there is a high consensus among urban experts that the introduction of specialised service centres between a group of cities is the most likely way for the provision of services in future urban settlements in developing countries. Also, existing urban settlements are more likely to work as regional service centres. This reflects the experts' belief that the majority of the proposed future settlements will not work as a regional service centres. This confirms the idea that the majority of these settlements will be of small size. This analysis also reveals that incorporation of primary services in every settlement is second most likely way for the provision of services in these settlements. This reflects experts' belief that that new settlements should be self-sufficient, which in turn, will support the viability of the proposed small-size settlements approach.

9.4 INCREMENTAL PLANNING APPROACH

The theoretical analysis, presented in Chapter Six, clearly demonstrates that the proposed approach of incremental planning and development of urban settlements is necessary to deal with the uncertainties that will always exist regarding the nature and extent of future technological change and its urban impacts, especially in developing countries. However, it is the purpose of this section to empirically examine the importance of this approach through the statistical analysis of urban experts' expectations. The main points revealed from this analysis are:

1. About 56 percent of urban experts consider building the whole settlement at one time as less appropriate (Question 14 in Questionnaire III). Moreover, about 35 out of this 56 percent view this approach as least appropriate. However, about 17 percent of urban experts view building the whole settlement at one time as somewhat appropriate (Table 8.28, Figure 8.24, and Table A4.17 in Appendix 4).
2. About 93 percent of urban experts consider the gradual development of future settlements as most appropriate, with highest average increase. Almost half of this percentage views this approach as most appropriate. Only 6 percent of urban experts view this approach as somewhat less appropriate. This reflects the high confidence among urban experts about the effectiveness of this approach.
3. Regarding the possible ways for the development of future new urban settlements, about 86 percent of the responses view the expansion and growth of new urban settlements in the form of new suburbs as more appropriate. Only 6 percent of urban experts view this approach as somewhat less appropriate. However, 71 percent of the responses view the expansion in the form of new independent urban units as more appropriate. About 11 percent view this approach as somewhat less appropriate.

Findings:

The statistical analysis of forecasting survey results reflects the high consensus among urban experts that the proposed incremental planning approach is the most appropriate way for the development of new settlements in developing countries, followed by expansion in the form of new suburbs and new independent urban units.

9.5 TECHNOLOGY AND THE FUTURE OF EXISTING SETTLEMENTS

Concerning the expected impacts of future technological achievements on existing urban settlements, especially big cities, the research had focused on investigating two important aspects; the future size and function of these settlements. The statistical analysis of urban experts' responses about these two points reveals that:

A. Regarding the Future Function of Existing Settlements:

1. About 90 percent (out of 97) of urban experts' responses (Question 16 in Questionnaire III) expect that these settlements are more likely to work as regional service centres for education, commerce, or entertainment. Moreover, only 3 percent of the responses view this as somewhat less likely. (Table 8.30, Figure 8.26, and Table A4.19 in Appendix 4).

2. About 55 percent of these responses expect that these settlements are likely to continue performing the same functions. However, about 22 percent of the responses view this as less likely. This reflects that this alternative is gaining less confidence than the previous one.

3. About 41 percent of the responses expect that existing settlements are more likely to perform some new functions; i.e. recreation, distribution centres, health, education, communication, retail etc. Only 3 percent of the responses view this as somewhat less likely.

B. Regarding the Future Size of Existing Settlements:

1. About 57 percent of urban experts responses (Question 15 in Questionnaire III) expect that the size of these settlements is likely to decrease. However, about 22 percent of the responses expect that the increase in the size of existing settlements is somewhat less likely to continue.

2. About 60 percent of the responses expect that the increase in the size of existing settlements is less likely to continue. Moreover, about 25 percent of the responses expect that the increase in the size of existing settlements is least likely to continue. However, about 39 percent of the responses expect that the increase in the size of existing settlements is somewhat likely to continue.

3. However, About 31 percent of the responses expect that the size of these settlements is somewhat less likely to decrease (Table 8.29, Figure 8.25 and Table A4.18 in Appendix 4).

Findings:

Based on this analysis, the future role of existing cities within the future national and regional urban systems in developing countries is expected to face a considerable change, which in turn will produce parallel changes in the size of these settlements. The most expected function for these settlements is to work as regional service centres for education, commerce, or entertainment. Concerning the size, this analysis shows that urban experts expect that the size of the existing cities is likely to decrease. Such decrease means that more people will move out of these settlements towards new urban settlements or existing rural ones.

These expected changes in the function and size of existing cities are of considerable importance and should be taken into account when developing future regional and national urban plans in developing countries.

Conclusion:

Future technological achievements of the 21st century are highly expected to have profound impacts on shaping the urban future in many of the developing countries. It is highly expected that these technologies will considerably change operation and production systems and the home-work relationship. Also, it is expected that these technologies will increase population mobility and will help overcome energy and utilities problems that usually confront urban development activities in remote and rural areas in developing countries.

Urban decentralisation is expected to be an effective approach for managing the urban future in developing countries. In addition, there is a high level of expectancy among both technology and urban development experts that future technology achievements will highly facilitate urban decentralisation in developing countries. Also, there is a high level of expectancy that the urban population in developing countries will be more inclined to disperse out of congested urban centres.

Regarding settlement size, there is a high consensus among urban development experts that the proposed small-size settlements approach would be effective in managing future urban development in developing countries. This analysis shows that settlement of 10,000-20,000 inhabitants seem to be more appropriate for new settlements in developing countries, followed by settlements of 20,000-50,000 inhabitants. This is while smaller settlement of 5,000-10,000 and larger settlements of 20,000-50,000 inhabitants could be suitable for settlements of special functions within their regional settings. This is while ettlements of less than 5,000 inhabitants are not recommended.

For the function of these settlements, it is highly expected that future urban settlements are likely to be of multiple related functions (IT & education, etc) or as centres for location-bound activities (tourism, mining). These two functions could be efficiently performed in small settlements within the recommended size categories of 10,000-20,000 or 20,000-50,000 inhabitants.

Regarding the possible ways for the provision of services in these settlements, there is a high consensus among urban experts that the introduction of specialised service centres between a group of cities is the most likely way for the provision of services in future urban settlements in developing countries. Also, existing urban settlements are more likely to work as regional service centres. This reflects the experts' belief that the majority of the proposed future settlements will not work as a regional service centres. This confirms the idea that the majority of these settlements will be of small size. This analysis also reveals that incorporation of primary services in every settlement is second most likely way for the provision of services in these settlements. This reflects experts' belief that that new settlements should be self-sufficient, which in turn, will support the viability of the proposed small-size settlements approach.

The statistical analysis of forecasting survey results reflects the high consensus among urban experts that the proposed incremental planning approach is the most appropriate way for the development of new settlements in developing countries, followed by expansion in the form of new suburbs and new independent urban units. About 56 percent of urban experts consider building the whole settlement at one time as less appropriate and view the gradual development of future settlements as most appropriate.

For existing urban settlements, the future role of these cities within the future national and regional urban systems in developing countries is expected to face a considerable change, which in turn will produce parallel changes in their size. The most expected function for these settlements is to work as regional service centres for education, commerce, or entertainment. Concerning the size, it is highly expected that the size of the existing cities is likely to decrease. Such decrease means that more people will move out of these settlements towards new urban settlements or existing rural ones.

RESEARCH SUMMARY AND CONCLUSIONS

The main purpose of this research is to examine the nature and extent of the future urban impacts of technology in developing countries and to define the necessary approaches for managing the urban future in these countries. Through its different stages, the thesis has reached some important findings. A summary of these findings, an analysis of the validity of research hypothesis and the proposed approaches, thesis contribution to knowledge and the suggested areas for future research are presented in this chapter.

10.1 SUMMARY OF FINDINGS

10.1.1 Technology and urban change

The first objective of this thesis was to investigate the relationship between technology and urban change and to explore the urban impacts of technological achievements in the areas of transportation, telecommunication, and infrastructure. In fulfilling this objective the thesis has examined the possible ways through which technology affects urban change (Chapter Two) and examined the possible urban impacts of the main technological forces (Chapter Three).

Based on the analysis of how technology affects the defining characteristics of urbanisation, technology is expected to affect urbanisation in three possible ways: (1) through changing the social behaviour and the nature of human needs and aspirations which in turn affect pattern of urban change, (2) through improving the prevailing economic conditions which affect the human abilities to meet their needs and aspirations, which in turn affects the pace and scale of urban change, and (3) through introducing and improving many technological forces; mainly transportation, telecommunications, energy and urban utilities which yield direct physical urban changes (Figure 2.1). These three factors are highly interrelated and affect each other. Because of the increasing international economic, cultural and political interaction, many studies view globalisation as an effective factor in shaping the urban future in both the developed and developing countries. Therefore, and in addition to the three factors mentioned earlier, the urban impacts of globalisation and the role of technology in this process have been discussed in details in Chapter Two.

- Technology, Social Change, and Urbanisation:

In investigating the relationship between technology and social change and how social change affects urban change process, numerous studies have emphasised the crucial role of science and technology in transforming the socio-economic structures of societies. In addition, the analysis of the main theories about technology and social change reveals that, despite their different views on how technology introduces social change, all these theories agree that technology affects the social structures of all societies. Also, the analysis of technology's role in the improvement of health, food and nutrition, and economic growth, affirms that technology is of considerable importance for the future of human development. In addition, the analysis of the main urban sociology concepts, especially the 'ecological approach' in urban analysis developed by Robert Park, and the characterisation of 'urbanism as a way of life' developed by Louis Wirth, reveals that social factors are of considerable impacts on urban change process.

- Technology, economic Growth, and Urban Change:

For the relationship between technology and economic growth and how economic growth affects urban change process, there is an extensive literature that stresses the role of technological change and industrialisation in economic development. Technology systems shaped not only the evolving national economies but also the pace and character of urbanisation. Many economists argue that each technological stage has been followed by a corresponding economic cycle; such as Kondarative and Kuznets cycles, and a city development cycle. This analysis reveals that economic growth is one of the driving forces for urban change.

- Technology, Globalisation, and Urban Change:

For globalisation and how it is affected by technology and how it affects urbanisation, there is an extensive literature that views technology achievements, especially in areas of transportation and telecommunications technologies, as important catalysts for globalisation. Many studies argue that these technologies significantly increase the integration of production systems and markets, the speed of communications, and the velocity of capital flows. For the urban impacts of globalisation, many analysts stress the influential role of globalisation in the emergence of global functions for some cities and regions all over the world. The seminal work of John Friedmann, Peter Hall, and Saskia Sassen about 'world cities', 'global cities' and 'global city regions' emphasise the influential role of globalisation in shaping the urban future in both developed and developing countries.

- Urban Impacts of Main technological Forces:

- TRANSPORTATION TECHNOLOGY

Advancements in transportation technology have resulted in increasing mobility, improving accessibility, increasing diffusion and falling costs of transportation facilities, and space-time convergence. These changes have significantly influenced city's size, form, structure, and function within the regional settings. The urban impacts of transport technology at the regional level were profound. In the pre-industrial era, cities were in a balanced relationship with each other and with the rural surroundings. This situation explains why these cities were of similar size. Only during the Industrial Revolution and since the introduction of new transportation modes that affect the regional setting, especially the railways and the automobile, such balance had significantly changed. New technologies of high-speed ground transport, automated transit and 'smart streets' (intelligent Vehicle-Highway Systems) are expected to be of high influence in shaping the future of urban development.

- INFORMATION TECHNOLOGY

The increasing diffusion of information technologies is not only affecting where people work and live, but also changing the character of activities that occur in the home, workplace, and automobile. Information and telecommunications technologies introduced many new, but widely used, prefixes especially *Tele...* and *Distance*. These technologies have also changed the home environment, function and design. Many of public services that were usually provided within designated public buildings such as schools, libraries, or prisons are now being provided in the home. The diffusion of information technologies is expected to drastically increase the complexity of cities through increasing the numbers and types of interactions among individuals, firms, technical systems, and the external environment. Information systems are opening new opportunities for new combinations of people, equipment, and places. Therefore, a dramatic change in the spatial organization of activities within cities and large metropolitan regions is highly expected.

Although there are some predictions that telecommunications will lead to "death of distance" and that "death of distance" will lead to "death of cities", many analysts assert that telecommunication could both centralize and decentralize urban activities. Peter Hall (1999) considered the argument that the 'death of distance' will lead to the 'death of cities' as exaggerating simply because it ignores the significance of face-to-face contact and the continuing significance of agglomeration. Moreover, while telecommunications will significantly shrink the space and consequently reduce the effect of distance as a deterrent factor, advantages of site location will continue to be influential. This will facilitate the development of rural, remote and under-developed regions and incorporating them in the national development plans.

- RENEWABLE ENERGY TECHNOLOGIES

Renewable energy is the main effective alternative for the depleting fossil energies because it is abundant, with well-established technology and that its main ingredients are completely free. The cost of power generation from renewable sources has dropped significantly over the past decade and several technologies are now cost effective not only for off-grid applications but for grid-connected power as well. Many of the developing countries, such as Indonesia, India, China, Egypt and Morocco, have progressively started production and installation the PV units. Renewable energy opens up new opportunities not only for urban development but also for the comprehensive development process at both regional and national levels. Renewable energies provide distributed, ubiquitous and redundant renewable power supply systems that are highly needed for the vast undeveloped deserts in many developing countries. For urban development, there is no doubt that these technologies will minimise the role of energy supply sources as determining factors in selecting the location and size of future urban settlements. It clearly adds more freedom in locating urban development projects and not to be strictly located near electricity grids.

- NEW URBAN UTILITIES TECHNOLOGIES

New urban utilities technologies are of considerable importance in shaping cities and patterns of urbanisation. Technology advancements in areas of water supply and the use of solar pumps are rapidly advancing. In the area of sanitation, the World Bank supports the ecological sanitation approach which is designed to suite the need on remote location. Such approach respects ecological integrity, conserves and protects fresh water resources, promotes dignified and healthy living, and recycles nutrients for use in agriculture. Because of the rapid developments and the increased competitiveness, the prices of many of these technologies are decreasing sharply. Advancements in urban utilities technologies are expected to affect the urban environment in two ways. First, the large size of population needed for the economic functioning of water and sanitation stations is no longer required. Many of the currently available water and sanitation systems are suitable for small urban or rural communities, and even for single houses. Second, such systems represent an economical alternative for utilities networks in remote rural locations, and sometimes in urban fringes. These advantages make the construction and the functioning of small urban communities technically and economically possible. The analysis reveals that although new urban utilities technologies will have considerable impacts on existing settlements, they open up new opportunities for managing the urban future in many of the developing counties. Also, these technologies will facilitate the spread of development activities to remote and under-developed regions.

- URBAN IMPACTS OF MAIN TECHNOLOGICAL FORCES: FORECASTING SURVEY RESULTS

In confirmation with the literature review findings, the forecasting survey reveals that ICTs, transportation, energy, and utilities technologies are the main technologies that are highly expected to be of considerable impact on the urban future in developing countries (Questions 4 and 3 in Questionnaires I and III). According to the forecasting survey results, it is highly expected that these technologies will considerably change current operation and production systems and home-work relationship. Also, it is highly expected that these technologies will increase population mobility and will help overcome energy and utilities problems that usually confront urban development in remote and rural areas. A summary of the forecasting survey results regarding the expected urban impacts of each of these technologies is presented in section 9.1.

- Technology and Urban Change: Forecasting Survey Results

In confirmation with the above discussion about the possible impacts of technology on urban change in developing countries, more than 67 percent of urban experts' responses expect that future technological achievements will be of considerable impact on urban development in developing countries (Question 2, Questionnaire III). Technology is highly expected to change home-work relationship. About 50 percent of technology experts' responses and 64 percent of urban experts' responses expect that the total amount of time needed for travelling to work and other daily activities will decline (Question 4 in Questionnaires II and III). In addition, about 60 percent of technology experts and 49 percent of urban experts expect that the long established interdependence between place of residence and work location will decline. Moreover, 65 percent of technology experts and 67 percent of urban experts expect that the commuting distance between home and work will increase significantly.

There is a high consensus among urban experts that future technological achievements will increase the attractiveness of rural settlements more than that of urban ones (Question 4 in Questionnaires II and III). About 51 percent of the responses indicate that the attractiveness of rural centres to urban population is expected to increase, while 49 percent of the responses show that attractiveness of urban centres will increase at a lower rate. About 59 percent urban experts and 65 percent of technology experts expect that settling remote and uninhabited areas will increase.

Through this extensive analysis of the four main ways through which technology affects urbanisation (social change, economic growth, globalisation, and technological forces), through the examination of the possible urban impacts of main technological forces, and through the analysis of relevant forecasting results, the thesis has thoroughly investigated the relationship between technology and urban change and fulfilled its first objective.

10.1.2 Patterns and Problems of Urban Change in Developing Countries

The second objective of this thesis was to examine the nature and extent of the main urban change problems in developing countries and how they are different from those in more developed countries. In fulfilling this objective the thesis has investigated the main differences in patterns of urban change in developed and developing countries and patterns and problems of urban change in Africa, as a group sample of developing countries, and in Egypt.

- MAIN DIFFERENCES IN PATTERNS OF URBAN CHANGE IN DEVELOPED AND DEVELOPING COUNTRIES

The thesis empirical analysis of urban change patterns in countries of different technological capabilities (developed, less, and least developing countries) reveals two main important facts (section 4.2). First, developed and developing countries present different trends regarding the shares of different sizes of settlements of their national urban populations. In more developed, and more technically advanced countries, the share of large urban settlements is considerably decreasing and the share of smaller ones is increasing. This is while almost all developing regions present a different pattern of increasing share of large settlements and sharply declining share of smaller ones. Second, developed and developing countries present contrasting trends regarding the average size of settlements. While the average size of large urban settlements is declining in more developed countries, it is rapidly increasing in developing countries. This analysis shows that there is a strong correlation between the level of technology prevailing in a society and patterns of urban change in that society. In addition, this analysis clearly shows that urban systems in developing countries suffer two main problems: the increasing size of its primate cities and the rapid rate of urban concentration.

- PATTERNS AND PROBLEMS OF URBAN CHANGE IN AFRICA

Urban systems in almost all African countries have faced many unprecedented changes during the last five decades. Although these changes were similar to those experienced in all developing countries, the rate and the scale of urban changes in Africa were very much beyond the capacity of the socio-economic systems of many African countries. Africa presents a strange phenomenon of rapid urbanisation without economic growth. Rapid urbanisation and the concentration of urban population and the emergence of primate cities are the main patterns of urban change in Africa. Urban poverty, unemployment, and environmental pollution are serious problems in almost all African cities, especially primate ones.

- PATTERNS AND PROBLEMS OF URBAN CHANGE IN EGYPT

Through the investigation of urban change in Egypt, the thesis came to three important conclusions. First, the urban system of Egypt suffers high urban concentration levels in certain regions of the country; namely Greater Cairo, Alexandria, and Canal cities. To these very small regions, all migration streams are heading from all over the country, from both the urban and rural areas. Upper Egypt regions are the main losers of both urban and rural populations. Second, new towns built in Egypt since 1977 were of very limited influence in correcting this pattern of urban concentration. Third, the urban system of Egypt suffers high differential growth of the different settlement sizes as large cities are usually growing faster than smaller ones which usually lose their population in favour of larger cities. In 2003, 51% of the country's urban population were in only 2 large cities of over a million people in size: Greater Cairo (Cairo, Giza, Shubra Al-Khaymah) 38 percent, and Alexandria 13 percent.

The detailed analysis of urban problems that accompanied the increasing primacy of Greater Cairo region reveals three important facts. First, despite the numerous advantages of the region that usually attracts more people and investments to it, such increasing primacy created a web of social, economical, and urban problems. Second, urban poverty and its associated social and urban problems are high and growing in GCR. Housing shortage and emergence and the growth of slums are very high and rapidly growing in the region despite the government efforts to control them. Third, the region is facing mounting transportation, infrastructure, and environmental problems. These mounting problems of the increasing primacy of GCR call for a more comprehensive vision at the national level to control and minimise the increasing primacy of the region and to overcome its problems in the region itself and in the country as whole. In doing so, the adoption of some national policies, designed to control and minimise regional disparities, is a necessary approach.

Through this analysis, the thesis asserts that the increasing size of large cities, the rapid rate of urban concentration, and the emergence of primate cities are the main urban change problems in developing.

10.1.3 Proposed Approaches for Managing Urban Future in Developing Countries

The third objective of the thesis was to develop urban development approaches that could be more effective in addressing the main urban problems in developing countries and that could efficiently meet the expected impacts of future technological achievements. The selection of these approaches takes into account the possible urban impacts of different technological forces and how to utilise these technologies in implementing these approaches.

In fulfilling this objective, and after reviewing the relationship between technology and urban change and after examining patterns and problems of urban change in developing countries, the thesis has identified three approaches for managing the urban future in developing countries: urban decentralisation, small-size settlements, and incremental planning and development of urban settlements. Next, in section 10.3, the thesis presents an appraisal of these approaches regarding their importance in managing the urban future in developing countries and the role of technology in implementing each of these approaches. Also, it presents the forecasting survey results regarding the appropriateness and applicability of each of these approaches.

10.2 AN APPRAISAL OF THE RESEARCH HYPOTHESIS

The thesis' hypothesis is that future technological achievements of the 21^{st} century will have significant impacts on shaping the urban future in many of the developing countries, as the prevailing economic and social forces will undergo significant changes. The previous analysis of the relationship between technology and urban change and the theoretical analysis of technology impacts on social change, economic growth, and globalisation (Chapter Two) demonstrate that the rapid and impressive technology achievements of the 21^{st} century will have significant impacts on shaping the urban future in many of the developing countries.

The extensive analysis of the urban impacts of main technological forces (Chapter Three) reveals that recent technological achievements, mainly the areas of transportation, telecommunications, renewable energies and urban utilities were of considerable impacts on the urban environment. It is highly expected that technology achievements of the 21^{st} century will be more impressive and more influential in shaping the urban environment.

Through the forecasting survey, the statistical analysis of both urban and technology experts' responses clearly reveals that future technological achievements of the 21^{st} century are highly expected to have profound impacts on shaping the urban future in many of the developing countries. It is highly expected that these technologies will considerably change operation and production systems and the home-work relationship. Also, it is highly expected that these technologies will increase population mobility and will help overcome energy and utilities problems that usually confront urban development activities in remote and rural areas. A summary of the statistical analysis of both technology and urban development experts' responses to questions relevant to the research hypothesis is presented in section 9.1.

Through its different stages and its theoretical and empirical dimensions, this analysis demonstrates that technology achievements are advancing rapidly and are expected to have profound impacts on shaping the urban future in many of the developing countries, and hence proves that the thesis' first hypothesis is valid.

10.3 AN APPRAISAL OF THE PROPOSED APPROACHES

The third objective of the thesis was to develop urban development approaches that could be more effective in addressing the main urban problems in developing countries and that could efficiently meet the expected impacts of future technological achievements. The selection of these approaches takes into account the possible urban impacts of different technological forces and how to utilise these technologies in implementing these approaches.

In fulfilling this objective, and after reviewing the relationship between technology and urban change and after examining patterns and problems of urban change in developing countries, the thesis has identified three approaches for managing the urban future in developing countries: urban decentralisation, small-size settlements, and incremental planning and development of urban settlements. Next, in section 10.3, the thesis presents an appraisal of these approaches regarding their importance in managing the urban future in developing countries and the role of technology in implementing each of these approaches. Also, it presents the forecasting survey results regarding the appropriateness and applicability of each of these approaches.

10.3.1 Urban Decentralisation Approach

The thesis' first proposed approach is that decentralization and dispersion of urban population, mainly at the regional level, is a necessary approach for managing the urban future in developing countries and that it will be highly facilitated by future technological achievements. The thesis argues that future technological achievements would increase population mobility and would introduce and enhance new forms of work, education, and entertainment, which consequently will facilitate the adoption of such approach. The importance and applicability of this approach has been tested through the literature review, the analysis of urban problems in Africa and in Egypt, and through the forecasting survey of both technology and urban development experts' opinions and expectations (section 9.2).

A-Indications from the Literature Review:

The literature review presented in section 6.1.1 reveals that almost all urban planning theorists view urban decentralisation as a necessary approach for achieving a more sustainable urban development. Ebenezer Howard and Lewis Mumford are among the most influential proponents of urban decentralization. In his book "Garden cities of To-Morrow" (1902), Howard asserted the growing consensus against population concentration in the already over-crowded cities. In support of his arguments for decentralisation, he critically examined the evils of slum housing, long work journeys, and the deteriorated environment in these overcrowded cities. Consequently, he suggested that city dwellers should be relieved of these disadvantages through being moved into new 'garden Cities". Lewis Mumford viewed decentralisation as a necessary approach to avoid the danger of turning "town and country" into an "amorphous suburban mass" (Mumford 1966, 34). In practice, decentralisation became a major aim of post-war British urban policy. The advent of the 'spatial technologies', namely the automobile, the railways, and telecommunications are argued to have changed the nature of the case for decentralisation in other ways Howard could not have envisaged: it became a widespread autonomous trend both for households and firms (Coursey 1977, 13).

Although most of the frequently stated advantages of decentralisation are mainly focusing on its effects at the local level, the most significant advantages of urban decentralisation are at the regional level. At the regional level, the urban decentralisation approach addresses urban problems within their regional and national contexts that usually influence urban localities. Therefore, managing urban areas within these contexts is seen to be more effective and more rewarding for the urban areas and their rural hinterlands. In many cases, urban decentralisation at local level could represent in itself some sort of urban concentration, as is the case of new towns around Cairo (section 5.2.1.4). Although these towns were an attempt to achieve some urban decentralisation of Cairo's population, this process has improved life quality and the economic prosperity of Greater Cairo Region, compared to other regions of the country, and consequently increased its attractiveness to new migrants from different regions of Egypt. Therefore, although this process represents urban decentralisation at local level, it is an urban concentration process at national level.

For developing countries, where the pace of urban growth and urban concentration has reached critical levels, urban decentralisation is of particular importance. The constantly high rates of population natural increase and the rapid rural-urban migration are simultaneously causing immense growth in urban population in these countries. The ever-increasing size of Third World cities and its impacts on concentrated poverty and urban deterioration has drawn the attention of national planners, policy makers and researchers alike. Most of the national governments in developing countries have begun to realise that the concentration of population and activities in a few leading cities are serious threats to the achievement of their stated development goals. A more detailed investigation of urban decentralisation advantages for developing countries is presented in section (6.1.1.1).

-Technology as an Enabler for Urban Decentralisation:

Many urban studies argue that technological achievements have significantly influenced the distribution of urban population. Brochie, Newton, Hall, and Nijkamp (1985, 12) have studied the role of technology in the spatial diffusion of urbanisation and argue that technology affects the dispersion of urban activities and the interactions between them. This argument is based on the idea that the dispersal of non-residential activities may be measured by their mean distance from the urban centre or by the number of dispersed centres within the metropolitan area, and that dispersal of interactions may be measured by the mean flow distance (Figure 6.1). Mackett and Lodwick (1985, 254) acknowledged the argument of Brochie, Newton, Hall, and Nijkamp (1985) calling their graph (Figure 6.1) an "urban technological triangle". A more detailed analysis of these arguments is presented in section 6.1.3.

The analysis of urban impacts of different technology sectors (presented in Chapter 3) demonstrates that these technologies could facilitate urban decentralisation. For transportation technologies (section 3.1), it is evident that such technologies have considerably increased population mobility, which in turn has increased their ability of residing further away from city centres. Peter Hall (1970) asserted that there is a close interrelationship between the available forms of urban transport and the form of urban growth. Pacione (2001, 248) stressed that the development of railways and trams during the nineteenth century was crucial in separating home and workplace, encouraging functional specialization of land uses in the city. Also, many urban experts such as Hall 1993, Pacione 2001, Herbert and Thomas 1997, Hart 2001, have emphasised the role of transportation technologies of the Post-Industrial era in facilitating population deconcentration, post-suburbanisation - the emergence of edge cities – on the local level, and in promoting urban decentralisation and diffusion of settlements on the regional level (table 3.2, Chapter 3).

For telecommunications technologies (section 3.2), many urban studies have emphasised the regional spatial impacts of ICTs. Manuel Palao and Garcia-Suelto (1975) expect that ICTs would directly contribute to physical decentralisation. They argued that the new ways of using ICTs are found both to ease problems of city congestion and to improve the quality of life in rural areas. In a similar vein, Roger Pye and Thomas, H. (1976, 92) confirmed that telecommunications were extremely important in decisions about office relocation. Many recent studies have supported the previous arguments of Manuel Palao and Garcia-Suelto (1975), and Roger Pye (1979). Peter Gordon and Harry W. Richardson (1997, 95) stressed the role of the rapid advances in communications technologies in facilitating the movement out of cities that the automobile had initiated. They stress that today's cities will continue to become less compact and the city of the future will be anything but compact.

Many other studies argue that technology will eliminate the need for cities as centres of interaction (Moss and Townsend 2000; UNCHS-Habitat 1995; Cairncross 1997, 18). Negroponte (1996) and Wheeler *et al* (2000) argue that the post-information age will remove the limitations of geography. Moreover, some studies argue that the future advancement of telecommunications technologies would lead to the "death of distance" which will lead to "death of cities" stressing that distance would no longer determine the cost of communicating electronically (Doxiadis, 1960; Gilder and Peter 1995; Cairncross, 1997). Also, it is argued that telecommunications would surmount distance not only through 'shrinking of space' but also through 'extension of people' into a position in which they can bridge distances (SPECTRE 2002).

However, the argument "death of distance" will lead to "death of cities" has been criticised as being over simplistic and exaggerating. Jed Kolko (1998, 4) argued that telecommunications have led to the "death of distance" but not to the "death of cities". Also, Peter Hall (1999) considered the argument that the 'death of distance' will lead to the 'death of cities' as exaggerating simply because it ignores the significance of face-to-face contact and the continuing significance of agglomeration (section 3.2.4.2). Admittedly, some other studies argue that telecommunications could both centralize and decentralize urban activities as it could help both to concentrate and to disperse economic activities (Gottmann, 1983; Scott, 1995; and Wheeler *et al.* 2000). But in fact this depends mainly on the advantages and motivations behind the decision to centralise or decentralise. This argument coincides with the thesis stance that views technology just as a tool, 'neutral' or 'value-free' (neither good or bad in itself), and that what matters is not the technology but the way in which we choose to use it. In this regard, the thesis argues that while telecommunications will significantly shrink the space and consequently reduce the effect of distance as a deterrent factor, site location will continue to be influential. For example, although the distance has not become the determining factor in choice between two locations, location advantages (i.e. regional settings, natural resources, environmental advantages) became more and more important in this regard. Therefore, the decision to settle or to build a new settlement in any location will not be mainly governed by distance but rather by the advantages of such location. This will increase the possibility of developing rural, remote and under-developed regions and incorporating them in the national development plans (section 3.2.4.2).

Similarly, advancement of renewable energy and urban utilities technologies (section 3.3 and 3.4) is expected to facilitate urban decentralisation. For developing countries, photovoltaic (PV) and wind energy technologies offer unique opportunities for supplying electricity to remote and scattered rural and desert settlements without the need for the extremely expensive networks. Also, these advancements are expected to help overcoming energy and utilities problems that usually confront urban development activities in remote and rural areas of developing countries.

Although it is evident from the literature review that future technological achievements will facilitate urban decentralisation, the research tried, in a further step, to empirically verify this argument. The comparative analysis of patterns of urban change in countries of different technological statuses (developed, less, and least developed countries), presented in section 4.4, confirms that there is a strong relationship between the level of technology and patterns of urban change prevailing in any society. This analysis reveals that all countries of the industrial world had shown a considerable degree of urban decentralisation, this is while all countries in the developing world are still experiencing urban centralisation and suffer mounting urban structure imbalances regarding the ever increasing size of large metropolitan areas.

-Urban Decentralisation in Egypt:

Although policymakers in Egypt, as in all the developing countries, claim to have adopted of urban decentralisation, it seems that such approach have been applied only at the local level. The analysis provided in sections 5.2.1 and 6.1.4 clearly demonstrate that government efforts mainly focused on alleviating urban problems of primate and large cities of the country. The three 'generations' of new towns in Egypt were built around very close to these large cities. Even the sequence of these 'generations' has been in accordance with urban concentration level of these cities.

The analysis of urban problems in Egypt, as an example of developing countries, revealed that urban concentration is one of the serious urban problems in the country (Chapter 5). Although there are only 3 cities of more than 1 million inhabitants out of the country's 211 urban settlements in Egypt, their share of the total urban population reached 51.14 percent in 2003. Moreover, the analysis of current migration streams shows that the Greater Cairo Region and the urban governorates of Alexandria, Port

Said, and Suez were the main targets for population migration with net in-migration of about 1.45 million people during 1986-1996 period. This is while the Delta and Upper Egypt regions have lost about 840,000 and 685,000 of their urban population. The highest percentage of population loss was in the Upper Egypt region that lost about 17 percent of its urban population during the same period.

B-Indications from the Forecasting Survey:

In confirmation with the literature review findings, the statistical analysis of both urban and technology experts' responses demonstrates that urban decentralisation is expected to be effective in managing the urban future in developing countries. Also, it shows that future technological achievements are highly expected to facilitate the adoption of the proposed urban decentralisation approach in developing countries. Section 9.2 confirms these points through presenting a detailed analysis of the forecasting survey results regarding factors affecting the spatial distribution of urban population in developing countries, the spatial impacts of different technology sectors, targeted areas of population movements, and the location of future new urban settlements in developing countries.

The literature review, the analysis of urban patters and problems in Africa and in Egypt, and the statistical analysis of forecasting survey results demonstrate that urban decentralisation is a necessary approach for managing the urban future in developing countries and that future technological achievements would highly facilitate urban decentralisation in these countries during the next 30-40 years.

Although it has been verified that urban decentralisation is an appropriate approach for most of the developing countries of increasing technological capabilities, national variations regarding socio-economic conditions and technological capabilities play a considerable role in determining the scale, pace, and policies needed to implement such approach. Therefore, the application of such approach should be based on an extensive analysis of the spatial characteristics and problems of urban systems, patterns of population distribution and migration streams, and the socio-economic and technological capabilities of each country.

Taking into account the thesis stance that views technology just as a tool that could both centralize and decentralize urban activities; achieving urban decentralisation requires that technological achievements should be driven by a sincere political will for implementing urban decentralisation. In this regard, urban decentralisation is expected to be better achieved within a wider national comprehensive process of political, economical, and administrative decentralisation. Moreover, governments should introduce some incentives that encourage real estate and industrial development companies to participate in the development of targeted regions. Also, new measures should be introduced for building technologically-sound regional infrastructure facilities. This is to ensure that these facilities could be adaptable to future technological changes and would be efficient for a considerable period of time. These facilities are of considerable importance for the implementation of urban decentralisation approach.

For Egypt, urban decentralisation at the regional level is of considerable importance. Focus should be directed to migration-generating regions rather than migration-targeted regions. Urban decentralisation towards migration-generating regions, such as Upper Egypt and frontier regions, will foster the development process and create more jobs in these regions. This will minimise the regional development disparities, and consequently alleviate urban problems in migration-targeted regions such as Cairo.

10.3.2 Small-Size Urban Settlements Approach

The thesis' second proposed approach is that small-size urban settlement is a necessary approach to avoid the problems of current large-scale urban centres and to help implement the proposed urban decentralization approach. This approach has been tested through the literature review, the analysis of urban problems in Egypt and in Egypt, and through the forecasting survey of both technology and urban development experts' opinions and expectations (section 9.3).

A-Indications from the Literature Review:

The literature review (section 6.2.1) reveals that small-size settlements are widely seen as of considerable advantage and necessary for achieving sustainable urban development in developing countries. In 1965, Constantinos Doxiadis stressed the values that small cities have for their own inhabitants, for those in big cities, and for the world population and civilisation. Moreover, he posed an important question: how do we know that big cities can survive without the small ones? Also, he argued that this has never happened before and that we are not allowed to let it happen without being aware of its repercussions to our welfare.

The role of this size-category of settlements is widely recognised as vital for economic growth and restructuring regional and national urban systems. This is, in part, because of the recognition that a considerable proportion of the world's population live in them. In 2000, over half the world's urban population and a quarter of its total population lived in urban centres of less than half a million inhabitants. Much of this population was in market towns and administrative centres with between 5,000 and 100,000 inhabitants (Satterthwaite and Tacoli 2003). In 2000, more than 60 percent of urban population of Africa, the Caribbean and South-Eastern Asia were in urban centres with less than half a million inhabitants (UN, 2002).

The high percentage of population living in small settlements demonstrates that this size-category of settlements have some qualities that enabled them to attract and sustain this huge number of population worldwide. Many recent studies have investigated the advantages and the potentials of these settlements. The most important of these advantages is that these settlements increase rural agricultural incomes by acting as centres of demand and market nodes for agricultural produce from the rural region. In addition, small settlements reduce costs and improve access to a range of public and private services and goods from within and outside their region by acting as centres for the production and distribution of goods and services to their rural region. Moreover, this size-category of settlements is effective in attracting rural migrants from the surrounding regions through demand for non-farm labour and thereby decreases pressure on larger urban centres (Satterthwaite and Tacoli 2003).

On the other hand, the thesis has examined the declining attractiveness of large urban settlements (section 6.2.2). In addition to the analysis of the old arguments about agglomeration economies, environmental and social costs of urban concentration, the thesis puts special emphasis on the impacts of natural and human-made disasters on large urban settlements in developing countries. In the era of spread and proliferation of mass-destruction weapons, having large cities or metropolitan agglomerations became a very serious strategic mistake. For a country like Egypt, having about 20 percent of the country's total population in a single location, such as Cairo, is really a serious problem. In a situation like this, population dispersion to a number of small-size settlements is the most effective and necessary measure.

In the light of the considerable advantages of small urban settlements, this approach is expected to be an effective tool for the adjustment of the urban national and regional imbalances for many reasons. First, and because of dispersed nature of existing rural settlements in Egypt, small-size settlements are expected to be more efficient in meeting the socio-economic needs of the small clusters of rural and urban settlements and more adaptable to future technological changes. Second, these small-size settlements can easily fit within, and adapted to, the regional settings of existing urban and rural settlements. Small-size settlements offer better chances for the incremental development and the continuous evaluation and reassessment of the approach's effectiveness and suitability. A matter that is not achievable with large-size settlements, as is the case in Egypt where a bundle of new large settlements were built. Third, small-size settlements are expected to facilitate the implementation of the proposed urban decentralisation and incremental planning and development approaches, as it would facilitate the dispersion of urban population to a larger number of settlements that could be built according to the need. Fourth, small-size settlements are easier to manage and suit the management capacity of developing countries.

Although the importance and effectiveness of the small-size settlements were evident through the previous arguments, defining the optimum size for the small city is still an important issue. Since defining an optimum size for the future urban settlement is a hard task and depends on the socio-economic conditions and the development level of each country or a region, defining a certain minimum size, however, is a useful criterion. Waugh (1968) suggests a community of 6,000 as the minimum size needed to constitute a suburban area, as at that size there will be sufficient services to justify recognition as a separate entity. In confirmation with these arguments, many countries use smaller number of population as threshold for settlements to be considered as urban. Moreover, Moles, R. *et al* (2000) recommend some smaller and some larger sizes as well. They recommend that a minimum population threshold level of 1000–2000 would enhance viability for a primary school, some local services and centralised sewage treatment. Also, a settlement with 15,000–30,000 people enables a secondary school, public and commercial services, and some environmental infrastructure. More important, it recommends that a development pattern with settlement sizes in the 1000–2000 and 20,000–30,000 population bands clustered around public transport nodes is likely to be most sustainable (Moles, R. *et al* 2000). More analyses of these and other arguments regarding settlement's shape and density are presented in section 6.2.1.

-Technology as an enabler for the Small-Size Settlement Approach:

In addition to their environmental qualities, technological achievements especially in areas of telecommunications and transport technologies have significantly increased the attractiveness of small urban settlements. These technologies have made life in these settlements more attractive as they made them more physically accessible and virtually connected with the rest of their region and country. Moreover, these technologies have introduced in these settlements many of the formerly large-settlements' services, mainly entertainment, shopping, and education. Moreover, the emergence and the growth of telework activities made these settlements more attractive to a wide variety of new businesses. Also, recent developments in renewable solar and wind energies, making them more efficient and more economic, could facilitate settling areas that are away from the national grid. Also, the development of small water purification and sanitary treatment is expected to support this attitude. More details about the urban impacts of these technologies are presented in Chapter 3.

-An Appraisal of Small-Settlements Approach in Egypt:

The extensive analysis of urban system in Egypt, presented in sections 5.2.2 and 6.2.4, demonstrate that the proposed small-size settlement approach is not among the main objectives of urban development policy in Egypt. This is true for both old and new urban settlements in the country.

Regarding old cities, large urban agglomerations continue to dominate the distribution of urban population in Egypt. Although the share of primate cities (of more than 1 million population) of total urban population has declined from 56.6 percent in 1976 to 48.8 percent in 1996, it starts rising again and reached 51.1 percent in 2003. Also, although the share of settlements of 100-500 thousand inhabitants has increased from 18.3 percent in 1976 to 23.6 in 2003 and the share of settlements of 20,000-99,999 inhabitants has increased from 19.8 percent in 1976 to 22.7 in 2003, the share of smaller settlements of less than 20,000 inhabitants has declined sharply from 5.1 percent to 0.6 in during the same period (table 5.3). For the new cities, almost all of the 16 new cities are of large size. Four of them are of 500,000 target population; 7 are of 250,000 target population; 2 are of 120,000 target population; 2 of 70,000 target population, and only 1 of 35,000 target population.

However, there was a dramatic spread of large villages (10,000-20,000 inhabitants) across the Egyptian countryside. Although these settlements are rural either regarding their lifestyle or the agricultural economic base, some studies have classified them as "urban villages". In 1996, urban villages of more than 10,000 people have increased in number from only 400 in 1986 to about 628 in 1996, and their share of the total population has increased from 3.2 percent in 1947 to 8 percent in 1976, and to 17.5 percent in 1996. This reflects the increasing attractiveness and competitiveness of this size-category of settlements. It also reflects the importance of this category of rural settlements in developing a more balanced urban system in Egypt and confirms Jamal Hamdan's idea (1990) that "urbanism begins in the village" (section 6.2.4).

B-Indications from the Forecasting Survey:

In confirmation with the literature review, the statistical analysis of the forecasting survey reveals a high level of expectancy among both technology and urban development experts that future technology achievements would highly affect the size of both new and existing urban settlements in developing countries. It also reveals that urban experts view the small size of urban settlements as more appropriate for developing countries. According to this analysis, settlement size of 10,000-20,000 inhabitants is highly expected be more appropriate for new settlements in developing countries, followed by settlements size of 20,000-50,000 inhabitants. This is while smaller settlements of 5,000-10,000 and larger settlements of 20,000-50,000 inhabitants could be suitable for settlements of special functions within their regional settings. Settlements of less than 5,000 inhabitants are not recommended.

Section 9.3 confirms these points through presenting a detailed analysis of the forecasting survey results regarding the expected size of new urban settlements, the future function and the possible ways for the provision of services in these settlements. The last two points are of considerable importance in defining settlement size.

Regarding the future function of these settlements, it is highly expect that future urban settlements are likely to be of multiple related functions (IT & education, etc) or as centres for location-bound activities (tourism, mining). These two functions could be efficiently performed in small settlements within the recommended size categories.

Regarding the possible ways for the provision of services in new urban settlements, the statistical analysis of urban experts' responses to Question 11 in Questionnaire III reveals that the introduction of specialised service centres between a group of cities is the most likely way for the provision of services in future urban settlements in developing countries. Also, about 90 percent of urban experts' responses to Question 16 in Questionnaire III expect that existing urban settlements are more likely to work as regional service centres. This reflects the experts' belief that the majority of the proposed future new settlements will not work as a regional service centres. This confirms the idea that the majority of these settlements will be of small size. This analysis also reveals that incorporation of primary services in every settlement is second most likely way for the provision of services in these settlements. This also reflects experts' belief that that new settlements should be self-sufficient, which in turn, will support the viability of the proposed small-size settlements approach.

<u>The literature review and the statistical analysis of urban and technology experts' responses demonstrate that the proposed small-size settlements approach would be effective in managing the urban future developing countries in the next 30-40 years</u>. This analysis shows that settlement size of 10,000-20,000 inhabitants seem to be more appropriate for new settlements in developing countries, followed by settlements size of 20,000-50,000 inhabitants. This is while smaller settlement of 5,000-10,000 and larger settlements of 20,000-50,000 inhabitants could be suitable for settlements of special functions within their regional settings. Settlements of less than 5,000 inhabitants are not recommended.

Although it has been verified that small-size settlements is an appropriate approach for most of the developing countries of increasing technological capabilities, national and regional variations regarding socio-economic conditions, technological capabilities, and regional potentials and problems play a considerable role in determining new settlements' size, function, and location in relation to existing ones. This requires that these factors should be investigated at both the regional and national levels. Also, in addition to the size, settlement shape and density are decisive factors in determining its sustainability and require special investigation in each country.

For Egypt, this approach is of special importance for overcoming the mounting problems of its large urban agglomerations (section 5.3) and for the application of the proposed urban decentralisation approach. For the application of the small-size settlements approach in Egypt, the research recommends the development of large rural settlements through a '*rural urbanisation*' process, and to incorporate these settlements within the national urban system. This process is expected to be more efficient in minimising regional disparities and in correcting urban system imbalances. Also, it is expected to be more economical than building new settlements.

10.3.3 Incremental Planning Approach

The thesis' third proposed approach is that incremental planning and development of the future urban settlements is a necessary approach to deal with the uncertainties that will always exist regarding the extent of future technological change and its urban impacts, especially in developing countries where the availability and reliability of information is limited. These uncertainties are: (1) uncertainties in defining the extent and the rate of future technological change in developing countries, (2) uncertainties about developing the necessary capacity in these countries needed to better define the future urban impacts of technology and to devise and implement the policies and strategies necessary to manage such impacts, and (3) uncertainties about the degree of acceptance and adaptability of local populace to the proposed approaches. In addition to these uncertainties, the volume of the expected urban change is high. Therefore, the research proposes the incremental planning and development approach as a necessary approach to best deal with these uncertainties.

This approach has been tested through the literature review (section 6.3) and through the forecasting survey of urban development experts (section 9.4).

A-Indications from the Literature Review:

Incremental planning is developed mainly to overcome the shortcomings of Rational Comprehensive Planning (RCP) methodology. To apply the RCP approach, the decision-makers should have: (1) a well-defined problem; (2) a full array of alternatives to consider; (3) complete information about the consequences of each alternative; (4) full information about the values and preferences of citizens; and (5) full adequate time, skills, and resources (MacLeod 1996). Due to all these requirements, the RCP approach is viewed as unrealistic and can only be applied to relatively simple problems and only in a modified form Lindblom (1959) argue that its non-implementability takes away any point in using it. Therefore, and based on these shortcomings of RCP and taking all the uncertainties mentioned before into account, the RCP seems to be inappropriate for managing the urban future in developing countries experiencing rapid technological and socio-economic changes.

In "*Incrementalism*" social interaction is substituted for mental processes in systematic calculation and that subjectivity is part of this process (Friedmann, 1987). Also, while exclusion of factors is accidental in the RCP, it is deliberate, systematic and defensible in *Incrementalism* (Lindblom 1959). Also, *Incrementalism* rejects the notion that policies can be guided in terms of central institutions of a society expressing a collective "good" that ensure the appropriate assessment of society's potentials and needs.

MacLeod (1996) argues that although incremental decisions outnumber fundamental ones, they do not outweigh them and that fundamental decisions set the context for incremental ones. Furthermore, he argues that no single tradition of planning can do everything. In practice, planners usually make repetitive attempts to solve problems, starting off being incremental and becoming more comprehensive. They thus take advantage of the strengths of each approach while avoiding their respective shortcomings, a methodology known as "Mixed Scanning". Usually, planning departments use the RCP approach to develop the Official Plan and employ the incremental approach to implement it in daily planning practice.

The main advantage of the incremental planning approach is that according to this approach the problem confronting the decision-maker is continually redefined. This allows for countless end-means and means-ends adjustments that, in effect, make the problem more manageable. Consequently; there is no one decision or "right" solution but a "never-ending series of attacks" on the issues at hand through serial analyses and evaluation. These features make such approach more appropriate for situations where high levels of uncertainties are expected.

Also, incremental planning is more flexible and adaptable to societal changes, which makes it more suitable for planning the urban future in developing countries. In this approach, plans are not constructed by a strict process but by a series of consultations largely based on peoples' actual experiences, needs and aspirations (Hudson 1979). Moreover, large decisions are divided into smaller ones and distributed among a large number of stages and actors who make decisions independently and pursuing their separate interests in the light of the prevailing conditions at each stage. This again makes planning problems more manageable. The state serves as an independent adjudicator seeking compromises between these groups. This process brings out the public interest in the light of the actual socio-economic and technological capabilities of the society (Gunton 1984).

In practice, incremental planning is usually associated with incremental implementation of the proposed plans. The basic idea of incremental implementation is to blur the distinction between the design and implementation phases. The main idea of this approach is founded on the experience-based assumption that design and implementation decisions strongly affect one another, and thus a rigorous separation of design and implementation does not accomplish its goal (section 6.3).

Based on this analysis, and for the purpose of this research focusing on developing countries, incremental planning approach is expected to be highly appropriate for many reasons. First, it best deals with the lack of necessary reliable data in these countries. Second, it provides better chances for the optimal use of financial and environmental resources as it continuously evaluates the socio-economic, technological, and environmental changes in the society. Third, it ensures the gradual transition from the existing to the targeted situations, and consequently protects societies from the unexpected socio-economic impacts of sudden changes.

-Incremental Planning in Egypt

Incremental planning is not applied in planning or implementation of urban development activities in Egypt, either on the local or the regional level. On the local level, and although the development of each new city was set in stages, all these stages are planned and designed in advance with no possibility of modification in the light of the changing socio-economic and technological condition. This is mainly because almost all infrastructure networks, mainly transportation, usually built at one time for the whole city. This predefines the physical form of the city and, to a large extent, its population size. Moreover, the first stage is usually about the half of the city. Also, in many large new cities such as 10th of Ramadan and 6th of October, sparse development activities started in all stages within the first five years of the city development start.

On the regional level, a number of new cities were built together giving no chance for assessment and evaluation. For example, four cities with total target population of about two millions were built almost at the same time around Cairo. This was, in fact, in addition to another six settlements of 250,000 inhabitants each. The large size in addition to the large number of these settlements demonstrates that incrementalism is not applied in Egypt's urban development policy.

B-Indications from the Forecasting Survey:

The statistical analysis presented in section 9.4 reveals that about 93 percent of urban experts consider the gradual development of future settlements as most appropriate, with highest average increase. Almost half of this percentage views this approach as most appropriate (question 14 in Questionnaire III). Moreover, about 56 percent of urban experts consider building the whole settlement at one time as less appropriate, and about 35 (out of this 56 percent) view this approach as least appropriate (Table 8.28, Figure 8.24, and Table A4.17 in Appendix 4). This reflects the high confidence among urban experts about the effectiveness of this approach for developing countries.

The literature review and the statistical analysis of urban experts' responses demonstrate that the proposed incremental planning approach would be effective in managing the urban future in developing countries during the next 30-40 years. Such approach is a necessary approach to deal with uncertainties that will always exist regarding the extent of future technological change and its urban impacts, especially in developing countries where the availability and reliability of information is limited. According to this analysis, the gradual development of these settlements is expected to enable developing countries to be more efficient and more flexible in meeting the expected impressive socio-economic impacts of technology. Also, it ensures the gradual transition from the existing to the targeted situations, and therefore protects societies from the unexpected socio-economic impacts of sudden changes. Moreover, it provides better chances for the optimal use of financial and environmental resources as it continuously evaluates the socio-economic, technological, and environmental changes in the society.

10.4 TECHNOLOGY AND THE FUTURE OF EXISTING SETTLEMENTS

Because of the comprehensive nature of technology impacts on society, technology will introduce considerable changes to the urban system as a whole including existing cities, especially the large ones. To draw a comprehensive idea about future changes in the urban system, the forecasting survey tried to survey the expectations of urban development experts about the expected future changes to the size and functions of these cities.

The statistical analysis of forecasting survey results, presented in section 9.5, shows that the future role of existing cities is expected to face considerable changes, which in turn will produce parallel changes in the size of these settlements. The most expected function for these settlements is to work as regional service centres for education, commercial, or entertainment. Concerning the size, this analysis shows that urban experts expect that the size of the existing cities is likely to decrease. Such decrease means that more people will move out of these settlements towards new urban settlements or existing rural ones.

10.5 CRITIQUE OF METHODS

Although all efforts have been made to apply a rational methodology, now and after having a more comprehensive understanding of the research constraints and results, some points of self-critique have been reached, which could be helpful in advancing future research in this subject. First, the subject 'technology and urban change' is a broad, complex, and debateable issue, which makes the task of this research very hard. However, this broad vision was necessary to reach a comprehensive understanding of the problem and its dimensions and then it would be possible to examine each of these dimensions in more details. Second, although Delphi Technique is an effective and recommended technique in the area of this research, it does not ensure the best possible results. In Delphi Technique, consulted experts are less encouraged to give comments about the raised issues. Such comments are necessary to add depth to the survey results through benefiting more from experts' experiences and recommendations. Also, in Delphi Technique, responses are based, in some cases, on expert's personal interpretations of some of the questions, which may differ from that intended by the researcher. Third, although surveying experts' expectations is important in the area of this research, city-residents expectations and preferences are also important and must be surveyed.

10.6 CONTRIBUTION TO KNOWLEDGE

Through its different stages, this research has made an original contribution to knowledge in five main areas. In the following points, these contributions are listed in the order they are addressed in this thesis.

- The thesis has identified the possible urban impacts of main technological forces (Chapter Three). Although the urban impacts of telecommunications and transportation technologies have been studied before, the main contribution of the thesis in this regard is the identification of the possible urban impacts of renewable energy and urban utilities technologies in developing countries (sections 3.3 and 3.4). In addition, the thesis has verified the possible impacts of these technologies through the forecasting survey. According to the forecasting survey results, there is a high consensus among technology and urban development experts that these technologies will have a considerable impact on shaping the urban future in developing countries (section 9.1). It is highly expected that these technologies will help overcome energy and utilities problems that usually confront urban development in remote and rural areas. These technologies are expected to minimise the role of energy and urban utilities as determining factors in selecting the location and size of future urban settlements.

- The thesis has empirically examined the theory that there is an association between the level of technology prevailing in a society and patterns of urban change in that society. The thesis empirically demonstrated that countries of different technological capabilities present different patterns of urban change regarding the size of urban settlements and the concentration of urban population (section 4.2).

- Although there are some studies that have analysed the possible urban impacts of technology in developing countries, the thesis has went further and investigated how these technologies could be employed for managing urban problems in these countries. The thesis has verified, through the analysis of relevant literature and through the forecasting survey, that future technological achievements are expected to facilitate the implementation of the proposed approaches for managing urban future in developing countries (Chapter Nine).

- The proposed approaches for managing urban future in developing countries constitute an original contribution of the thesis. These approaches are of comprehensive and complementary nature and address a wide array of urban problems in developing countries. Through the forecasting survey, urban experts expect that these approaches will be effective in meeting the comprehensive socioeconomic and urban impacts of technology in developing countries. While urban decentralisation is the ultimate objective, the small-size settlements approach is a necessary tool for achieving urban decentralisation in developing countries. This is while the incremental planning approach deals with uncertainties that will always exist, especially in forecasting the future urban impacts of technology in developing countries. Also, it provides better chances for the optimal use of financial and environmental resources. To the author's knowledge, the thesis was the first to propose and to empirically verify the importance and effectiveness of the incremental planning approach in managing the urban future in developing countries (sections 6.3 and 9.4).

- In addition to defining the appropriate size and function of new urban settlement, the thesis has contributed to knowledge through defining the appropriate function and size of existing cities, especially the large ones. In this regard, the thesis argues that technology achievements will not only affect the new settlements, but it will introduce considerable changes to the urban system as a whole including existing cities, especially the large ones. The thesis, has examined this argument through the forecasting survey. The statistical analysis of forecasting survey results, presented in section 9.5, shows that the future role of existing cities is expected to face considerable changes, which in turn will produce parallel changes in the size of these settlements. The most expected function for these settlements is to work as regional service centres for education, commerce, or entertainment. Concerning the size, this analysis shows that urban experts expect that the size of the existing cities is likely to decrease. Such decrease means that more people will move out of these settlements towards new urban settlements or existing rural ones.

In addition, the research provides a unique methodological tool for the analysis of technology-urban change relationship in developing countries. This methodology has combined both the theoretical analysis of such relationship and the empirical investigation of its current and future impacts. Also, it has combined the development of the necessary approaches for meeting these impacts and the empirical examination of the effectiveness and suitability of these approaches through surveying the opinions and expectation of technology and urban development experts (forecasting survey). To the author's knowledge, the thesis was the first to use such methodology in investigating the urban impacts of technology in developing countries.

10.7 POTENTIALS FOR FUTURE RESEARCH

The comprehensive analysis of technology-urban change relationship presented in this research calls for a more detailed investigation of all the involved factors. The theoretical implication of conceptualising such relationship is the need for constant research on analysing the changing nature and effects of the various factors involved in this process. Also, more research is needed on adapting the proposed approaches to the changing socio-economic and political conditions in developing countries. Also, the research findings pinpoint and highlight several issues for future research, as many questions are still unanswered: What are the best strategies for employing future technological achievements in the implementation of the proposed approaches? How would these approaches affect, and be affected by, ongoing development activities? And what are the possible role of local governments and non-governmental organizations in developing, supporting and evaluating these approaches? These questions remain open for real-life experiences of professionals as well as for research to guide these experiences.

On the empirical side, the proposed approaches open up further areas for future research. Although the research has surveyed the opinions of urban experts, the public opinion of large cities residents in developing countries, regarding their locational-preference and the expected changes to home-work relationship, is also important. Although this research has examined the appropriate size of new settlements in developing countries, more research is still needed regarding the spatial structure, form, and density of these cities. Also, more research is needed in revising current city planning regulations to meet the future impacts of technologies. For Egypt, more studies are needed in defining the possibilities, advantages, and requirements of rural settlements upgrading through the recommended 'rural urbanisation' or 'urban villages' approach.

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Appendix 1

QUESTIONNAIRE I: FORM AND LIST OF PARTICIPATING EXPERTS

Questionnaire I: Form

Sheffield Hallam University

The Centre for the Built Environment

Questionnaire I

For Science and technology Specialists

Technological impacts on the future urban policies

This research aims at defining the impact of technology on shaping the future of urban development in the next 30-40 years. The main purpose of this first questionnaire is to have as many experts as possible engaged in an individual brainstorming process so as to generate as many expectations and comments as possible for dealing with this issue.

Your comments and expectations need not to be fully developed. In fact, it is preferable to have each idea expressed in one brief sentence or phrase. No attempt will be made to evaluate or justify these ideas at this point in time. Your expectations and comments will be anonymously incorporated in the next questionnaire.

---

1. From your wide interests and experience, please indicate all areas of expertise starting by the closest to your field of specialization = 1

	1	2	3	Not relevant
a. Information Technology				
b. Transportation				
c. Energy				
d. Utilities (water, sewer, gas)				
e. Other: Please indicate below				

....

2. Please indicate all areas of expertise starting by the closest to your field of specialization = 1

	1	2	3	Not relevant
a. Research & Development				
b. Design				
c. Production				
d. Management				
e. Other: Please indicate below				

....

3. To what extent do you think current operation and production systems in your field will be changed in the next forty years?

a) No change	
b) Some change	
c) Considerable change	
d) Impressive change	

4. To the best of your knowledge and in your area of expertise, what are the main technological achievements expected to influence the future of urban development in the next 30-40 years? Please start by the most influential achievement and briefly clarify each of your choices.

A) ....
Clarify
....

B) ....
Clarify
....

C) ....
Clarify
....

D) ....
Clarify
....

E) ....
Clarify
....

Please write any comment you think it is important in the area of this research:

....
....
....

If you need any help to answer any question, please do not hesitate to contact me on:

Antar A. Abou-Korin, Centre for the Built Environment, Sheffield Hallam University,
Unit 9, Sheffield Science Park, Howard Street, Sheffield S1 1WB, UK
E-mail: Antar.Abou-Korin@shu.ac.uk
Tel.: 0044-114-279-9601 Fax 0044-114-225-3206

We need to contact you to provide you with the results of this questionnaire and to complete the second phase of it. So, it will be very kind of you if you can provide us with your e-mail address and URL (it is completely confidential):

E-mail: .... URL: ....
Name: .... Job title: ....

Thank you

The form is posted online at: http://www.shu.ac.uk/schools/research/cbe/feedback/korin/

Questionnaire I: List of Participating Experts

Name	Affiliation
Jean Rosenfeld	Chairperson-2000, The UK SOLAR ENERGY Society, UK
Steve Wiese	Conservation Services Group- Associate Members, Texas, USA
Brian Norton	Dean of the Faculty of Engineering, University of Ulster, UK
Peter L Pfeiffer	Architect and renewable energy system consultant, Barley + Pfeiffer Architects, Texas, USA
Oliver Carsten	Director of Research, Institute for Transport Studies, Univ. of Leeds, UK
Kim Chowns	DTLR - Department of Transport, Local Government and Regions, UK
Geoff Parker	Junior Vice Chairman, Chartered Institution of Water and Environmental Management, UK
Euan Robertson	Online Communications Manager, British Energy, UK
G Hegeman	Institute for Transport Studies- University of Leeds, UK.
Hardev Singh	Executive Director, Videsh Sanchar Bhavan, India
Matthew Page	Institute for Transport Studies- University of Leeds, UK
Juan S. Santos	Senior Consultant, System Planning, Electric Reliability Council of Texas, USA
Brian J. Reithel.	President, The Association of Information Technology Professionals, USA
Carol Harwell	Product Development, Austin Energy, USA
Graham Soult	Research Fellow, Centre for Urban Technology, University of Newcastle, UK
Stas Burek	Committee member, UK SOLAR ENERGY SOCIETY, Dept of Energy & Environmental Technology, Glasgow Caledonian University, UK
Rodrigo Firmino	Researcher, Centre for Urban Technology, University of Newcastle, UK
Peter Rogers	Lecturer, Centre for Urban Technology, University of Newcastle, UK
Greg Nemet	Research Manager, Institute for the Future, USA
Mike Bramhall	Professor, School of Engineering, Sheffield Hallam University, UK
Tony Free	British Energy, UK
C Hague	Lecturer, School of Engineering, Sheffield Hallam University, UK
Nigel Mortimer	Head of Resources Research Unit, School of Environment and Dev., Sheffield Hallam Univ., UK
Ashley Dobbs	Director, Telework Association, UK
Bala A Kumar	Head, Precision Interconnect India Pvt Ltd, India
John Grant	Resource Associate, School of Environment and Dev., Sheffield Hallam Univ., UK
David Alsmeyer	Information Services Manager, BTexact Technologies, UK
Ben Azvine	Head of Computational Intelligence Research, BTexact Technologies, UK
Ian Pearson	Futurologist, BTexact Technologies, UK
Gordon Dabinett	Reader in Urban & Regional Policy, School of Environment and Development, Sheffield Hallam University, UK
Maha Elsayed	Research Associate, School of Environment and Dev., Sheffield Hallam Univ., UK
Michael Reaney	Research fellow, School of Environment and Dev., Sheffield Hallam Univ., UK
Bob Briscoe	Head of Edge Lab, BTexact Technologies, UK
Robert Janssen	Hydraulic Engineer, Betchtel Group, USA
Ray Quay	Assistant Director of Planning in Phoenix, Arizona, USA

Appendix 2

QUESTIONNAIRE II: FORM AND LIST OF PARTICIPATING EXPERTS

Questionnaire II: Form

Sheffield Hallam University

The Centre for the Built Environment

Questionnaire II

For Science and technology Specialists

Hello;

This research aims at defining the impact of technology on shaping the future of urban development. The main purpose of this questionnaire is to exploit expectations of science and technology specialists for 30-40 year time horizon under the rapidly changing technology affecting the urban environment. In doing so, Delphi technique is employed.

Your opinion is highly important to us. It would be very kind if you have some time to complete this questionnaire. Because of the multidisciplinary nature of this research, this questionnaire may not exactly match your experience. **Please answer those questions you feel comfortable with.**

We do appreciate you help and looking forward to hearing from you

Best Regards;

Antar A. Abou-Korin,
Centre for the Built Environment, Sheffield Hallam University
Unit 9, Sheffield Science Park, Howard Street, Sheffield S1 1WB, UK
E-mail: Antar.Abou-Korin@shu.ac.uk
Tel.: 0044-114-279-9601, 0044-7766026632 (mobile) Fax: 044-114-225-3206

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1. From your wide interests and experience, please indicate all areas of expertise starting by the closest to your field of specialization = 1

a) Information Technology .... ( )
b) Transportation .... ( )
c) Energy .... ( )
d) Utilities (water, sewer, gas) .... ( )
e) Other: *please indicate below* .... ( )
....

---

2. Please indicate all areas of expertise starting by the closest to your field of specialization = 1

a) Research & Development .... ( )
b) Design .... ( )
c) Production .... ( )
d) Management .... ( )
e) Consultancy...................................... ( )
f) Other: *please indicate below* .... ( )
....

---

3. To what extent you think current operation and production systems in your field will be changed in the next forty years?

a) No change...................................... ( )
b) Some change...................................... ( )
c) Considerable change .... ( )
d) Impressive change...................................... ( )

Note: In answering some of the following questions, please note that:
0 = no change 1 or -1 equivalent to < 20% of change 2 or -2 equivalent to = 21-50% of change
3 or -3 equivalent to > 50% of change No Op.= No Opinion or do not know

4. How much do you expect technological achievements to influence the urban life in the next forty years?

	← Decrease				Increase →			No Op.
a) Total amount of time spent travelling for work and other daily activities	-3	-2	-1	0	1	2	3	
b) Interdependence between place residence and work location	-3	-2	-1	0	1	2	3	
c) Settling in remote or uninhabited areas	-3	-2	-1	0	1	2	3	
d) Commuting distance between home and work	-3	-2	-1	0	1	2	3	
e) The Use of public transportation	-3	-2	-1	0	1	2	3	
f) Private transportation ownership	-3	-2	-1	0	1	2	3	

5. In the area of urban transportation, how much do you expect technological advancements to affect the following aspects?

	← Decrease				Increase →			No Op.
a) Vehicle speed	-3	-2	-1	0	1	2	3	
b) Vehicle capabilities and safety (Navig. systems, etc.)	-3	-2	-1	0	1	2	3	
c) The role of private transportation	-3	-2	-1	0	1	2	3	
d) The role of public transportation at local level	-3	-2	-1	0	1	2	3	
e) The role of Public transportation at regional level	-3	-2	-1	0	1	2	3	
f) The role of public air transportation	-3	-2	-1	0	1	2	3	
g) The role of private air transportation	-3	-2	-1	0	1	2	3	

6. To the best of your knowledge, how much do you expect renewable energy sources (solar, wind,. etc) to affect the following aspects?.

	← Decrease				Increase →			No Op.
a) Dependence on fossil fuels	-3	-2	-1	0	1	2	3	
b) The cost of renewable-energy production (solar, wind)	-3	-2	-1	0	1	2	3	
c) Settling out of congested areas	-3	-2	-1	0	1	2	3	
d) The cost of energy supply networks (solar, wind)	-3	-2	-1	0	1	2	3	
e) The freedom of locating new urban communities	-3	-2	-1	0	1	2	3	

7. In the area of utilities, to what extent do you expect technological advancements to affect the following aspects?.

	← Decrease				Increase →			No Op.
a) Introduction of new techniques for water purification	-3	-2	-1	0	1	2	3	
b) Introduction of new techniques for sanitary treatment	-3	-2	-1	0	1	2	3	
c) Introduction of small water & sanitary treatment units	-3	-2	-1	0	1	2	3	
d) Facilitation of settling remote areas	-3	-2	-1	0	1	2	3	
e) Environmental improvement of rural communities	-3	-2	-1	0	1	2	3	

8. In the area of telecommunication and information technology, to what extent do you expect technological advancements in the next 30-40 years to affect the following aspects?

	← Decrease				Increase →			No Op.
a) Home-based work	-3	-2	-1	0	1	2	3	
b) Remote education (open univ., teleconferencing)	-3	-2	-1	0	1	2	3	
c) Online shopping	-3	-2	-1	0	1	2	3	
d) Home entertainment	-3	-2	-1	0	1	2	3	
e) Concentration of business activities in CBD of existing cities	-3	-2	-1	0	1	2	3	
f) Preserve current working conditions	-3	-2	-1	0	1	2	3	
g) Congestion of existing urban centres	-3	-2	-1	0	1	2	3	
h) The ability to settle in remote areas	-3	-2	-1	0	1	2	3	

9. To the best of your knowledge, how much do you expect future impact of technological achievements to alter the urban pattern?

	← Decrease				Increase →			No Op.
l) Dispersion of urban population to the suburbs	-3	-2	-1	0	1	2	3	
m) Dispersion of urban population to rural settlements	-3	-2	-1	0	1	2	3	
n) Concentration of population in few urban centres	-3	-2	-1	0	1	2	3	
o) Emergence of remote isolated urban communities	-3	-2	-1	0	1	2	3	
p) The size of future new urban settlements	-3	-2	-1	0	1	2	3	
q) The future size of existing cities	-3	-2	-1	0	1	2	3	

10. How much do you expect the rate of transferring these technological achievements to affect urban life in progressive developing countries in the next 30-40 years?.

a) No change .... ( )
b) Decrease .... ( )
c) Some increase .... ( )
d) Considerable increase .... ( )
e) Impressive increase .... ( )

11. Regarding technology transfer to developing countries, how much do you think it had been in the past ten years and how much do you expect it will be in the next 30-40 years?

	← Decrease				Increase →			No Op.
i) The future importance of markets in Developing countries	-3	-2	-1	0	1	2	3	
j) Transfer of telecommunication technologies in past ten years	-3	-2	-1	0	1	2	3	
k) Transfer of telecommunication technologies in next 30-40 years	-3	-2	-1	0	1	2	3	
l) Transfer of transportation technologies in the past ten years	-3	-2	-1	0	1	2	3	
m) Transfer of transportation technologies in next 30-40 years	-3	-2	-1	0	1	2	3	
n) Transfer of utility technologies in the past ten years.	-3	-2	-1	0	1	2	3	
o) Transfer of utility technologies in the next 30-40 years.	-3	-2	-1	0	1	2	3	
p) The future importance of developing countries markets in technology transfer in the next 30-40 years.	-3	-2	-1	0	1	2	3	

Please write any comment you think it is important in the area of this research:

....

....

....

We need to contact you to provide you with the results of this questionnaire and to complete the next phase of it. So, it will be very kind if you can provide us with your contact details (it is completely confidential):

Name: .... *Job title:* ....

E-mail: ....

Work Address: ....

Tel.: .... *Fax:* ....

• Please put this questionnaire in the attached addressed and stamped envelope and mail it back to us.

Thank you

The form is posted online at: http://homepages.shu.ac.uk/~aaboukor/Questionnaire%202.htm

Questionnaire II: List of Participating Experts

Name	Affiliation
Geoff Parker	J. Vice Chairman, Chartered Institution of Water and Environmental Management, UK
Steve Wiese	Senior Consulting Manager, Conservation Services Group, utilities, USA
Kim Chowns	Policy Advisor, Environmental Impact Assess. Branch, Office of Dep. Prime Minister, UK
Rodrigo Firmino	Researcher, Centre for Urban Technology, University of Newcastle Upon Tyne, UK
Matthew Page	Senior Research Fellow, Institute for Transport Studies, University of Leeds, UK
Romesh Kumar	Manager, Fuel Cell Technology, Argonne National Laboratory, USA
Steven Plotkin	Transportation energy analyst, Argonne National Laboratory, USA
Jamal Abed	Assoc. Prof. , American University of Beirut, Lebanon
Tarek Kazzaz	Associate Professor, American University of Beirut, Lebanon
Margaret Singh	Transportation energy analyst, Argonne National Laboratory, USA
Safwan Khedr	Professor and Chairman, Engineering, American University in Cairo, Egypt
Christopher Saricks	Transport. Systems Analyst, Argonne National Laboratory, U.S. Depart. of Energy, USA
Mahmoud Farag	Professor of Materials Engineering, American Univ. in Cairo, Egypt
Stuart Woodings	Analyst, British Energy, UK
Keith Smith	professor, Institute for New Technology, UN University, Netherlands
Lakshminarayanan	Chief Technical Adviser, Electronics Corporation of Tamil Nadu Limited, India
Wu Kwok Cheung	senior chemist, Sewage Treatment Division, Hong Kong
A.Sluzek	Associate Prof., Computer Engineering, Nanyang Technological Univ., Singapore
H.L. Al-Saedy	Prof . of IT, Faculty Of Computer Science and Engineering, Ajman University of Science and Technology, United Arab Emirates
I M Dharmadasa	Reader in Applied Physics, School of Science & Math., Sheffield Hallam Univ., UK
JP Singh	Senior General Manager,Videsh Sanchar Nigam Limited, Mumbai, India
Wolf-Dieter Munz	Professor, School of Engineering, Sheffield Hallam University, UK
J.L.J. Rosenfeld	Chairperson, The UK SOLAR ENERGY Society, UK
Bill Barraclough	Senior Lecturer, School of Engineering, Sheffield Hallam Univ., UK
Simon Marvin	Co-Director, The Centre for Sustainable Urban and Regional Futures, Salford Univ.- and Associate Member at Centre for Urban Technology, Univ. of Newcastle Upon Tyne, UK
Juan S. Santos	Senior Consultant - System Planning, Electric Reliability Council of Texas, USA
Alison Hill	Head of Communications, British Wind Energy Association, UK
Po-Han Chen	Assistant Prof., Civil and Envir. Eng., Nanyang Technological Univ., Singapore
N. Chaudhari	Associate Prof., Computer Engineering, Nanyang Technological Univ., Singapore
John Grant	Research Associate, Resources Research Unit, Sheffield Hallam University, UK
Age Mariussen	S. research fellow, Studies in technology, Innovation & Economic Policy, STEP, Norway
Francis Wilson	Ass. Prof., School of Civil and Environmental Eng., Nanyang Techn. Univ., Singapore
K. Anthony Jones	Senior Lecturer, Computer Engineering, Nanyang Technological Univ., Singapore
I M Robinson	Professor, School of Engineering, Sheffield Hallam University, UK
Hugh Lockhart-Ball	Committee Member, The UK SOLAR ENERGY Society, UK
Jamal Khatib	S. Lecturer; environment, water; School of Environment and Dev., Sheffield H. Univ., UK
Dan Davies	Develop. Engineering, Solar Century Co., UK
Lucy Southgate	Committee member-The UK SOLAR ENERGY Society, UK
Roger Booth	Consultant, Solar Century Co., UK
Peter W. Bonsall	Professor of Transport Planning, Institute for Transport Studies, Univ. of Leeds, UK
Chris A. Nash	Professor of Transportation, Institute for Transport Studies, Univ. of Leeds, UK
Tim Evans	Branch Chairman, Chartered Institution of Water and Environ. Management, UK
Toby Lee	Project Developer, AMEC Wind, UK
Brian Norton	Committee Member, UK Solar Energy Society & Dean, Fac. of Eng., Ulster Univ., UK
Niek Neal	Consultant, ESD Ltd, UK
A. Chisholm	Policy Officer, Chartered Institution of Water & Environmental Management, UK
Mark Standeven	Consultant, ESD Ltd, UK
David Bridger	Energy Consultant, ESD Ltd, UK
Ray Tillier	J. Vice-Chairman, Chartered Institution of Water and Environmental Management, UK
Tessa Tennant	Director of Companies, Solar Century, UK

Appendix 3

QUESTIONNAIRE III: FORM AND LIST OF PARTICIPATING EXPERTS

Questionnaire III: Form

Sheffield Hallam University
The Centre for the Built Environment

Questionnaire III
For Urban Academics, City Planners & Officials and Architects

Technology impacts on the future urban policies

Dear ....

This is a research questionnaire about the future impacts of the rapidly changing technology on urban development in developing countries. Through this questionnaire, we would like to survey the expectations of urban development specialists for the next 30-40 years.

Because of your high research profile in the area of this study, your opinion is very important to us. It would be very kind if you have some time to complete this short questionnaire.

We do appreciate you help and looking forward to hearing from you

Best Regards;

Antar A. Abou-Korin, Research Fellow, Centre for the Built Environment, Sheffield Hallam University
Unit 9, Sheffield Science Park, Howard Street, Sheffield S1 1WB, UK
E-mail: *Antar.Abou-Korin@shu.ac.uk*,
Tel.: 0044-114-279-9601, 0044-7766026632 (mobile), Fax: 0044-114-225-3206

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1. From your wide interests and experience, please indicate all areas of expertise starting by the closest to your field of specialization = 1

	1	2	3	Not relevant
a. Urban Academic				
b. City Planner				
c. City Planning Official				
d. Architect				
e. Other: Please indicate below				

---

2. To what extent do you think future technological advancements will affect urban development in developing countries in the next 30-40 years?
    a) Nil or un-measurable effect .... ( )
    b) Some effect (less than 20%) .... ( )
    c) Medium effect (20-50%) .... ( )
    d) Considerable effect (50-70%) .... ( )
    e) Impressive effect (more than 70%) .... ( )

---

3. To the best of your knowledge, what are the main technological advancements you expect to influence the future urban development policies? Please start by what you think the most influential.
    a) .... ( )
    b) .... ( )
    c) .... ( )
    d) .... ( )

Please give a brief description of the most important one:

....

Note: In answering some of the following questions, please note that:

1 or -1 equivalent to < 20% of change
2 or -2 equivalent to > 21-50% of change
3 or -3 equivalent to > 50% of change
No Op.= No Opinion or do not know

4. How do you expect future technological advancements to influence the following urban life aspects in the next forty years?

	← Decrease				Increase →			No Op.
a) Total amount of time spent travelling for work and other daily activities.	-3	-2	-1	0	1	2	3	
b) Interdependence between place of residence and work location	-3	-2	-1	0	1	2	3	
c) Settling in remote or uninhabited areas.	-3	-2	-1	0	1	2	3	
d) Commuting distance between home and work.	-3	-2	-1	0	1	2	3	
e) The Use of public transportation.	-3	-2	-1	0	1	2	3	
f) Private transportation ownership.	-3	-2	-1	0	1	2	3	
g) Attractiveness of urban centre to rural population.	-3	-2	-1	0	1	2	3	
h) Attractiveness of rural centre to urban population.	-3	-2	-1	0	1	2	3	

5. In the area of urban transportation, how do you expect technological advancements to affect the following aspects in developing countries?

	← Decrease				Increase →			No Op.
a) Vehicle speed	-3	-2	-1	0	1	2	3	
b) Vehicle capabilities and safety (Navigation systems, .etc.)	-3	-2	-1	0	1	2	3	
c) The role of private transportation.	-3	-2	-1	0	1	2	3	
d) The role of public transportation at local level	-3	-2	-1	0	1	2	3	
e) The role of Public transportation at regional level	-3	-2	-1	0	1	2	3	
f) The role of public air transportation	-3	-2	-1	0	1	2	3	
g) The role of private air transportation	-3	-2	-1	0	1	2	3	
h)h) Population Mobility	-3	-2	-1	0	1	2	3	
i) i) The ability to settle in remote areas	-3	-2	-1	0	1	2	3	

6. To the best of your knowledge, to what extent do you expect renewable energy sources (solar, wind,. etc) to affect the following aspects in developing countries?

	← Decrease				Increase →			No Op.
a) Dependence on fossil fuels	-3	-2	-1	0	1	2	3	
b) The cost of renewable-energy production (solar, wind)	-3	-2	-1	0	1	2	3	
c) Settling out of congested urban areas	-3	-2	-1	0	1	2	3	
d) The cost of energy supply networks (solar, wind)	-3	-2	-1	0	1	2	3	
e) The ability to settle in remote areas	-3	-2	-1	0	1	2	3	

7. In the area of utilities, to what extent do you expect technological achievements to affect the following aspects?

	← Decrease				Increase →			No Op.
a) Introduction of new techniques for water purification	-3	-2	-1	0	1	2	3	
b) Introduction of new techniques for sanitary treatment	-3	-2	-1	0	1	2	3	
c) Introduction of small water & sanitary treatment units	-3	-2	-1	0	1	2	3	
d) Facilitation of settling remote areas	-3	-2	-1	0	1	2	3	
e) Environmental improvement of rural communities	-3	-2	-1	0	1	2	3	

8. In the area of telecommunication and information technology, to what extent do you expect technological achievements in the next 30-40 years to affect the following aspects in developing countries?

	← Decrease				Increase →			No Op.
a) Home-based work	-3	-2	-1	0	1	2	3	
b) Remote education (open universities, teleconferencing)	-3	-2	-1	0	1	2	3	
c) Remote social interaction (video phones, internet, ...)	-3	-2	-1	0	1	2	3	
d) Online shopping	-3	-2	-1	0	1	2	3	
e) Home entertainment	-3	-2	-1	0	1	2	3	
f) Concentration of businesses in CBD of existing cities	-3	-2	-1	0	1	2	3	
g) Change in current work conditions.	-3	-2	-1	0	1	2	3	
h) Congestion of existing urban centres	-3	-2	-1	0	1	2	3	
i) The cost of telephone and energy networks.	-3	-2	-1	0	1	2	3	
j) The ability to settle in remote areas	-3	-2	-1	0	1	2	3	

9. To the best of your knowledge, how much do you expect future technological achievements to alter the movement of urban population in developing countries?

	← Decrease				Increase →			No Op.
a) Concentration of population in few urban centres	-3	-2	-1	0	1	2	3	
b) Dispersion of urban population to rural settlements	-3	-2	-1	0	1	2	3	
c) Dispersion of urban population to the suburbs	-3	-2	-1	0	1	2	3	
d) Dispersion of urban population to new urban communities around existing large urban centres	-3	-2	-1	0	1	2	3	
e) Dispersion of urban population to new remote urban communities	-3	-2	-1	0	1	2	3	

10. To the best of your knowledge, how do you expect the function of future urban settlement to be?

	← Least likely				Most Likely →			No Op.
a) Single specialised function (IT, commercial, Health, education, industrial, etc.)	-3	-2	-1	0	1	2	3	
b) Multiple related functions (IT & education, etc)	-3	-2	-1	0	1	2	3	
c) Multiple unrelated functions	-3	-2	-1	0	1	2	3	
d) Centre for location-bound activities (tourism, mining, .)	-3	-2	-1	0	1	2	3	

11. To the best of your knowledge, what are the probable ways for the provision of services (education, health, shopping, etc.) in future new urban settlements?

	← Least likely				Most Likely →			No Op.
a) Introduction of specialised service centres in every settlement	-3	-2	-1	0	1	2	3	
b) Introduction of specialised service centres between a group of cities	-3	-2	-1	0	1	2	3	
c) Incorporation of primary services in every settlement	-3	-2	-1	0	1	2	3	
d) Emergence of new forms for the provision of some services (Education, health, police, etc.), please give example below	-3	-2	-1	0	1	2	3	

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12. Regarding location of future new urban settlements, to what extent do you expect they would be more likely located? Please tick one only.

a) Less than 10 km away from a large urban centre	
b) 10 – 20 km away from a large urban centre	
c) More the 20 km away from a large urban centre	
d) Freely located	

13. The future new urban settlement could be of different sizes, which of the following you consider to be the most appropriate in the next 30-40 years?

	← Least likely					Most Likely →		No Op.
a) Very small (<1,000 inhabitants, Group of families, environmental considerations)	-3	-2	-1	0	1	2	3	
b) Small settlements (1,000-5,000 inhabitants, that support the economic provision of primary services)	-3	-2	-1	0	1	2	3	
c) Medium urban centres. (5,000-10,000 inhabitants)	-3	-2	-1	0	1	2	3	
d) Large urban centres (10,000-20,000 inhabitants)	-3	-2	-1	0	1	2	3	
e) Very Large Urban Centres (20,000-50,000 inhabitants)	-3	-2	-1	0	1	2	3	
f) Other: please indicate below	-3	-2	-1	0	1	2	3	

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14. The development of future new urban settlement could take different approaches, which of the following do you consider to be the most appropriate in the next 30-40 years?

	← Least likely					Most Likely →		No Op.
a) Whole settlement built in one time	-3	-2	-1	0	1	2	3	
b) Gradually built	-3	-2	-1	0	1	2	3	
c) Expansion in the form of new suburbs	-3	-2	-1	0	1	2	3	
d) Expansion in the form of new independent urban units	-3	-2	-1	0	1	2	3	

15. In your opinion, and in the light of the rapid technological change, how will the size of existing urban settlements change in the next 30-40 years?

	← Least likely					Most Likely →		No Op.
a) Continue to increase	-3	-2	-1	0	1	2	3	
b) Decrease	-3	-2	-1	0	1	2	3	
c) Will not be affected	-3	-2	-1	0	1	2	3	

16. For developing countries, how do you expect the future function of existing urban settlements in the next 30-40 years?

	← Least likely					Most Likely →		No Op.
a) Regional service centres (education, commercial, entertainment)	-3	-2	-1	0	1	2	3	
b) Continue performing the same functions	-3	-2	-1	0	1	2	3	
c) New Functions (*please specify below*)	-3	-2	-1	0	1	2	3	

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Please write any comment you think it is important in the area of this research:

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We may need to contact you to discuss some of your comments. So, it will be very kind of you if you can provide us with your contact details (it is completely confidential):

Name: .... *Job title:* ....

E-mail: .... *Tel.:* .... *Fax:* ....

Thank you

This form is posted online at: http://homepages.shu.ac.uk/~aaboukor/Questionnaire%202.htm

Questionnaire III: List of Participating Experts

Name	Affiliation
Hazem A. Hammad	Assistant Professor, Dept. of Arch. Assiut University, Egypt
Ashraf M. Soliman	Assistant Professor, Dept. of Archit., Minia Univ., Egypt
Mahmoud A Abdellatif	Professor, Dept. of Arch. Assiut University, Egypt
Mohamed Sadek	Associate Professor, Faculty of Eng., Port Said, Egypt
Mohamed M. Maatouk	Assistant Professor, Dept. of Archit., Minia Univ., Egypt
Ibrahim Alshaye	Environmental Planner, Arriyadh Development Authority, Riyadh, Saudi Arabia
Mamdouh Ali Yousef	Asociate Professor, Dept. of Arch. Assiut University, Egypt
Safwan Assaf	Associate Professor, College of Architecture, Al-Baath University, Homs, Syria.
Kevin Keller	Associate Planner, City of Los Angeles, American Planning Association, USA
Phil Winters	TDM Program Director, Urban Transport Research Centre, Univ. South Florida, USA
Gary Brosch	Research Associate, Urban Transport Research Centre, Univ. South Florida, USA
Ed Bart	Research Associate, Urban Transport Research Centre, Univ. South Florida, USA
Bruce Tonn	Professor, Graduate School of Planning, University of Tennessee, USA
Umar G. Benna	Professor, College of Architecture and Planning, King Faisal University, Saudi Arabia
Steven Polzin	Director - Public Transp., Urban Transport Research Centre, Univ. of South Fl., USA
Jean-Paul Rodrigue	Assistant Professor, Dept. of Geography, The Hofstra University, USA
Steve Fotios	S. lecturer, Architecture group, Sch. of Env. and Dev., Sheffield Hallam Univ., UK
Steve Sharples	Professor - Urban Policy - Unit 9 Science Park, Sheffield Hallam Univ., UK
Jeremy Dawkins	Convenor Centre for Sydney, UNSW Sydney NSW 2052 Australia
Anna de Jager	Lecturer, Univ. of South Africa, Dept. of Geography and Environment, South Africa
Babar Aruna	Reader in Housing Studies, Development Planning Unit, Bartlett Faculty of the Built Environment - Univ. College London, UK
Anna Soave	Teacher, Development Planning Unit, Bartlett Faculty of the Built Environment - University College London, UK
S. Yirenkyi-Boateng	Professor, Dept. of Geography, University of South Africa.
Amany Nagi	Lecturer Assistant, Dept. of Archit., Minia Univ., Egypt
Alison Todes	Prof., School of Architecture, Planning & Housing, University of Natal, South Africa
Michael Kahn	Professor, School of Architecture, Planning & Housing, Univ. of Natal, South Africa
Nancy Odendaal	S. Lecturer, School of Architecture, Planning & Housing, Univ. of Natal, South Africa
Mike Batty	Professor of Spatial Analysis and Planning, Director of Centre for Advanced Spatial Analysis, UCL, London, UK
Karol A. Megalla	City Planner, City Council, Minia, Egypt
Laurette Coetzee	Board Member, The South African Planning Institution, South Africa
Ted Kitchen	Professor of Planning and Urban Regeneration, School of Environment and Development, Sheffield Hallam University, UK
Pieter Swanepoel	Chairperson of Association of Municipal Planners, South Africa
Khaled Abdelhalim	Assistant Professor, Dep. of Architecture, Helwan University, Egypt
Manar Ali Mohamed	Architect, Dept. of Archit., Minia Univ., Egypt
Richard Cardew	Associate Prof, Head of Real Estate program, Urban & Regional Studies, University of New South Wales, Australia
Paul Sanders	lecturer - architect, University of Natal - Durban, South Africa
Percy Langa	Board Member, The South African Planning Institution, South Africa
R Odney Harber	Prof., School of Architecture, Planning, and Housing, Univ. of Natal, South Africa
M. Schoonraad	Lecturer, Department of Town and Regional Planning, Univ. of Pretoria, South Africa
Amal Y. Mohamed	City Planner, City Council, Minia, Egypt
Mashary A. Al-Naim	Assistant Prof., College of Arch. & plan., KFU, Saudi Arabia
Alethea Duncan- Brown	Senior lecturer, University of Natal , Durban, School of Architecture, South Africa
Aymen Hashem Alsayed	Lecturer, Dept. of Architecture, Assiut University, Egypt
Mohamed Ayman Daef	Associate Professor, Dept. of Architecture, Assiut University, Egypt

Continued......

Questionnaire III: List of Participating Experts - *Continued*

Name	Affiliation
Michelle van der Molen	Director, The South African Planning Institution, South Africa
Ndaba Ndzombane	Director, Eastern Cape Chairman, South African Planning Institution, South Africa
Ahmed O. El-Kholei	Professor of Urban Planning, Faculty of Eng. Menofia University, Egypt
Hannes Lerm	Town and Reg. Planner, Chairman, South African Planning Institution, South Africa
Ahmed Y. Rashed	Assistant Prof., United Arab Emirates University, Arch Dept. , UAE
Dalia Shawky Soryal	City Planner, City Council, Minia, Egypt
Khaled S. Owaiss	Architect, Dept. of Archit., Minia Univ., Egypt
Gordon Dabinett	Reader in Town & Regional Planning, University of Sheffield, UK
Beverly Ward	Director for Ethnography and Transport Systems, Centre for Urban Transport Research, University of South Florida, USA
Talal AL-Harigi	City Planner / Facility Engineer, K. Saudi Arabia
Ahmad M. Hamada	City Planner, City Council, Aswan, Egypt
Paul Syms	Professor of Urban Land Use, Sheffield Hallam Univ., UK
Jenny Dixon	Professor, Dept of Planning, University of Auckland, New Zealand
Heba Hassan	Architect, Dept. of Archit., Minia Univ., Egypt
Hugh Reynolds	Visiting research fellow, School of Environment & Dev., Sheffield H. Univ., UK
Mohamed M. Kamal	Architect, Dept. of Archit., Minia Univ., Egypt
Dalia M. El Shreef	City Planner, City Council, Minia, Egypt
Francis W. Wambalaba	Research Faculty, Urban Transport Research Centre, Univ. South Florida, USA
Essam Abdel Aziz	Assistant Professor, City Council, Minia, Egypt
S. Baylis	Town Planner, Gauteng Chairman, South African Planning Institution, South Africa

Appendix 4

FREQUENCY DISTRIBUTION OF RESPONSES TO QUESTIONNAIRES II AND III

A4.1 Frequency Distribution of Responses to Questionnaire II

Table A4.1: Frequency distribution of responses to the expected influence of technological achievements on urban life during the next 30-40 years

Level of Change	A		B		C		D		E		F	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	1	1.75	6	10.53	3	5.26	0	0.00	1	1.75	2	3.51
-2	15	26.32	19	33.33	1	1.75	7	12.28	3	5.26	2	3.51
-1	11	19.30	9	15.79	6	10.53	9	15.79	9	15.79	5	8.77
0 = no change	9	15.79	2	3.51	10	17.54	3	5.26	7	12.28	12	21.05
1	8	14.04	7	12.28	16	28.07	13	22.81	16	28.07	15	26.32
2	7	12.28	11	19.30	18	31.58	20	35.09	13	22.81	11	19.30
3	4	7.02	2	3.51	3	5.26	4	7.02	7	12.28	8	14.04
Total	55	96.49	56	98.25	57	100.00	56	98.25	56	98.25	55	96.49

Freq. = Frequency V. % = Valid percent A, B, C, D, E, F = question 4 variables

Table A4.2: Frequency distribution of responses to the expected impacts of advancements in urban transport technologies

Level of Change	A		B		C		D		E		F		G	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	2	3.51	0	0.00	1	1.75	0	0.00	0	0.00	1	1.75	1	1.75
-2	4	7.02	0	0.00	4	7.02	4	7.02	1	1.75	0	0.00	0	0.00
-1	4	7.02	0	0.00	5	8.77	4	7.02	5	8.77	3	5.26	6	10.53
0 = no change	19	33.33	3	5.26	10	17.54	6	10.53	8	14.04	9	15.79	16	28.07
1	16	28.07	10	17.54	20	35.09	20	35.09	14	24.56	19	33.33	18	31.58
2	8	14.04	25	43.86	13	22.81	15	26.32	17	29.82	11	19.30	6	10.53
3	2	3.51	19	33.33	4	7.02	8	14.04	11	19.30	11	19.30	3	5.26
Total	55	96.49	57	100.0	57	100.0	57	100.0	56	98.25	54	94.74	50	87.72

Freq. = Frequency V. % = Valid percent A, B, C, D, E, F, G = question 5 variables

Table A4.3: Frequency distribution of technology experts' responses to the expected impacts of renewable energy technologies (solar, wind,. etc)

Level of Change	A		B		C		D		E	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	8	14.04	7	12.28	0	0.00	1	1.75	3	5.26
-2	16	28.07	22	38.60	1	1.75	14	24.56	2	3.51
-1	23	40.35	19	33.33	4	7.02	21	36.84	6	10.53
0 = no change	2	3.51	3	5.26	19	33.33	6	10.53	18	31.58
1	3	5.26	5	8.77	13	22.81	9	15.79	14	24.56
2	5	8.77	0	0.00	11	19.30	3	5.26	9	15.79
3	0	0.00	1	1.75	3	5.26	1	1.75	2	3.51
Total	57	100.00	57	100.00	51	89.47	55	96.49	54	94.74

Freq. = Frequency V. % = Valid percent A, B, C, D, E = question 6 variables

Table A4.4: Frequency distribution of technology experts' responses to the expected change in urban utilities technologies

Level of Change	A		B		C		D		E	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
-2	0	0.00	0	0.00	0	0.00	1	2.17	2	4.35
-1	0	0.00	0	0.00	0	0.00	2	4.35	2	4.35
0 = no change	4	8.70	3	6.52	5	10.87	9	19.57	6	13.04
1	12	26.09	19	41.30	18	39.13	15	32.61	19	41.30
2	18	39.13	17	36.96	11	23.91	13	28.26	16	34.78
3	8	17.39	4	8.70	8	17.39	6	13.04	1	2.17
Total	42	91.30	43	93.48	42	91.30	46	100.00	46	100.00

Freq. = Frequency V. % = Valid percent A, B, C, D, E = question 7 variables

Table A4.5: Frequency distribution of technology experts' responses to the expected impacts of telecommunication and information technologies

Level of Change	A		B		C		D		E		F		G	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	0	0.00	0	0.00	0	0.00	0	0.00	4	7.02	4	7.02	2	3.51
-2	0	0.00	0	0.00	0	0.00	0	0.00	5	8.77	12	21.05	4	7.02
-1	0	0.00	0	0.00	0	0.00	0	0.00	18	31.58	24	42.11	19	33.33
0 = no change	3	5.26	2	3.51	0	0.00	0	0.00	4	7.02	7	12.28	11	19.30
1	13	22.81	13	22.81	17	29.82	13	22.81	10	17.54	5	8.77	12	21.05
2	28	49.12	26	45.61	24	42.11	19	33.33	9	15.79	1	1.75	4	7.02
3	13	22.81	16	28.07	15	26.32	25	43.86	1	1.75	0	0.00	2	3.51
Total	57	100.0	57	100.0	56	98.25	57	100.0	51	89.47	53	92.98	54	94.74

Freq. = Frequency V. % = Valid percent A, B, C, D, E, F, G = question 8 variables

Table A4.6: Frequency distribution of technology experts' responses to the expected impacts of overall technological achievements on urban patterns

Level of Change	A		B		C		D		E		F	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	1	1.82	0	0.00	0	0.00	2	3.64	1	1.82	0	0.00
-2	6	10.91	2	3.64	1	1.82	0	0.00	3	5.45	3	5.45
-1	11	20.00	5	9.09	7	12.73	4	7.27	12	21.82	7	12.73
0 = no change	9	16.36	12	21.82	11	20.00	12	21.82	9	16.36	9	16.36
1	17	30.91	18	32.73	22	40.00	18	32.73	11	20.00	20	36.36
2	10	18.18	15	27.27	8	14.55	7	12.73	13	23.64	9	16.36
3	0	0.00	3	5.45	6	10.91	6	10.91	1	1.82	6	10.91
Total	54	98.18	55	100.00	55	100.00	49	89.09	50	90.91	54	98.18

Freq. = Frequency V. % = Valid percent A, B, C, D, E, F = question 9 variables

Table A4.7: Frequency distribution of the technology experts' responses about technology transfer to developing countries.

Level of Change	A		B		C		D	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	0	0.00	0	0.00	0	0.00	0	0.00
-2	1	2.04	0	0.00	0	0.00	1	2.04
-1	1	2.04	0	0.00	1	2.04	2	4.08
0 = no change	2	4.08	5	10.20	2	4.08	10	20.41
1	16	32.65	19	38.78	11	22.45	24	48.98
2	17	34.69	18	36.73	17	34.69	6	12.24
3	10	20.41	4	8.16	18	36.73	2	4.08
Total	47	95.92	46	93.88	49	100.0	45	91.84

Level of Change	E		F		G		H	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	0	0.00	0	0.00	0	0.00	0	0.00
-2	0	0.00	0	0.00	0	0.00	0	0.00
-1	2	4.08	4	8.16	2	4.08	1	2.04
0 = no change	1	2.04	7	14.29	0	0.00	1	2.04
1	18	36.73	18	36.73	10	20.41	13	26.53
2	18	36.73	12	24.49	22	44.90	20	40.82
3	10	20.41	2	4.08	10	20.41	13	26.53
Total	49	100.0	43	87.76	44	89.80	48	97.96

Freq. = Frequency V. % = Valid percent A, B, C, D, E, F, G, H = question 11 variables

A4.2 Frequency Distribution of Responses to Questionnaire III

Table A4.8: Frequency distribution of urban experts' responses to the expected influence of technological achievements on urban life during the next 30-40 years

Level of Change	A		B		C		D		E		F		G		H	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	3	4.92	11	18.03	3	4.92	1	1.64	1	1.64	0	0.00	6	9.84	1	1.64
-2	24	39.34	14	22.95	5	8.20	7	11.48	5	8.20	2	3.28	10	16.39	7	11.48
-1	12	19.67	5	8.20	9	14.75	2	3.28	8	13.11	8	13.11	5	8.20	11	18.03
0 = no change	7	11.48	4	6.56	8	13.11	8	13.11	6	9.84	4	6.56	7	11.48	11	18.03
1	7	11.48	6	9.84	17	27.87	7	11.48	18	29.51	10	16.39	5	8.20	10	16.39
2	6	9.84	14	22.95	15	24.59	20	32.79	12	19.67	26	42.62	16	26.23	15	24.59
3	2	3.28	5	8.20	4	6.56	14	22.95	10	16.39	9	14.75	9	14.75	6	9.84
Total	61	100.0	59	96.72	61	100.0	59	96.72	60	98.36	59	96.72	58	95.08	61	100.0

Freq. = Frequency V. % = Valid percent A, B, C, D, E, F, G, H = question 4 variables

Table A4.9: Frequency distribution of urban experts' responses to the expected impacts of transport technologies in developing countries

Level of Change	A		B		C		D		E		F		G		H		I	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	1.64	0	0.00	0	0.00
-2	4	6.56	1	1.64	2	3.28	3	4.92	2	3.28	0	0.00	0	0.00	2	3.28	3	4.92
-1	4	6.56	0	0.00	8	13.11	6	9.84	4	6.56	1	1.64	1	1.64	2	3.28	2	3.28
0 = no change	11	18.03	4	6.56	3	4.92	4	6.56	7	11.48	11	18.03	10	16.39	1	1.64	10	16.39
1	25	40.98	22	36.07	18	29.51	20	32.79	11	18.03	17	27.87	29	47.54	16	26.23	18	29.51
2	11	18.03	15	24.59	19	31.15	23	37.70	25	40.98	20	32.79	7	11.48	17	27.87	12	19.67
3	4	6.56	16	26.23	11	18.03	4	6.56	9	14.75	5	8.20	3	4.92	20	32.79	15	24.59
Total	59	96.72	58	95.08	61	100.0	60	98.36	58	95.08	54	88.52	51	83.61	58	95.08	60	98.36

Freq. = Frequency V. % = Valid percent A, B, C, D, E, F, G, H, I = question 5 variables

Table A4.10: Frequency distribution of urban experts' responses to the expected impacts of advancements in renewable energy sources in developing countries.

Level of Change	A		B		C		D		E	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	4	6.78	10	16.95	0	0.00	6	10.17	2	3.39
-2	22	37.29	12	20.34	2	3.39	11	18.64	0	0.00
-1	13	22.03	16	27.12	5	8.47	17	28.81	3	5.08
0 = no change	4	6.78	6	10.17	16	27.12	9	15.25	12	20.34
1	7	11.86	5	8.47	12	20.34	7	11.86	17	28.81
2	6	10.17	5	8.47	16	27.12	6	10.17	16	27.12
3	0	0.00	1	1.69	6	10.17	2	3.39	9	15.25
Total	56	94.92	55	93.22	57	96.61	58	98.31	59	100.00

Freq. = Frequency V. % = Valid percent A, B, C, D, E = question 6 variables

Table A4.11: Frequency distribution of urban experts' responses to the expected impacts of technological advancements in urban utilities in developing countries.

Level of Change	A		B		C		D		E	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	0	0.00	0	0.00	0	0.00	0	0.00	1	1.72
-2	0	0.00	0	0.00	1	1.72	1	1.72	1	1.72
-1	1	1.72	1	1.72	0	0.00	2	3.45	0	0.00
0 = no change	4	6.90	5	8.62	5	8.62	5	8.62	6	10.34
1	14	24.14	13	22.41	19	32.76	26	44.83	19	32.76
2	24	41.38	24	41.38	15	25.86	15	25.86	21	36.21
3	15	25.86	15	25.86	18	31.03	5	8.62	6	10.34
Total	58	100.00	58	100.00	58	100.00	54	93.10	54	93.10

Freq. = Frequency V. % = Valid percent A, B, C, D, E = question 7 variables

Table A4.12: Frequency distribution of urban experts' responses about the expected impacts of telecommunication & information technology in developing countries during the next 30-40 years

Level of Change	A		B		C		D		E		F		G		H		I		J	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq	V. %
-3	c	0.00	0	0.00	0	0.00	0	0.00	0	0.00	4	6.56	0	0.00	3	4.92	7	11.4	1	1.64
-2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	15	24.5	1	1.64	10	16.3	18	29.5	2	3.28
-1	1	1.64	0	0.00	0	0.00	0	0.00	0	0.00	17	27.8	1	1.64	15	24.5	11	18.0	5	8.20
0 = no change			1	1.64	5	8.20	7	11.4	3	4.92	8	13.1	7	11.4	10	16.3	4	6.56	8	13.11
1	20	32.7	14	22.9	16	26.2	19	31.1	19	31.1	8	13.1	17	27.8	8	13.1	6	9.84	14	22.95
2	19	31.1	22	36.0	18	29.5	21	34.4	17	27.8	6	9.84	20	32.7	8	13.1	8	13.1	22	36.07
3	21	34.4	24	39.3	21	34.4	14	22.9	22	36.0	2	3.28	12	19.6	2	3.28	5	8.20	7	11.48
Total	61	100.0	61	100.0	60	98.36	61	100.0	61	100.0	60	98.36	58	95.08	56	91.80	59	96.72	59	96.72

Freq. = Frequency V. % = Valid percent A, B, C, D, E, F, G, H, I, J = question 8 variables

Table A4.13: Frequency distribution of urban experts' responses about the expected impacts of technology on the movement of urban population in developing countries

Level of Change	A		B		C		D		E	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	7	11.67	1	1.67	0	0.00	0	0.00	1	1.67
-2	15	25.00	5	8.33	0	0.00	0	0.00	0	0.00
-1	9	15.00	13	21.67	1	1.67	0	0.00	10	16.67
0 = no change	7	11.67	10	16.67	8	13.33	6	10.00	9	15.00
1	9	15.00	14	23.33	11	18.33	14	23.33	21	35.00
2	10	16.67	12	20.00	29	48.33	24	40.00	11	18.33
3	2	3.33	4	6.67	10	16.67	16	26.67	8	13.33
Total	59	98.33	59	98.33	59	98.33	60	100.00	60	100.00

Freq. = Frequency V. % = Valid percent A, B, C, D, E = question 9 variables

Table A4.14: Frequency distribution of urban experts' responses about the expected function of future urban settlement

Level of Change	A		B		C		D	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	8	13.11	1	1.64	2	3.28	1	1.64
-2	13	21.31	2	3.28	5	8.20	0	0.00
-1	12	19.67	1	1.64	6	9.84	0	0.00
0 = no change	8	13.11	6	9.84	5	8.20	6	9.84
1	9	14.75	12	19.67	18	29.51	22	36.07
2	8	13.11	26	42.62	13	21.31	22	36.07
3	0	0.00	13	21.31	9	14.75	7	11.48
Total	58	95.08	61	100.00	58	95.08	58	95.08

Freq. = Frequency V. % = Valid percent A, B, C, D = question 10 variables

Table A4.15: Frequency distribution of urban experts' responses about the probable ways for the provision of services in future new urban settlements

Level of Change	A		B		C		D	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	3	5.36	0	0.00	0	0.00	0	0.00
-2	6	10.71	1	1.79	0	0.00	0	0.00
-1	9	16.07	3	5.36	5	8.93	1	1.79
0 = no change	5	8.93	4	7.14	5	8.93	4	7.14
1	16	28.57	18	32.14	17	30.36	15	26.79
2	10	17.86	24	42.86	16	28.57	12	21.43
3	4	7.14	5	8.93	13	23.21	10	17.86
Total	53	94.64	55	98.21	56	100.00	42	75.00

Freq. = Frequency V. % = Valid percent A, B, C, D = question 11 variables

Table A4.16: Frequency distribution of urban experts' responses about the size of the future new urban settlements

Level of Change	A		B		C		D		E	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	11	20.00	3	5.45	1	1.82	0	0.00	1	1.82
-2	16	29.09	9	16.36	1	1.82	1	1.82	4	7.27
-1	6	10.91	18	32.73	6	10.91	1	1.82	1	1.82
0 = no change	11	20.00	5	9.09	5	9.09	5	9.09	7	12.73
1	5	9.09	9	16.36	20	36.36	10	18.18	11	20.00
2	2	3.64	10	18.18	14	25.45	22	40.00	11	20.00
3	3	5.45	0	0.00	7	12.73	12	21.82	20	36.36
Total	54	98.18	54	98.18	54	98.18	51	92.73	55	100.00

Freq. = Frequency V. % = Valid percent A, B, C, D, E = question 13 variables

Table A4.17: Frequency distribution of urban experts' responses about the development of the future new urban settlements in the next 30-40 years

Level of Change	A		B		C		D	
	Freq.	V. %	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	22	34.92	0	0.00	0	0.00	3	4.76
-2	7	11.11	1	1.59	2	3.17	2	3.17
-1	6	9.52	3	4.76	2	3.17	2	3.17
0 = no change	9	14.29	0	0.00	2	3.17	6	9.52
1	8	12.70	10	15.87	19	30.16	11	17.46
2	1	1.59	22	34.92	19	30.16	21	33.33
3	2	3.17	27	42.86	16	25.40	13	20.63
Total	55	87.30	63	100.0	60	95.24	58	92.06

Freq. = Frequency V. % = Valid percent A, B, C, D = question 14 variables

Table A4.18: Frequency distribution of urban experts' responses about the size of existing urban settlements in the next 30-40 years

Level of Change	A		B		C	
	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	18	28.57	1	1.59	17	26.98
-2	18	28.57	8	12.70	10	15.87
-1	5	7.94	5	7.94	8	12.70
0 = no change	0	0.00	5	7.94	9	14.29
1	8	12.70	11	17.46	2	3.17
2	9	14.29	14	22.22	0	0.00
3	5	7.94	10	15.87	1	1.59
Total	63	100.00	54	85.71	47	74.60

Freq. = Frequency V. % = Valid percent A, B, C = question 15 variables

Table A4.19: Frequency distribution of urban experts' responses about the future function of existing urban settlements in the next 30-40 years

Level of Change	A		B		C	
	Freq.	V. %	Freq.	V. %	Freq.	V. %
-3	0	0.00	0	0.00	1	1.72
-2	0	0.00	5	8.62	0	0.00
-1	2	3.45	8	13.79	1	1.72
0 = no change	2	3.45	13	22.41	3	5.17
1	8	13.79	13	22.41	15	25.86
2	21	36.21	10	17.24	5	8.62
3	23	39.66	9	15.52	4	6.90
Total	56	96.55	58	100.00	29	50.00

Freq. = Frequency V. % = Valid percent A, B, C = question 16 variables

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