

HI-TECH PLACE, MELBOURNE

TECHNOLOGY PRECINCTS AND THE DEVELOPMENT OF HIGH TECHNOLOGY
INDUSTRY IN METROPOLITAN MELBOURNE

A THESIS SUBMITTED FOR THE MASTER OF ARTS IN TOWN PLANNING DEGREE

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LIST OF ABBREVIATIONS

ABS	Australian Bureau of Statistics
ACF	Australian Commission for the Future
ASIC	Australian Standard Industrial Classification
ASTEC	Australian Science and Technology Council
AVG	Average
CBD	Central Business District
CC	Core-Central Zone
CHG	Change
CPT	Centre-Periphery Theory
CRC	Co-operative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DITAC	Department of Industry, Technology and Commerce
DITR	Department of Industry, Technology and Resources
EBT	Export Base Theory
EPAC	Economic Planning Advisory Council
ES	Employment Size
ESC	Employment Size Category
FE	Fringe-East Zone
FN	Fringe-North Zone
FS	Fringe-South Zone
FW	Fringe-West Zone
GPT	Growth Pole Theory
HTI	High Technology Industry
IE	Inner-West Zone
IN	Inner-North Zone
IRIS	Integrated Register Information System
IS	Inner-South Zone
IW	Inner-West Zone
LGA	Local Government Area

ME	Middle-East Zone
MFP	Multi-Function Polis
MN	Middle-North Zone
MPE	Ministry for Planning and Environment
MS	Middle-South Zone
MSD	Melbourne Statistical Division
MSDA	Melbourne Statistical Division Average
N/A	Not Applicable
NEC	Not Elsewhere Classified
N/K	Not Known
NO	Number
OE	Outer-East Zone
OECD	Organisation for Economic Cooperation and Development
ON	Outer-North Zone
OS	Outer-South Zone
OW	Outer-West Zone
PCT	Product Cycle Theory
R&D	Research and Development
RCT	Regional Cycle Theory
SLA	Statistical Local Area
TDP	Technology Development Program
TPP	Technology Precincts Policy
UK	United Kingdom
USA	United States of America

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SYNOPSIS

In essence, the following thesis examines the development of high technology industry (HTI) in metropolitan Melbourne. The thesis focuses on an assessment of the Victorian Government's spatially-focussed HTI development policy known as the "Technology Precincts Policy" (TPP) which was adopted in 1988. Under this policy, five technology precincts have been established in Melbourne to encourage the development of HTI.

Two main approaches were employed to evaluate the TPP, namely, a review of relevant literature and an analysis of unpublished data obtained from and produced by the ABS specifically for this thesis. The primary analysis involved determining the geographical orientation and locational preferences of HTI in Melbourne compared to the location of the five designated technology precincts.

From the findings of the two research approaches, it is concluded that the TPP is not a relevant, accurate or successful policy in terms of the development of HTI in Melbourne. This is primarily because the policy is too spatially-focussed and the designated technology precincts do not reflect the actual factors that influence the location and development of HTI in Melbourne.

Given the thesis findings, an alternative HTI development policy for Melbourne is recommended. The recommended policy focuses on the Melbourne metropolitan area as a whole and would involve a range of integrated and co-ordinated State Government initiatives and measures. Its goal would be an economic and urban environment in Melbourne which encourages innovation and HTI development throughout the metropolis, rather than seek a specific outcome in a particular spatial order.

CHAPTER ONE
INTRODUCTION

1.1 THESIS CONTEXT

The past two decades have seen growing interest around the world in high technology industry (HTI). With the increasing importance of high technology products and processes in world trade and industrial development, the expansion of productive capabilities in high technology is viewed as essential for improving and sustaining economic growth. Consequently, a major aspect of many government economic growth policies is the development of HTI.

There is no universally accepted definition of HTI. However, industries within this class of manufacturing have a number of characteristics that distinguish them from other types of industry. The most common indicators include generous research and development (R&D) spending, new products and processes and a highly skilled workforce engaged in engineering, scientific and technical work. For these reasons, they are often called knowledge intensive or technology intensive industries. HTI includes manufacturers of aircraft, computers, electronics and pharmaceuticals.

Another characteristic of HTI which has attracted considerable attention from governments, scholars and authors is its geographical orientation and locational preferences. In this regard, Hall and Markusen state that "though high-technology industry is not bound to certain locations by reason of scarce or bulky materials, or ties to immediate markets, nevertheless it shows a pronounced tendency to cluster in a few locations and to appear scarcely at all in many others" (1985: 144).

The most notable and successful clusters of HTIs are California's "Silicon Valley", Massachusetts' "Route 128", England's "M4 Corridor" and Scotland's "Silicon Glen", which have all developed strong regional economies based on HTI. Research has shown that several factors contribute to this phenomenon and that such factors can be developed in some locations to create the right environment for the growth of HTIs. As Markusen et al. state, "High tech location is explicable, therefore manipulable" (1986: 174).

Many governments have developed policies aimed at enhancing specific locations, areas or regions that they consider have the right ingredients and characteristics for the growth of HTIs, the aim being to encourage the development of such industries in the area concerned. It is the Victorian Government's spatially-focussed HTI development policy which is the focus of this thesis.

1.2 THESIS FOCUS

This thesis will focus on the Victorian Government's spatially-focussed HTI development policy, known as the "Technology Precincts Policy" (TPP).

The Victorian Government's TPP was developed in the latter half of the 1980s largely by Dr Edward Blakely, an economic development planner from the USA. Blakely (1987, 1988) argued that innovation and technology development activities are highly concentrated in areas that contain institutions of higher education and scientific research. According to Blakely, such areas are focal points for the growth and expansion of HTIs. Thus, Blakely suggested, by designating and supporting these areas, the government would foster their growth as centres of and magnets for HTI development. This would ultimately increase the overall economic competitiveness of Victoria and create new jobs for Victorians.

Blakely recommended to the Victorian Government the designation of six "technology precincts" in Victoria (five in Melbourne). The precincts were chosen for their suitability for accommodating and supporting the growth of HTIs, in particular, their proximity to and association with tertiary education institutions and major research facilities. The precincts would be formally designated, supported, promoted and resourced to provide environments which would encourage and facilitate the location of HTIs within the precincts or nearby. The ultimate aim was to produce internationally recognisable areas within which high technology research, development and commercialisation would occur on a world scale. The total group of precincts would, according to Blakely, provide a

nurturing arena for HTI, with a view to Melbourne becoming the HTI capital of Australia, like Silicon Valley is to the USA.

Blakely's five Melbourne precincts were formally designated by the Victorian Government in March 1988. The TPP was an initiative of a Labour Government (led by Premier John Cain at the time), and the precincts still remain in place after the election of the Liberal/National Coalition Government in October 1992. Approximately six years after their designation, it appears that many, if not all of Melbourne's technology precincts have had only limited success in attracting or developing HTIs, at least not as much as the Government originally envisaged (MPE, 1988; McLennan Magasanik Ass. Pty. Ltd. et al., 1990; Roper, 1991).

Blakely's concept was derived primarily from the experiences of places in Japan and the USA, such as Silicon Valley. The precincts he recommended basically hinge on one principle: that HTIs are or will be attracted to locations near higher education institutions and scientific resources. However, according to Macdonald, "any high technology policy based on the simple assumption that there are just two or three universal prerequisites for all high technology firms - say a convenient airport, a nearby university and pleasant surroundings - should be treated with considerable suspicion" (1985: 10).

Furthermore, whilst developed by a respected practitioner in the field of economic development planning, there is a distinct lack of data and evidence to support Blakely's concept in the context of Melbourne (if not Australia). In general, only a small amount of limited research into the locational preferences, or location, of HTI in Melbourne has yet been done. According to Macdonald, "a perpetual gulf between research and policy cannot be tolerated. An understanding of high technology industry is necessary before policy at any level is likely to be effective" (1985: 16). Moreover, "If high technology is important, then it is also important that high technology policy be correct - rather than simply highly visible - if opportunities are not to be missed and resources wasted" (Macdonald, 1985: 7).

1.3 THESIS AIMS

Given the above, this thesis has basically three inter-related aims:

- To identify the geographical orientation and locational preferences of HTI in metropolitan Melbourne, that is, where HTI firms are located, where HTI is growing, where it is declining and the reasons why.
- To determine the relevance, accuracy and success of the Victoria's TPP and, more specifically, Melbourne's five technology precincts.
- If necessary, to make recommendations regarding the TPP and/or new measures for the development of HTI in metropolitan Melbourne.

It should be noted from the outset that this thesis does not aim or intend to examine or investigate each individual technology precinct. It is the technology precinct concept vis-a-vis the actual location of HTI in Melbourne that is the focus of this thesis.

1.4 THESIS STRUCTURE

The next chapter reviews two major bodies of literature which provide a broad understanding of the issues behind this thesis. This literature concerns regional economic growth and industrial location. The chapter focuses on the theories and concepts used in this literature to explain regional economic growth and industrial location.

In Chapter Three, the geographical orientation of HTI is discussed. The primary locational factors that have been found to influence HTIs around the world are outlined in this chapter and the findings of four empirical studies into the location of HTIs are also reviewed.

Chapter Four of this dissertation describes the economic and policy context with respect to HTI. Japan's significant success in HTI development is discussed to provide an understanding of the international context. The Australian and then the Victorian Governments' policy approaches to the development of HTI are then outlined. The technology park, being probably the most common form of spatially-focussed or location-specific HTI development policy measure, is also discussed in this chapter.

The Victorian TPP is reviewed in detail in Chapter Five. A history of the TPP is provided and then the findings of a number of related studies are discussed.

Chapter Six presents the major part of this thesis in that it examines, in detail, HTI location in Melbourne. Due to the limited research into the location of HTI in Melbourne this chapter is based on primary analysis, that is, an analysis of unpublished data obtained from and produced by the ABS specifically for this thesis. The locational preferences of HTI in Melbourne are discussed and these preferences are compared to the location of the five designated technology precincts in Melbourne. Important locational patterns, trends and factors emerge which have implications for HTI development in Melbourne.

Finally, Chapter Seven concludes the dissertation. This includes recommendations regarding the TPP and HTI development in metropolitan Melbourne.

CHAPTER TWO

REGIONAL ECONOMIC GROWTH AND INDUSTRIAL LOCATION

2.1 INTRODUCTION

Understanding the broad issues relevant to this thesis can be aided by a review of two major bodies of literature concerning regional economic growth and industrial location.

Regional economic growth is an issue that has been the subject of a considerable amount of research literature over the last several decades. This literature provides an understanding of the processes and determinants of regional economic growth, variations and imbalances. A number of theories are used in this literature to explain regional economic growth. The following section of this chapter will provide an outline of the most relevant of these theories and will discuss why they are relevant to this thesis.

Industrial location has also been the subject of much literature over the last several decades. This literature focuses on industrial location factors and decisions and is therefore highly relevant to this thesis. Like the regional economic growth literature, certain theories and concepts have been developed to explain industrial location. The third section of this chapter will outline these theories and concepts.

2.2 REGIONAL ECONOMIC GROWTH

The fortunes of regions and sub-regions vary greatly; some are relatively prosperous, others are not so fortunate. For example, at the regional level in the UK, the south-east has been much more prosperous than the north-east over a long period of time. Regional economic growth theories attempt to provide an understanding of why this is so.

There is no single comprehensive regional economic growth theory, but a number of different theories that explain or emphasise different aspects of regional development. In the context of this thesis it is not necessary or possible to outline all of the regional economic growth theories. The theories summarised below are therefore only partial theories, each dealing with regional economic growth differently, but in ways that are

considered most relevant to the subject of this thesis. These summaries are syntheses of the work of several authors on the subject of regional economic growth, particularly Glasson (1978), Wheeler and Muller (1986) and Rees and Stafford (1986).

2.2.1 Export Base Theory

One of the simplest regional economic growth theories is the Export Base Theory (EBT). This theory states that a region's growth is determined by its competitive advantage over other regions and, more specifically, its inter-regional and international export performance. Income received from the sale of exports induces economic development in the region through "the development of residentiary activities, capital and labour movements and the development of external economies" (Glasson, 1978: 107). Thus, the level of external demand for the products of a region's export industries is a critical determinant of regional economic growth. The success of Silicon Valley's regional economy is an apt example.

The importance of high technology products in modern society and world trade is significant and is increasing. The EBT therefore provides an understanding of why the development of HTI is seen by many governments around the world, from local to national, as essential for improving and sustaining economic growth.

2.2.2 Growth Pole Theory

Probably the most widely known theory of regional economic growth is the Growth Pole Theory (GPT), originally developed by the French economist Francois Perroux in the early 1950s. It should be noted that Perroux's original concept concentrated on the development of "growth poles" (industrial sectors) in economic space, not geographical space. However, the theory was later extended to include the geographical dimension using the terms "growth point" or "growth centre" to describe the geographical manifestation of a growth pole.

The GPT states that a region does not grow economically at the same rate over all of its area, but tends to grow most rapidly at a point or points while lagging or remaining stagnant elsewhere. These rapidly growing points exert dominance over the entire region.

Associated with all growth poles are "propulsive firms". These firms are characterised as relatively large, innovative companies belonging to leading industries which are new, dynamic and fast growing with strong inter-industry linkages and an advanced level of technology. There may be just one propulsive firm or a number of them in a growth pole. If there are a number of firms they may be dispersed or clustered. The location of the propulsive firm(s) may be due to a number of factors such as natural resources, infrastructure or a labour supply in the area.

The rapid growth of propulsive firms, called "propulsive growth", induces the "polarisation" of other economic activities into the growth pole. In other words, more and more economic activities become associated with the development of the propulsive firm(s). This process of economic polarisation will eventually lead to geographical polarisation as the flow of resources to and the eventual concentration of economic activity around the propulsive firm(s) creates a growth centre or centres within the region.

The main cause of the process of geographical polarisation is "agglomeration economies". Three types of agglomeration economies can be identified. The first type is "scale economies" that involve cost savings internal to the firm made possible when the level or scale of operations is increased. For example, large-scale production allows technical economies such as job specialisation. The second type of agglomeration economies is "localisation economies" that allow firms in the same or closely related industry to gain by locating near to each other. Such firms may benefit from sharing a skilled labour pool, repair services or R&D facilities. Other benefits may include innovation diffusion and communication linkages. The third category of agglomeration economies is "urbanisation economies" that involve savings a firm enjoys as many different industries and economic activities grow in a particular area. Such savings may result from access to a larger

market and an improvement in the provision of services and facilities such as transport, hospitals and schools.

Despite polarisation, the GPT states that, in time, the propulsive qualities of the growth pole radiate outwards. The economic growth in the growth pole or centre will partially spill over to the benefit of the region outside the pole or centre. In other words, in the long run regions will tend towards equal levels of prosperity. These positive effects are called "trickling down" or "spread" effects.

The GPT has definite relevance to this thesis. In GPT terms, most firms that produce high technology products would be called propulsive firms and this provides an understanding of why HTIs are seen as so important from an economic development point of view. The process of geographical polarisation also helps explain why many governments have developed policies aimed at enhancing specific areas for the growth of HTIs. Virtually all spatially selective industrial development policies, such as the TPP, can be derived in some way from the GPT.

2.2.3 Centre-Periphery Theory

The Centre-Periphery Theory (CPT) was first developed by Hirschman and Myrdal in the late 1950s. This theory centres around the notions of "cumulative causation" and "divergent" regional growth. In essence, these concepts state that once the development process is under way, a number of factors have a strong tendency to reinforce the further growth of a well-established industrial area and cause little growth around such an area.

This theory holds that market forces tend to attract economic activity to certain core areas that acquired an initial advantage through technology, location or other factors, similar to the GPT. However, the CPT states that this process is cumulative and self-sustaining, because of the benefits of agglomeration economies, and results in very little growth outside the core, contrary to the GPT.

Whilst the existence of "spread effects" is acknowledged, the CPT states that such effects will invariably be more than offset by "backwash" (polarisation) effects. Thus, firms outside the core become depressed by the considerably more competitive firms in the core. This process produces areas of growth (the core) and areas of stagnation or decline (the periphery).

More than the GPT, the CPT provides a rationale for industrial development policies aimed at specific areas, particularly for the lower levels of government. This is because, according to the CPT, regions or areas that do not develop a core will be destined to stagnate or even decline economically.

2.2.4 Regional Cycle Theory

Despite the tendency for core areas to remain strong, as held by the CPT, there are many examples of formerly important industrial areas which have experienced economic decline. The Regional Cycle Theory (RCT) provides an explanation of this phenomena.

The RCT maintains that once an industrial area is established it goes through a sequence of change which can be described as youth, maturity and old age.

The first stage, industrial youth, is a period of rapid growth when the relative locational advantages of the area or region are first recognised and exploited. Investment capital becomes available, new technology is either imported or developed and skilled labour is attracted to the area. The young industrial area gains a competitive advantage over other regions.

During the second stage, maturity, the industrial area achieves a dominance over other regions. However, other industrial areas begin to develop and competition becomes increasingly severe as new areas vie for more and more market share. To meet this competition some activities move from the mature industrial area to the developing area(s).

In the old age stage the locational advantages of the original area begin to disappear and are eventually lost. Buildings may become obsolete, congestion often becomes a problem, property taxes may increase and skilled labour is often no longer attracted to the area. New and cheaper areas become available.

In essence, the RCT argues that regional economic growth is always in a state of flux. This theory is a reminder that regular monitoring of regional economic activity is necessary and relevant policies should be reviewed and revised accordingly. The RCT is particularly applicable to spatially-focussed industrial development policies in that the area or areas of focus may decline in importance over time and new, more important ones may develop. The relevance of the RCT to this thesis will become more clear later.

2.3 INDUSTRIAL LOCATION

There have been significant changes over time in approaches to the study of industrial location. There are now a number of theories and concepts that address the question of industrial location from different points of view and these will be summarised below. These summaries are syntheses of the work of several writers on the subject of industrial location, particularly Glasson (1978), Smith (1981), Rees and Stafford (1986) and Chapman and Walker (1991).

2.3.1 Normative Industrial Location Theory

Before about 1960, most analytical work regarding industrial location was concerned with the location of the individual factory and the variables influencing the choice of new sites. Much of this work involved reference to the concepts provided by normative industrial location theory which was first formulated by economists in the early part of this century. In essence, the normative approach involves the search for the best or optimal industrial location at a particular time. Three branches of this theory can be identified; the least cost approach, the market area approach and the profit maximisation approach.

The least cost approach to industrial location theory relies upon the 1909 work of the German economist Alfred Weber. Weber's basic principle was that the best location was the one at which costs are minimised. Furthermore, Weber believed that three factors in particular influenced industrial location; transport costs (the primary determinant), labour costs and agglomerative forces. Thus, the locational objective for the business person "involves an optimum in substitution between these factors, selecting a site which minimises total costs" (Glasson, 1978: 129).

The problem with the least cost approach is the over-emphasis of the cost factors, simply assuming that the firm will be able to sell all it produces wherever it locates. In contrast, other writers have allowed demand to vary but assumed that costs were fixed. This concept is called the market area approach and is based on the principles that buyers are scattered over a wide area but demand varies from area to area. Thus, firms will seek the location which best captures sales, that is, where demand and therefore revenue is at its greatest. The market is therefore a major location determinant. Firms will also react to their competitors giving a degree of locational interdependence as the best location changes according to the strategies of others.

The least cost and market area approaches to the study of industrial location are both one-sided. The profit maximisation approach is the logical outcome of these two approaches. This approach states that, in practice, both costs and revenue vary with location and the best or optimal industrial location is the one which allows the greatest profit. That is, the place at which total revenue minus total costs is greatest. Such a location may be neither the least cost nor the maximum revenue location.

2.3.2 Spatial Margins to Profitability

Central to the normative approaches outlined in the previous section are certain assumptions regarding those responsible for selecting the best industrial location. These assumptions are embraced within the concept of "economic man". This idealised decision-

maker has only one goal - profit maximisation - and possesses complete knowledge of all relevant economic information. In reality, however, no decision-maker can possess such characteristics and firms do not always find the optimum location.

This problem with the normative approach led to the development in the late 1950s of the concept of spatial margins to profitability. As Smith states, "Spatial variations in total cost and total revenue create an optimum location at which profits may be maximised, and also spatial margins beyond which profitable operation is not possible; within the margin the firm is free to locate anywhere, providing profit maximisation is not required" (1981: 115).

The spatial margin to profitability thus bounds the area within which there is freedom of locational choice. This concept replaced the notion of a single optimum location at which maximum profit is achieved with a broader area of economic viability within which sufficient profit may be made to allow continued operation of the factory. The freedom to indulge in sub-optimal behaviour is spatially constrained - economic circumstances impose limits to how far factory location can depart from the optimum and still survive.

2.3.3 The Behavioural Approach

The main defect of normative industrial location theory is that it fails to inform how industrial location decisions are actually made in the real world. The concept of spatial margins to profitability recognised the possibility of sub-optimal behaviour in the choice of factory location. Thus, in the 1960s a number of writers attempted to develop a theory which would explain how and why individuals and organisations actually choose industrial locations.

Whilst a single, general behavioural industrial location theory capable of incorporating the variety of human motivations and actions has not been developed, a basic concept has emerged. In essence, the argument of the behavioural approach is that industrial location decisions are taken by individuals and organisations that diverge, to varying extents, from

the theoretical norm of economic man. Since decision-makers do not, in reality, possess either the level of knowledge or the powers of reason ascribed to economic man they adopt courses of action which they perceive to be satisfactory.

One of the main exponents of the behavioural approach was Alan Pred who, in the late 1960s, developed the "behavioural matrix". This matrix is a device to assist in understanding real-world deviations from concepts or theories based on the assumptions of economic man. Pred applied this matrix to a number of decision-making situations including the selection of a factory site.

Pred's matrix presents the quality of relevant information available to a decision-maker down the left-hand side and the ability of the decision-maker to use that information across the top. A decision-maker positioned in the bottom right of the matrix possesses a good level of knowledge as well as a good ability to use it. In this case there would be a high probability of a good location choice. As knowledge and the ability to use it decrease, towards the top left of the matrix, the probability of a good choice of location decreases. The emphasis of Pred's matrix is on probability because there is a chance that a firm with little knowledge could be lucky enough to make a good location decision.

Other analytical work into location decision-making behaviour has, for example, concerned the goals of industrial organisations and their decision-makers. For many firms, the choice of location may be due to a particular policy designed to achieve some non-spatial goal. Other strands of work into this field of enquiry have stressed the importance of "contact systems" (or how firms are placed in relation to communication flows whereby information is disseminated and received), the experience of learning, the actions of other participants or competitors and personal biases (eg. the proximity of an entrepreneurs own home).

2.3.4 The Geography of Enterprise Approach

In the late 1960s it was recognised that the location of individual factories can often only

be understood in relation to the wider corporate systems to which they belong. The geography of modern society is increasingly determined not by the actions of isolated individuals, but by the strategies of large organisations. This wider concern regarding industrial development led to what is called the geography of enterprise approach.

Central to the geography of enterprise approach is an awareness of the power of large industrial corporations and a concern with the spatial ramifications of decision-making within such firms. One of the principal objectives of large organisations is to minimise economic uncertainties. One element of corporate power is the ability to directly influence the surrounding economic environment such as the spatial distribution of manufacturing activity.

The geography of enterprise approach is primarily concerned with corporate decisions rather than the actual location decision. This is because many essentially non-spatial decisions have geographical consequences. For example, the decision of a firm to increase output or to manufacture a new product might result in the firm establishing a factory in a new location. Alternatively, a firm faced with a decreasing market for its product may decide to close one (or more) of its factories.

This approach represents a major shift away from earlier theories and concepts regarding industrial development. Whereas earlier approaches were concerned with the effect of the economic environment (spatial factors) upon industrial location, the geography of enterprise approach is concerned with the effect of industrial organisations upon the economic environment.

2.3.5 The Structural Approach

In the approaches previously outlined the question of industrial location is viewed from a managerial perspective. That is, the best location is defined in terms of the presumed aim(s) of the entrepreneur, firm or organisation. In the 1970s, however, a new approach

emerged based on a resurgence of interest in Marxist ideas.

The emphasis of the structural approach is on the need to understand industrial location within a framework of the broader political economy. That is, the structural approach sees industrial location within an all-embracing perspective comprising the totality of economic, political and social processes.

The structural approach acquired a large following in the early 1980s when the world's economies were in the midst of the worst recession since the 1930s and when major changes took place in the distribution of manufacturing activity. According to Chapman and Walker:

Marxist analyses regard such changes as just one aspect of a process of restructuring which represents a stage in the development of capitalism. Thus, it is suggested that each of these stages is associated with characteristic distributions of economic activity. ... the present 'crisis of capitalism' is distinguished by the displacement of manufacturing jobs from the metropolitan core toward the rural periphery and the concentration of service employment in the cities. (1991: 28)

2.4 SUMMARY

The research literature outlined above shows that regions tend to grow economically in areas that possess certain characteristics and attributes while lagging, stagnating or declining elsewhere. One of the main reasons for this phenomenon is the benefits of agglomeration economies. However, not all economic growth areas remain strong for ever, some experience decline and new, more advantageous areas develop.

This literature also shows that industrial location is determined by a number of basic factors such as transport, labour, agglomeration and market forces. But there are also behavioural, corporate and wider economic, political and social factors which may also influence industrial location decisions.

CHAPTER THREE
HIGH TECHNOLOGY INDUSTRIAL LOCATION

3.1 INTRODUCTION

Regrettably, a theory of location for HTI does not exist. Whilst the industrial location theories and concepts are relevant to this thesis in terms of providing a general understanding of industrial location factors and decisions, they do not specifically address high technology industrial location which tends to be abnormal in some respects. HTIs tend to be influenced by some specific locational factors more than others, some of which tend not to apply, or apply differently, in the case of non-HTIs. Due to this and the growing interest in HTI over the past two decades, there is now a body of literature specifically relating to high technology industrial location. The primary locational factors that influence HTI, as derived from this literature, will be discussed in the following section of this chapter. Section 3.3 will then review the findings of four empirical studies into the determinants of the location of HTI.

3.2 THE PRIMARY FACTORS

The most important factors that have been found to influence the location of HTIs are discussed below. This discussion is a synthesis of the work of several authors on the subject of HTI, particularly Hall (1985), Markusen et al. (1986), Malecki (1986), Rogers and Larsen (1986), Rees and Stafford (1986) and Aydalot and Keeble (1988).

3.2.1 Transportation

Traditionally, industrial location theory has underscored the costs of moving materials to the factory and products to the market. For HTIs, however, both the inputs (materials) and outputs (products) are characteristically of high value in relation to their weight - transportation costs therefore make up only a small proportion of the total product cost. HTIs also tend to use a wide variety of inputs from different suppliers; thus, the advantages of locating near any one supplier are neutralised by the distances separating them from other suppliers. Transportation is, therefore, a factor of some locational

importance for HTIs but more in terms of ease and speed rather than cost. HTIs tend to be more concerned than most manufacturers about easy access to major, rapid transportation facilities such as freeways and airports. This applies not only for the transportation of the inputs and outputs but also for the movement of managerial and technical personnel.

3.2.2 Labour

Regardless of the type of industry, labour is one of the most (if not the most) important industrial location factors. Most industries will try to locate close to their labour or in locations attractive to their labour.

In general, HTIs require two types of labour: routine process and assembly workers and highly skilled professionals. The latter, however, are the most significant because they are scarce and highly mobile between firms. HTIs must be able to attract and retain such personnel to survive. This has a critical influence on the location of HTIs because highly skilled workers, due to their affluence, tend to live in a limited number of places; usually suburbs with good "amenities" (see below).

3.2.3 Amenities

For many industries, amenities have become an important locational determinant. However, for HTIs this is a particularly important factor in terms of attracting and retaining the essential skilled personnel, as outlined above. In this regard, attractive amenities include: attractive natural features and a pleasant climate; quality housing; good schools, public transport, roads and shops; low pollution; recreational opportunities etc. In essence, this factor leads HTIs to locations with high value quality-of-life attributes, often towards the urban periphery.

3.2.4 Agglomeration

Agglomeration is another key locational determinant for HTIs for two main reasons. This industry is highly innovative and tends to comprise a large number of small firms. Small innovative firms tend to have a high degree of reliance on external economies, particularly "localisation economies". As stated in Section 2.2.2, localisation economies allow firms in the same or related industry to gain by locating close to each other. Firms in an agglomeration may benefit from sharing a skilled labour pool or specialised services which are scarcely available (such as R&D facilities). Close proximity of linked firms may also be advantageous in terms of the easy interchange of materials and products. Other benefits may include better innovation diffusion and communication linkages between firms. Silicon Valley is often cited as the classic example of the advantages of agglomeration given the large number of HTI firms in the area and its success in HTI development.

3.2.5 Innovation

Innovation is particularly significant when studying HTI. Innovation is the act or process of introducing something new. In the industrial context, innovation is the commercial application of a recent invention. HTIs are characteristically innovative. Most importantly, the innovative qualities of HTI have spatial consequences.

One theory that has been used by a number of authors to explain the process of industrial innovation and its spatial consequences is the Product Cycle Theory (PCT). First developed by the economist Raymond Vernon in the mid-1960s, the PCT holds that manufactured products and the industries that produce them typically go through an evolutionary cycle comprising three stages. This theory has an implicit locational dimension since each stage of the product cycle has different locational requirements. In essence, the product cycle leads firms to first concentrate and then disperse as agglomerative factors are displaced by cost-cutting imperatives.

The first stage (or innovation stage) of the product cycle according to the PCT is characterised by the early development of the product. This stage requires substantial R&D and is therefore usually carried out in an industrial agglomeration or core area where, amongst other things, innovation diffusion can best be exploited. The second stage (or growth stage) is when production methods and the product are perfected and the level of R&D required is reduced. External demand for the product expands which encourages attempts to maximise economies of scale in large plants and a search for cheap labour. The third and final stage (or standardisation stage) of the product cycle is when production becomes standardised and there is a decline in the number of firms producing the product. Agglomeration economies and linkages become less important and production may shift away from the initial core to a more low-cost peripheral location.

Another important aspect of industrial innovation is the tendency of new industries (or innovative sectors) to locate in places different from older ones. As Markusen et al. state, "There are suggestions in the economic history literature that innovative industry tends to develop in areas different from the previous industrial concentrations, because the latter suffer from some hardening of the innovative arteries" (1986: 138). This is consistent with the Regional Cycle Theory mentioned in Section 2.2.4.

3.2.6 Research and Development

R&D is an essential ingredient of innovation. The major places of R&D activity are government R&D establishments (including universities) which are generally found in a small number of places. Evidence from both the USA and the UK suggests a link between government R&D and the locations of new HTIs. For example, in the UK there is a heavy concentration of government R&D in south-east England and this region easily leads in industrial innovations. Furthermore, the marked concentration of HTIs along the M4 Corridor west of London appears to be closely related to the initial presence of government R&D establishments in the area.

The above facts might seem to indicate that all HTIs will be attracted to a limited number of locations near government R&D establishments where they can best exploit the R&D activities of such places. However, this is not necessarily always the case. HTIs are not always reliant on R&D or government R&D establishments.

At the innovation stage of the product cycle most new HTIs require substantial inputs of R&D. However, in the growth and standardisation stages the need for R&D is reduced. In fact, in these latter two stages of the product cycle, manufacturers may only carry out non-innovative R&D in the interests of maintaining their position in the market or fine-tuning the product.

A large amount of R&D takes place in the laboratories of many private enterprises, both small and large. The difference lies in the fact that large multi-plant, multi-national enterprises usually have considerable freedom to choose their location due to, amongst other things, the quality of their own R&D or because they no longer require substantial inputs of R&D. Smaller firms, on the other hand, are often extremely sensitive to economies of agglomeration when it comes to R&D, as in other activities. However, such economies may exist in an area which does not contain any government R&D establishments but might contain, for example, other similar or related firms or the headquarters of a major industrial corporation.

3.2.7 Entrepreneurship

According to Rogers and Larsen, "The most important single factor in the rise of a "Silicon Valley" is entrepreneurial fever" (1986: 234). Innovation requires entrepreneurs - people who, by risk and initiative, will try to introduce something new in order to make a profit. Furthermore, successful entrepreneurs often cause new entrepreneurs to emerge and become involved in the innovation process. New entrepreneurs in a particular field of innovation will often locate near the original entrepreneur(s) in order to gain from the benefits of agglomeration economies. An entrepreneurial business climate is an important

ingredient for any area to become successful in terms of HTI.

3.2.8 Infrastructure

Infrastructure is another important locational factor for HTIs, particularly because most new HTI firms are small ventures. Physical infrastructure is important for HTIs but they also require many forms of non-physical infrastructure, probably more than most other types of industry. Some of the important infrastructure requirements for HTIs have already been mentioned such as transportation facilities, a supply of labour and specialised services. Other important infrastructure includes financiers, suppliers and markets. Good telecommunications can also be important. Due to their wide range of infrastructure requirements, the sharing of infrastructure is a basic reason why HTIs tend to gather together.

3.2.9 Taxes

"Within the industrial location literature, no issue is more debated than the influence of taxes on site selection" (Rees and Stafford, 1986: 45). Whilst many authors have concluded that taxes are not a major industrial locational factor, there is some evidence from the USA to suggest that taxes are an important locational factor for HTIs. Low taxes, rates and charges may be somewhat more valued by HTIs since they are less constrained by the traditional factors such as markets and materials. This issue remains unresolved suffice to say that taxes may be an important locational factor for HTIs.

3.3 EMPIRICAL STUDIES

To demonstrate the relative importance of the various factors outlined above, the results of four empirical studies into the determinants of HTI location will be reviewed below. The first three studies reviewed were undertaken in the USA. These studies were chosen to be reviewed because they clearly demonstrate the primary factors that influence the

location of HTIs. They were also chosen because of their large scale and wide coverage in that they cover the whole of the USA. (Most other studies into the location of HTIs are either very general or relate to particular areas or regions.) For these reasons, the findings of the three USA studies reviewed below can be used to gain a broad understanding of the factors that probably influence the location of HTIs in Australia. This is important because no similar studies have been undertaken into the location of HTIs throughout Australia. However, two relatively small studies regarding the location of HTIs in Melbourne have been undertaken. One of these will be briefly reviewed below, but the other, which relates to the TPP, will be reviewed in Section 5.4.

Table 3.1 sets out the findings of two studies undertaken in the USA in the early 1980s. Part A of the table ranks the ten most important factors that influenced the location of a number of HTIs compared to a number of non-HTIs. Part B of the table (the result of a different study to Part A) ranks the ten most important factors that influenced the location of a number of HTIs at the regional and sub-regional levels.

Table 3.1: Location Factors Influencing New Manufacturing Plants

A. High-Technology and Other Plants

Rank	High-Technology Plants	Other Plants
1	Labour	Labour
2	Transportation availability	Market access
3	Quality of life	Transportation availability
4	Markets access	Materials access
5	Utilities	Utilities
6	Site characteristics	Regulatory practice
7	Community characteristics	Quality of life
8	Business climate	Business climate
9	Taxes	Site characteristics
10	Development organizations	Taxes

B. High-Technology Plants: Selection of Region and within-Region Location

Rank	Selection of Region	Selection within Region
1	Labour skills/availability	Labour availability
2	Labour costs	State/local tax structure
3	Tax climate within region	Business climate
4	Academic institutions	Cost of property/construction
5	Cost of living	Transport for people
6	Transportation	Ample area for expansion
7	Markets access	Proximity to good schools
8	Regional regulatory practices	Proximity to amenities
9	Energy costs/availability	Transport facilities for goods
10	Cultural amenities	Proximity to customers

Source: Rees and Stafford, 1986: 43

For all industries, according to Table 3.1, labour is the most important locational factor. For HTIs, no one factor stands out as the next most significant locational factor, however, taxes, transportation, business climate and quality of life are all very important. These factors are not as important in relation to the location of non-HTIs. It is significant that R&D availability, or the proximity of R&D establishments, is not a significant factor according to these studies.

One of the most comprehensive studies of HTI and its locational preferences is that by Markusen, Hall and Glasmeier (Markusen et al., 1986). In this study the authors developed eleven theoretical notions or hypotheses regarding the locational preferences of HTI (in the USA). The authors then used these hypotheses to identify thirteen specific variables or factors which they believed have a major influence on the location of HTIs. These factors were then tested empirically.

The eleven hypotheses developed by Markusen et al. are set out below.

High tech industry is attracted to major airports with good national and international passenger and air cargo activities.

High tech industries are drawn to areas with good natural amenities, in particular mild and sunny climates.

High tech industries concentrate in areas offering attractive housing at reasonable prices.

High tech industries are attracted to areas with educational and cultural advantages, including good educational opportunities, an array of specialized cultural services, low levels of pollution and good recreational opportunities.

High tech industries are attracted to regions which are weakly unionized, and have low wage rates and high unemployment rates.

High technology industry will be attracted to areas with a high degree of internal accessibility and connectivity, as for instance with well developed highway systems.

High technology industries will be drawn to areas with a well-established infrastructure of specialized business services.

High technology industries are drawn to places which have an anti-regulatory, free-enterprise ideology.

High technology industry will be drawn to centers of industrial R&D which will tend to locate close to headquarters of major industrial corporations.

High technology industry will be generated in locations with concentrations of federally funded fundamental scientific research.

High tech industry will be generated in areas with high concentrations of defense spending.

(Markusen et al., 1986: 133-142)

The thirteen factors identified by Markusen, Hall and Glasmeier are shown in Column 1 of Table 3.2 (below). It can be seen from this table that the factors fall into five categories. The first category consists of factors relating to the local labour force. The second category contains factors relating to an area's amenities. The third group consists of factors relating to the local access features. The fourth group is intended to capture the agglomerative features of an area which are often thought to be important for HTIs. The fifth and final category consists of factors relating to the socio-political characteristics of an area.

Table 3.2: Factors Associated with Metropolitan High Tech Job and Plant Location

Column 1: Locational Variable and Category	Column 2: Hypothesized Sign
A. LABOUR	
1. Wage Rate	Negative
2. Unionization Rate	Negative
3. Unemployment Rate	Positive
B. AMENITIES	
4. Climate Index	Positive
5. Housing Price	Negative
6. Educational Options	Positive
C. ACCESS FEATURES	
7. Freeway Density	Positive
8. Airport Access	Positive
D. AGGLOMERATION	
9. Fortune 500 (Major Businesses)	Positive
10. Business Services	Positive
11. University R&D	Positive
E. SOCIO-POLITICAL	
12. Defense Spending	Positive
13. Percentage Black Population	Negative

Source: Markusen et al., 1986: 155.

Markusen, Hall and Glasmeier believed that all of the factors outlined in Column 1 of Table 3.2 had an influence on the location of HTIs. However, some of the thirteen factors were thought to be positively related to the location of HTIs and some were thought to be negatively related. This aspect of each factor is shown in Column 2 of Table 3.2. Thus, the wage rate (the cost of labour in an area) was hypothesised to be negatively related to the location of HTIs, the unionisation rate (the percentage of the labour force unionised) was also thought to be negatively related, the unemployment rate (a measure of surplus capacity in an area's labour supply) was expected to be positively related, and so on.

Markusen, Hall and Glasmeier tested their thirteen factors in a multiple regression model using Standard Metropolitan Statistical Areas data for the years 1972 and 1977. The results of this test showed that, overall, the most important factors which influence the location of HTIs fall under the three headings of amenities, access and agglomeration. More specifically, the four most consistently significant factors were defence spending, range of educational options, presence of business services and absence of black population. Perhaps the most interesting result of all was that some of the factors traditionally thought to be very important in attracting HTIs were in fact relatively insignificant. For example, university R&D and labour supply characteristics were not very important in explaining the distribution of HTIs.

Another important finding of the study by Markusen, Hall and Glasmeier was that HTIs show a distinct tendency to disperse over time, away from the agglomerations or core locations to peripheral (outer) metropolitan areas and beyond (i.e. interstate). This finding is consistent with the Product Cycle Theory previously mentioned.

A study carried out by Newton and O'Connor (1985) regarding high technology clusters in Melbourne concluded that the locational ingredients for successful HTI development include:

- high quality support infrastructure;
- proximity to research establishments;
- manufacturing diversity;
- high socio-economic status;
- new office space potential; and
- high residential amenity.

For the most part, these factors are consistent with those identified by the USA studies. There is one major exception and that is the USA studies found that R&D establishments were not a significant factor in the location of HTI in the USA.

3.4 SUMMARY

The literature regarding the location of HTI, as reviewed in this chapter, shows that the geographical orientation of HTI is, for the most part, explicable. The location of HTIs is linked to few key factors: transportation, labour, amenities, agglomeration, innovation and R&D. As a result of these locational factors, HTIs tend to cluster in a few locations and appear hardly at all elsewhere. The favourable locations also tend to be detached from the older industrial areas. However, over time, HTIs tend to disperse away from these core locations to peripheral areas.

If the geographical orientation of HTI is explicable, it must, at least to some degree, also be manipulable, particularly by government.

CHAPTER FOUR
ECONOMIC AND POLICY CONTEXT

4.1 INTRODUCTION

Over the last two decades high technology products have assumed increasing importance in world trade. For example, between 1970 and 1983, the value of high technology exports from OECD countries increased by an annual average of 15.3% while the proportion of high technology exports in total manufactured exports increased from 13.7% to 17.5%. Trade in high technology products is now one of the fastest growing areas of world trade (EPAC, 1987). By the year 2000, HTI is expected to be second only to the energy industry in terms of its importance in the world economy (Botkin et al., 1982).

The expansion of productive capabilities in the high technology area is seen by governments around the world as essential in making their economies more competitive, for increasing employment opportunities and for improving and sustaining economic growth in general. Whilst direct job generation through the growth of HTI is small, the indirect employment effects are quite significant. In Australia, an expanding, internationally competitive, local HTI sector is viewed as a key to reducing the country's current account deficit and to increasing the growth potential of the domestic economy (EPAC, 1987).

Given the above, an important part of many government economic growth policies is the development of HTI. In 1983, the USA's Office of Technology Assessment listed 148 State and regional HTI development initiatives in the USA alone (cited in Vaughan and Pollard, 1986: 268). Policies aimed at the development of HTI can and do involve a variety of measures. For example, in 1984, the USA's Office of Technology Assessment identified 38 different types of HTI development policies in 22 States of the USA (cited in Rees, 1986: 1). However, for the purpose of this thesis, two broad forms of government HTI development policy have been identified, those which are spatially-focussed and those which are more broadly-targetted.

Most HTI development policies are broadly-targeted, that is, they have no specific locational focus. These policies address the wider issues such as improving linkages between science and industry, increasing R&D activity, improving the technical skills base of the workforce and generally supporting the development of HTIs wherever they may be located. For example, the French and Japanese Governments both have a very strong alliance with their private HTIs and have become active partners in subsidising these industries. Consequently, over the last three decades both of these countries have experienced spectacular rates of growth, based largely on HTI (Botkin et al., 1982).

On the other hand, many governments around the world have adopted spatially-focussed, or location-specific, HTI development policies. This is largely due to the tendency of HTIs to cluster in a few locations and appear hardly at all elsewhere. As was stated in Section 2.2.2, virtually all spatially selective industrial development policies can be derived in some way from the Growth Pole Theory. The aim of these policies is to enhance specific locations that the government believes have the correct factors or attributes for the growth of HTIs. By enhancing such locations the object is to encourage HTI development in the designated area. Specific examples of this type of approach to the development of HTI include Japan's Technopolis Policy, Australia's Multi-Function Polis (MFP) and Victoria's TPP. Technology parks and the like are a popular, but simple, form of spatially-focussed HTI development measure. Most other forms of spatially-focussed HTI development policies are based on the technology park concept.

The two forms of HTI development policy outlined above are not mutually exclusive and governments can and often do adopt both forms (for example, Japan). In general, the spatially-focussed policies tend to supplement the broader policies and also tend to be favoured by the lower levels of government.

The following sections of this chapter will discuss four major policy approaches to the development of HTI which are important in the context of this thesis. In the following section of this chapter, a brief review of the Japanese Government's approach will be

provided, including a summary of their Technopolis Policy. Section 4.3 will outline the Australian Government's approach to the development of HTI, including a brief review of the MFP. Next, in Section 4.4, the strategies adopted by the Victorian Government will be discussed, excluding the TPP which will be reviewed in Chapter 5. In Australia and particularly Victoria, regional and local governments have only become involved in the development of HTI to a small degree, usually through technology parks or similar. Given this, and the fact that most other forms of spatially-focussed HTI development policy are based on the technology park concept, Section 4.5 will address this concept and will identify a number of examples both within Victoria and other States.

4.2 JAPANESE GOVERNMENT

At the international level there have been three significant success stories in terms of government development of HTI: West Germany, France and Japan. However, according to Hall, Japan's success has been the "most spectacular" (1985: 5). Japan is now a global force in HTI. The Japanese Government's approach to the development of HTI therefore provides a very good understanding and is representative of what is needed to succeed in this industrial sector on a world scale. Japan's relative proximity to and close relationship with Australia is also relevant.

Much of Japan's success in HTI is due to the efforts of the Ministry of International Trade and Industry (MITI) which arose after World War 2 out of the wartime Ministry of Munitions. Since then, MITI has played a critical role in coordinating and planning Japan's national industrial policy.

According to Rogers and Larsen, "MITI is the greatest concentration of brains and power in Japan" (1986: 213). The influence and power of MITI is vast and this is due to the fact that it represents a national consensus that technological innovation is the country's first priority for economic development.

The most significant aspect of MITI's approach to economic and industrial development is its relationship with private firms. Hall (1985: 5) called this relationship a "systematic and ruthless partnership". MITI interacts with Japanese private firms through formal associations and via informal relationships and by providing capital, tax incentives and R&D assistance. Rogers and Larsen summarise the nature of Japan's government/industry partnership in these words: "Thus MITI and private industry are interconnected in a network of influence relationships leading to a consensual process of decision making about industrial policy. MITI acts as a coordinator and an orchestrator of this process" (1986: 215).

4.2.1 The Technopolis Policy

The Technopolis Policy is one of Japan's largest ever industrialisation plans. The policy was initially developed by MITI in the early 1980s to assist areas depressed by declining traditional industries. MITI has also been primarily responsible for the implementation of the policy. According to Rimmer, the technopolis concept "involves linking the commercialisation of technology and economic development with the public and private sectors within a new city-state to spur economic performance and promote technological diversification" (1989: 17). In essence, the aim of the policy has been to designate, enhance and support certain areas of Japan as venues for technological and economic development.

Originally, MITI had intended to develop the technopolis concept in just two or three areas of Japan but twenty areas have now been designated under the Technopolis Act 1983. All of these are quite large non-metropolitan areas which are scattered throughout the country. The rationale for choosing non-metropolitan areas is based on an assessment that Japan's major cities are non-conducive to HTI development and there is also a recognition that innovation requires new industrial locations (Blakely, 1987).

Each proposed technopolis area had to satisfy a number of key requirements including: favourable physical, economic and social conditions; a current agglomeration of HTIs; available land and housing; a population of 150,000 nearby; accessible research facilities; and available air and ground transportation with links to overseas (Blakely, 1987). The aim of the Technopolis Policy is to integrate all of these elements, utilising resources from all over the region.

To facilitate the development of each of the designated areas, the Technopolis Policy brought together government, universities and private industry to plan each technopolis. Governments have provided incentives, such as tax relief and concessionary loans, to encourage industries to locate in the areas. A concerted approach to the provision of infrastructure and services is also a key aspect of the policy.

It is too early to assess whether the Technopolis Policy is, or will be, a success but it is a valuable example of a form of spatially-focussed HTI development policy.

4.3 AUSTRALIAN GOVERNMENT

For the most part, the Australian Government's approach to the development of HTI, both past and present, falls within the broadly-targeted policy area outlined in the introduction to this chapter. The Government's only involvement in the spatially-focussed policy area has been the Multi-Function Polis proposal (see Section 4.3.3).

The Australian Government, like most other OECD governments, has sought to encourage the development of HTI by a range of policy measures, such as:

- direct incentives to the private sector to increase R&D activity, including grants and tax deduction schemes;
- improvement of linkages between research institutions (e.g. CSIRO) and industry;

- assistance with marketing Australian products overseas through the Australian Trade Commission;
- sectoral policies to provide assistance to and encourage the development of specific industries such as the communications equipment and space industries;
- education and training policies to improve the technical and managerial skills base of the workforce and to improve entrepreneurial activity;
- contributing to and improving the availability of venture capital and finance for new companies, products and processes;
- improvement of technology transfer - the use of foreign technology (EPAC, 1986 & 1987).

4.3.1 The National Technology Strategy

In 1984, the Australian Government produced a draft National Technology Strategy for discussion purposes. This attracted over 250 written submissions from interested parties, including some strong criticism (ASTEC, 1990). As a result, a revised discussion draft was produced in 1985 (Department of Science and DITAC, 1985). This identified four broad science and technology objectives, as follows:

- To strengthen Australia's scientific and technological capability, especially in education and in public and private sector R&D.
- To improve the utilisation of technology in new and existing industries, and promote the development of new technologies.

- To ensure the implementation of effective mechanisms for the equitable sharing of the costs and benefits of technological change.
- To integrate science and technology policy with other government policies and to ensure effective co-operation between government agencies in Australia and overseas.

Within each of these objectives were specific priority actions, such as improving student perceptions of technology-oriented education and increasing interaction between public research institutions and the business sector.

In the event, the draft National Technology Strategy was never formally adopted by the Australian Government, mainly due to a lack of support from both within and without the Government (ASTEC, 1990).

4.3.2 The Co-operative Research Centres Policy

A good example of a particular HTI development policy of the Australian Government is the Co-operative Research Centres (CRCs) policy. It should be noted that, contrary to the use of the word "centres" in its name, this policy is not location-specific or spatially-focussed.

The CRCs policy was launched in March 1991 by the then Federal Minister for Science and Technology, Simon Crean. The aim of the policy is to support long term scientific research and training and to assist closer links between research and the market. The policy is directed at the problem that Australia's science and technology resources are fragmented by geography and institutional dispersion which has hindered development of the networks needed to improve innovation and technology development. The CRCs will draw together (network) research groups in universities, the CSIRO and other government research institutions and link them to researchers and users in industry and other sectors

of the economy (DITAC, 1991; Plunkett, 1991).

A total of fifty CRCs are planned to be operational by 1995 and the cost will be shared about equally between government and industry. Fifteen CRCs were initially announced and each involve the CSIRO and at least one university, and private industries are participating in twelve. For example, the CRC for Intelligent Decision Systems (Melbourne) involves Melbourne University, the Royal Melbourne Institute of Technology, the CSIRO, BHP, Qantas, IBM Australia and the Australian Artificial Intelligence Institute. The CRC for Aerospace Studies (Melbourne and Sydney) involves Monash University, Sydney University, the University of NSW, the CSIRO, Aerospace Technologies of Australia Pty Ltd and Hawker de Havilland Ltd (DITAC, 1991; Plunkett 1991).

4.3.3 The Multi-Function Polis

The Multi-Function Polis (MFP) proposal was first put to the Australian Government by Japan's Minister for International Trade and Industry in January 1987. Since then the MFP has probably been the subject of more research and media attention than any other major project in Australia's history. The MFP has been called, amongst other things, "Australia's newest new city proposal", "the clever country's capital", "the city of the future", "a new model city for the world" and "Australia's new world city". A more appropriate definition of the MFP is "A world competitive infrastructure platform for the growth industries of the 21st Century" (ACF, 1992: 4). The MFP is essentially a single location-specific HTI development measure.

In 1991, after much deliberation, a site for the MFP was chosen at Gillman, 15 kilometres north-west of Adelaide's city centre. Work on the site commenced in early 1993.

According to the Australian Commission for the Future (ACF) the MFP project has three main aims:

People. Helping to achieve the kind of society Australians want for the 21st Century - a society that is prosperous, skilled, international in outlook, sustainable and socially just.

Technology. Ensuring Australia's successful participation in the new growth industries that will be dominant in the 21st Century.

Environment. Linking the natural, social and economic aspects of the environment in new ways and by using new technology and skills to serve the community. (ACF, 1992: 5)

To achieve these aims, the ACF state that:

... the MFP project is developing two major intertwining elements:- a physical development which will showcase new urban solutions and new technologies and be a site for business, research centres etc to cluster; and a nationwide network of advanced technology industries, research and education centres. (ACF, 1992: 5)

4.4 VICTORIAN GOVERNMENT

Like the Australian Government and most other State Governments, the Victorian Government has sought to encourage the development of HTI by a range of policy measures.

To date, the Victorian Government's most significant HTI development policy initiative was its Technology Statement, released in 1986 (Victorian Government, 1986). This document announced a Technology Development Program (TDP) with two main objectives: "to build increased commercial development on Victoria's research base and to accelerate the incorporation of new technology into industry" (Victorian Government, 1986: 149). To achieve these objectives, the TDP comprised the following four elements:

The creation of a wide range of new partnerships between business, research institutions and scientists and the Government.

Specific measures to develop the technological infrastructure in Victoria.

Measures to encourage larger enterprises to contribute in a systematic fashion, to the commercialisation of Victorian research.

Support through the programs of the Department of Industry, Technology and Resources and the Victorian Economic Development Corporation, and in other ways, for the rapidly expanding activities of smaller companies in Victoria. (Victorian Government, 1986: 149)

In the Technology Statement the Government also announced three issues to which it would give "systematic attention":

The use of its purchasing power and other policy instruments to assist the commercial development of technology in Victoria.

Initiatives to ensure that trends in the education and training system are consistent with the technology development program.

A review of the adequacy of existing capital market structures to facilitate the proposed technological development. (Victorian Government, 1986: 149)

In 1987, the Victorian Government released an economic strategy for the State titled "Victoria - The Next Decade" (Victorian Government, 1987). In this strategy, the Government announced that it had decided to broaden the TDP through three new initiatives, as follows.

Development of a location strategy program to co-ordinate and integrate the establishment of regional technology precincts based on core technologies.

Further work to identify and evaluate new areas of opportunity for the Government to make strategic and catalytic investments ... in new technology based business ventures.

Implementation of a technology marketing program to highlight the benefits of and need for greater awareness and exploitation of our scientific and technological capacities. (Victorian Government, 1987: 133)

The proposed location strategy program referred to above resulted in the Victorian Government's Technology Precincts Policy. This will be reviewed in detail in the next chapter of this dissertation.

In general, the Victorian Government's TDP represented a determined approach to the development of HTI in Victoria. Amongst other things, the Program aimed to create the type of partnerships that have made the Japanese Government so successful in HTI development. The TDP also involved providing significant support to high technology enterprises in Victoria. The fact that the Australian Government has failed to develop an overall HTI development strategy (such as the TDP) also gives an indication of why the TDP was an admirable policy.

The TDP was implemented with some success in the years after it was announced. However, the Government's pro-active approach (particularly direct investment in high technology ventures) suffered a major downfall in the late 1980's, mainly due to the collapse of the Victorian Economic Development Corporation.

The Victorian Government's urban development strategies should also be mentioned as they are also relevant to this thesis. In 1987 the Government released an urban development strategy for metropolitan Melbourne titled "Shaping Melbourne's Future"

(Victorian Government, 1987a). In 1992 it released a State urban development strategy titled "A Place to Live" (Victorian Government, 1992). Both strategies recognised the economic importance of HTIs and included measures aimed at enhancing Melbourne and Victoria as a place for HTIs to develop.

In a section titled "Infrastructure for commercial and industrial development", the Government's urban development strategy for Melbourne announced the following measures under the heading of "New technologies":

Identify and support research and technological strengths in each region.

Develop a government telecommunications network to improve the effectiveness of government services.

Investigate the potential for a regional telecommunications facility ("teleport") near the Central City.

Encourage technology transfer and improved production through decentralised services throughout the metropolitan area, co-ordinated under the National Industry Extension Service.

Provide suitable zoning and infrastructure for special technology precincts and science park developments in appropriate locations.

Identify surplus government land suitable for the establishment of strategic industries (including high technology industries) and, where appropriate, attach conditions of sale to ensure this use. (Victorian Government, 1987a: 42)

The State urban development strategy was less specific than the metropolitan strategy in terms HTI development measures. However, many of the strategy's wider initiatives were relevant to the HTI sector. These included improving the State's transport and communication links, and physical and social infrastructure. It is notable that this strategy

highlighted the economic success of Melbourne's southern and eastern suburbs:

The south-east has the necessary attributes for continued prosperity. Medium-term residential growth is provided for in the south-eastern growth corridor. There are potentially more than 100,000 additional housing allotments, mostly in Berwick, Cranbourne and Pakenham. There are also opportunities for infill redevelopment. Vacant industrial land and buildings provide scope for industrial growth over the next twenty years. High technology industries will continue to develop, especially around Monash University. (Victorian Government, 1992: 46)

"A Place to Live" announced strategies to build on the economic success of Melbourne's eastern and southern suburbs, including the designation of Dandenong as a major metropolitan activity centre and the possibility of a new airport in the region.

With the election of the Liberal/National Coalition Government in October 1992, a new approach to industrial development in Victoria was introduced. In September 1993, the new Minister for Industry and Employment announced an industry strategy called "Doing Business in Victoria" (Minister for Industry and Employment, 1993). This strategy has four essential elements:

Improving the business environment by reducing Government input costs to business and reforming the labour market to make it more flexible and internationally competitive;

Reforming bureaucratic procedures by creating a streamlined and predictable planning and regulatory environment, and fast-tracking large investment projects, which will reduce costs and delays to business;

Facilitating investment and export performance in key industry sectors to create wealth and employment; and

Assisting business to improve competitiveness and productivity at the enterprise level and to focus on export opportunities. (Minister for Industry and Employment, 1993: 6-7)

Whilst this strategy relates to Victorian industry in general, it does not ignore the importance of HTI. In fact, HTIs have been identified in the strategy as some of the main industries for attention. A range of initiatives and measures will be pursued to facilitate the development of HTIs. For example, a Strategic Industry Research Foundation will be established and will receive funding of \$16.5 million over three years, to facilitate and encourage innovation and development of new technologies. Financial and other forms of assistance will be provided to new HTIs. The types of assistance envisaged will include grants to offset payroll tax, land tax, provision of infrastructure. Assistance with training, site selection and fast-tracking of regulatory approvals will also be provided. However, according to the Minister, the strategy "is not based on the handout mentality that existed in the eighties" (Minister for Industry and Employment, 1993a: 1).

It is clear that the new Victorian Government has no intention (at least for the time being) to pursue any form of spatially-focussed HTI development policy. No mention is made of this type of HTI development, or the TPP, in either the industry strategy outlined above or in a major statement made by the new Minister for Planning in August 1993 (Minister for Planning, 1993). However, the Minister for Planning did announce that the Government intended to review and revise the urban development strategies for Melbourne and Victoria, by late 1994.

4.5 THE TECHNOLOGY PARK CONCEPT

The technology park concept originated in the USA in the late 1940s. Since then the concept has been used and varied for a range of developments throughout the world under a variety of other names, such as, science park and research park. However, for the purposes of this exercise, the term "technology park" will apply to all of these developments because, in essence, they all based on the same principles.

Very basically, the aim of a technology park is to create an estate that is attractive to HTIs and related enterprises. Technology parks are an attempt to capitalise on the agglomerative tendencies of HTIs. They seek to emulate concentrations of HTIs like Silicon Valley and Route 128, including all they yield, but on a smaller scale. To achieve this, technology parks generally comprise the following features:

- a pleasant physical environment;
- low density development, generous open spaces;
- a nearby university or similar facility;
- specific occupancy criteria; and
- good quality buildings and landscaping. (Blakely and Bowman, 1986)

Technology parks have been established by both the public and private sectors, sometimes on an individual basis, sometimes jointly, and sometimes with the involvement of academic institutions.

In Australia, the most notable technology parks that have been established are Technology Park Adelaide, the Canberra Technology Park, the Western Australian Technology Park in Perth and the Gold Coast Technology Park. In Victoria, the Tally Ho Technology Park located in Melbourne's east (East Burwood) is probably the most notable example. (Jones et al., 1985; Blakely and Bowman, 1986; Wilson Sayer Core Pty Ltd, 1986.)

It is not necessary to discuss the individual details of the above-mentioned technology parks. However, some general observations should be noted. In terms of location, all of these technology parks are found in the outer areas of the cities concerned and three are situated adjacent to one or more major institutions. They vary in size between 15 hectares (Tally Ho) and 85 hectares (Adelaide) but all provide a high quality business environment in terms of infrastructure, amenities, services and appearance. Careful control and management of the development of the parks is another common feature. It is evident

that government involvement or support has been an important ingredient in the development of most of the parks. In fact, the Adelaide, Perth and Gold Coast parks were developed by the respective State Governments. The Adelaide and Perth parks are both managed by a statutory authority. Local government authorities have assisted the parks through their town planning schemes and other forms of support. For example, the City of Salisbury, the local government authority with jurisdiction over Technology Park Adelaide, offers firms establishing within the park exemption or partial exemption from their rates for up to five years. (Jones et al., 1985; Blakely and Bowman, 1986; Wilson Sayer Core Pty Ltd, 1986.)

Technology park development in Australia is in its infancy. Whilst the technology parks referred to above have all had some success, it would be fair to say that their success has been limited, and these are the most notable technology parks in Australia. In general, technology parks are rarely very successful. In fact, a study of technology parks in the USA has found that they fail, on average, half the time and several other studies into successful technology parks attribute their success to existing clusters of HTIs (ie. other factors) rather than the parks themselves (cited in Falk et al., 1992: 79). It should also be noted that a study in the late 1980's of three Australian technology parks, including the Western Australian Technology Park, found a low level of interaction between firms in the parks and a low level of interaction between the firms and the nearby university or research infrastructure (cited in McLennan Magasanik Associates Pty Ltd et al., 1990: 16).

4.6 SUMMARY

In essence, HTI is highly valuable in terms of economic growth. As a result, governments of all levels around the world have implemented a range of policy measures to encourage the development of HTIs within their jurisdictions. Most of these policies are broadly-targeted and these measures are very important. But some government policies involve spatially-focussed measures such as the technology park, or are based on the technology park concept. The success and value of technology parks, however, is questionable.

CHAPTER FIVE
THE TECHNOLOGY PRECINCTS POLICY

5.1 INTRODUCTION

This chapter will review Victoria's Technology Precincts Policy. It will provide a history of the policy's development and will discuss the relevant literature.

5.2 DEVELOPMENT OF THE POLICY

The technology precinct concept had its genesis in the mid-1980s when a number of politicians, academics and government officials in Victoria (including Barry Jones, the then Federal Minister for Science) saw a need for locational strategies to encourage and facilitate technology development in Victoria. This idea later gained the support of the then State Government Department of Industry, Technology and Resources (DITR).

In 1986, DITR commissioned Dr. Edward Blakely, an economic development planner of California, in association with consultants Cameron McNamara of Sydney, to undertake a study with the following objectives:

Establish essential preconditions (support systems) for advanced technology development;

Advise on support systems required in Victoria to facilitate technology development;

Advise on implementation of technology initiatives;

Determine government support for initiatives on technology and innovation (eg. science parks, technology centres, incubators). (Blakely, 1987: a)

In the original project brief, the proposed study was divided into three stages. Stage 1 would provide an examination of the international context for advanced technology development in Victoria and an assessment of literature pertaining to technology development. Stage 2 of the study would analyse Victoria's existing technology

development activities on an area basis. Finally, Stage 3 would make recommendations on policy formulation and implementation measures to facilitate technology development in selected areas of Victoria (Blakely, 1987). However, as will be shown below, the study did not proceed exactly according to this original schedule.

5.2.1 Stage One

In February 1987, Blakely produced a report on Stage 1 of the study for DITR. This report, titled "Infrastructure for Technology and Innovation" (Blakely, 1987), found that innovation and technology development are tied very closely to particular locations that possess certain strengths and characteristics and that government promotion of such locations has a pronounced effect on the development of advanced technology industries within the area. More specifically, based on an assessment of relevant literature and overseas "models" of technology development (eg. Japan's Technopolis Policy), Blakely argues that HTIs require special "support systems", such as:

Information, communication and the formation of strategic networks. Face to face contact between key participants in the technology development process is fundamental to advanced technology development;

Entrepreneurs and scientists are more important than factors such as markets, sources of materials, labour and transport costs;

Education and research facilities. The presence of a university close by is not sufficient. The university should be a major research centre and have links with commercial development efforts in the area. The university environment also needs to be entrepreneurial;

A technology image is important for a region. Some of the ways of creating a technology image are:

- identifying a core technology or theme for technology development in the area. This core technology or theme should be based on the resources in the area;
- the use of universities to enhance the technology image of a region;
- use of concepts such as science parks, technology parks, and technopolis to facilitate the development of a technology image.

Management, marketing and finance are as important for technology development as other support systems. Academics and researchers very often lack entrepreneurial, marketing, financial and management skills;

Government support. Indirect government support measures to create an environment conducive to technology development are more successful than direct involvement in technology development. Decentralised government systems are more responsive to technology development because new ideas are often generated at the local level. For this reason, local government support and economic development initiatives are very important in technology development;

Infrastructure. Some of the principles applying to infrastructure are:

- It is important to view the entire area and not the facility (technology park, science park) as the technology development area;
- all ingredients for technology development must be available in the technology development area, including cheap land, venture capital, skilled personnel and an accessible university science facility;
- quality of real estate developments must be superior. (Blakely, 1987: c, d)

Later in the Stage 1 report, Blakely identified and examined six areas within Victoria which were seen as "representative" of the need to spatially target technology and economic development initiatives. These were Monash University and surrounds, La Trobe University and surrounds, the Southbank area, Bendigo, Knox and Werribee. According to Blakely, these areas had the potential to contribute to technology and economic development in Victoria for various reasons but needed support to realise that potential.

Stages 2 and 3 of the study would "move from the framework to a solid set of programs and projects that will accelerate the State Technology Strategy by building on an institutional framework and expertise to complete major technology developments". More specifically, in Stage 2 the consultants intended to "assist groups and organisations, including the state Government, coordinate and integrate their efforts to support technology development across government departments and among the various regions". In Stage 3, they intended to "provide on the spot assistance to the state government and local groups in the direct implementation of specific projects" (Blakely, 1987: g-h).

As a result of Blakely's Stage 1 findings, the Victorian Government announced in April 1987 that it had decided to broaden its Technology Development Program by "Development of a location strategy program to co-ordinate and integrate the establishment of regional technology precincts based on core technologies" and "establishing principles and guidelines for joint action by the State Government, local government and industry to encourage the establishment of advanced technology precincts" (Victorian Government, 1987: 133 & 146).

5.2.2 Stage Two

In January 1988, Blakely produced a report on Stage 2 of the study commissioned by DITR. This report, titled "High Technology and Location" (Blakely, 1988) recommended to the Victorian Government the introduction of what is now known as the "Technology Precincts Policy" (TPP). According to the report, the TPP is based on the requirements for

gaining an international reputation for Victoria as a major technology centre. The report states that such requirements include the need to:

Gain international attention for the location and associated "core" technologies.

Provide for a mechanism to link higher education resources to technology production and dissemination.

Develop a unique institutional and geographical arrangement that presents a technology image but does not merely copy other overseas models, e.g. technology parks, etc.

Allocate and concentrate state government resources in a manner that builds internationally competitive infrastructure that will stimulate new technology firm formation and attract existing firms to the area. (Blakely, 1988: i)

To achieve the above, Blakely recommended the designation of a number of "technology precincts" within Victoria. The report describes the technology precinct concept as follows:

Technology precincts are a new concept and method of producing in Victoria, and primarily in Melbourne, internationally "recognisable" areas in which research, development and commercialisation occur on a world scale. These precincts are associated with institutions of higher education in geographic areas that have significant scientific resources, but lack a coherent form through which these resources can be organised and recognised. The areas selected as precincts form a "network" of inter-related places with specific scientific and technological opportunities.

Each of the selected sites requires separate development and articulation. The total group of sites, much like the Silicon Valley, will provide the nurturing arena for high growth, new technology firms and the dissemination point for new technology and techniques to existing industry across the state and the nation. (Blakely, 1988: ii)

Blakely identified six specific geographic areas of Victoria as appropriate technology precincts for promotion by the Victorian Government. Such precincts were selected on the basis of the following requirements:

The designated areas should be large enough to include a mixture of institutions (eg. universities, hospitals, public and private research laboratories and private sector firms).

In order to gain international recognition (as have Silicon Valley, North Carolina Triangle and the Cambridge technology area), the designated areas should provide a unique approach to the assembly of resources within the area.

The areas should include, as active participants, one or more research universities that have established international reputations in certain core technologies.

The land and sites available should enable a wide range of new and established technology firms to locate.

There should be a sufficiently broad range of facilities provided to encourage technology firms to locate in the area. These facilities must incorporate special infrastructure (e.g. telecommunications, access to advanced computers or testing equipment, etc). In addition, these facilities should be linked by common urban planning and transportation systems. Furthermore, there should be shared recreation, demonstration/museum and cultural activities as well as access to government sponsored research and university resources.

The area should be surrounded by high quality housing, retail, office and related urban amenities.
(Blakely, 1988: 2)

Two sets of three precincts were proposed by Blakely (1988) based on the above requirements. The first set were called "R&D Oriented Technology Precincts". According to the report, these precincts would be centred on institutions with unique core

technologies and magnet infrastructure. Their primary aim would be to maximise the commercial and industrial spinoffs of research and development activities that occur within the institutional centres. The specific precincts within this set proposed by Blakely were:

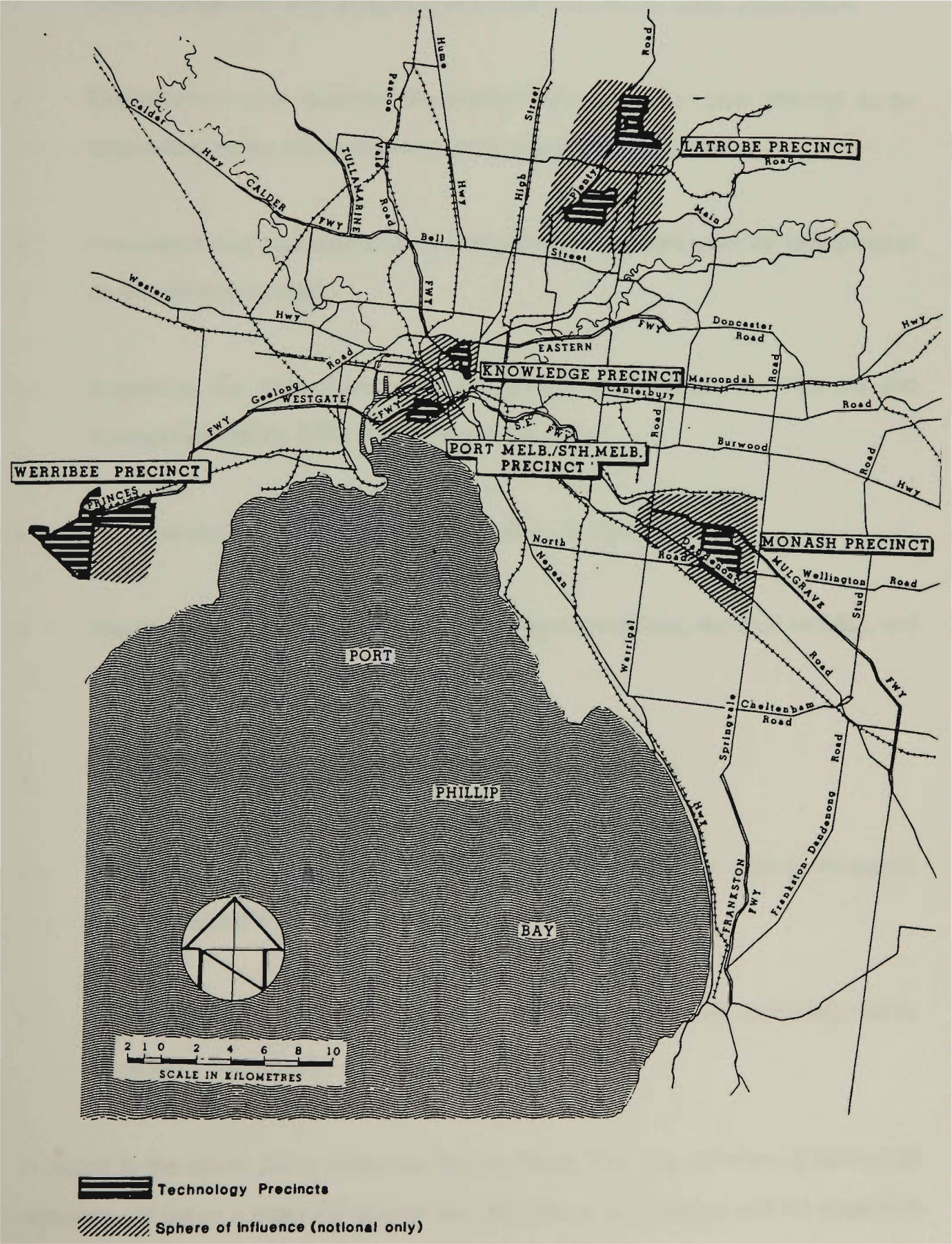
- Monash Precinct (centred on Monash University).
- La Trobe Precinct (centred on La Trobe University).
- Knowledge Precinct (incorporating a number of institutional centres including Melbourne University and the Royal Melbourne Institute of Technology).

The second set of precincts proposed by Blakely were called "Production Oriented Technology Precincts". According to the report, these precincts would be centred on areas with a technology production orientation, special infrastructure and magnet facilities. Their primary aim would be to promote the development and application of technology and science to both new and existing firms within the precincts. The specific precincts within this set proposed by Blakely were:

- Werribee Precinct (centred on the State Research Farm).
- Port Melbourne/South Melbourne Precinct (proximity to the Knowledge Precinct, the Central Business District, transportation facilities, the World Trade Centre, etc).
- Bendigo Precinct (centred on the Bendigo College of Advanced Education).

Figure 5.1 shows the location of the five technology precincts proposed by Blakely for metropolitan Melbourne.

Figure 5.1: The Location of the Five Melbourne Metropolitan Technology Precincts Proposed by Blakely



Source: Blakely, 1988: 5.

In his Stage 2 report, Blakely recommended that the proposed TPP be implemented by a range of measures, including:

- Formal designation and recognition of the precincts by the State Government.
- Establishment of a "precinct development committee" for each precinct to be responsible for the overall planning and management of the area.
- Formulation and implementation of a "precinct development plan" by each precinct development committee.
- Support by the State Government through the (then) Ministry for Planning and Environment (MPE), DITR and Ministry of Education.
- Provision of new statutory planning tools for each precinct.
- Provision of magnet infrastructure (e.g. telecommunications, research facilities, etc) for each precinct.
- A joint MPE/DITR steering committee to guide the precincts.
- Financial support for each precinct from the State Government, local governments, universities and industries.
- Encourage and support the development of incubator centres, technology parks, etc within the precincts.

In regard to the above policy measures, Blakely wrote "This concentration of technology resources will act as a major stimulus for new technology firm creation and the expansion of existing technology based firms in these precincts" (1988: 2).

This was Blakely's last report regarding the TPP. No Stage 3 report was produced but Blakely did provide some further assistance later in the process.

5.3 FORMALISATION OF THE POLICY

In March 1988, the Victorian Government approved the designation of the five Melbourne precincts, as proposed by Blakely. This was formalised by an amendment (RL4) to the regional section of all planning schemes in the metropolitan region and to the local section (maps) of the planning schemes of the ten municipalities that contained a technology precinct. A copy of the planning scheme amendment and the explanatory report which accompanied the amendment is provided in Appendix A. It should be noted that this amendment introduced overlay controls covering the precincts rather than rezoning the land. The Bendigo Precinct was similarly designated by an amendment (No. 13) to the Strathfieldsaye Planning Scheme. A copy of a press release by DITR regarding the designation of the technology precincts is also provided in Appendix A. It can be seen from this statement that the Government believed that the new precincts would be highly successful in creating private investment and jobs in Victoria.

5.4 SUBSEQUENT HISTORY

Soon after the designation of the six technology precincts, the consultants Tide International Pty Ltd were commissioned by DITR to report on:

The current status of each precinct and establishment of short and long term goals.

Problems to be solved unique to each precinct, and the linkages between the precincts.

A suggested program of work for each precinct over the next two years.

Other relevant issues concerned with the implementation of precinct goals and objectives. (Tide International Pty Ltd, 1988: 1.2)

In July 1988, Tide International Pty Ltd produced a report titled "Technology Precincts in Victoria" (Tide International Pty Ltd, 1988). For this report, a workshop regarding each precinct was held, attended by government representatives, key precinct individuals and Dr Edward Blakely. Through these workshops, the consultants identified a number of problems and issues with respect to the precincts. The following quotes from the consultants' report demonstrate some of the general problems or issues identified:

The precinct development concept is not yet sufficiently understood by all concerned. The notion of the Technology Precinct as a process or mode of operation focussing on, but not confined to, a particular gazetted area needs to be emphasised.

In each Precinct, there is a need to clarify the notion of the precinct (and its sphere of influence) and its relationships, where relevant, to district centres, other technology-associated parks, affiliated institutions and major infrastructure.

There is currently an undue focussing on the geographic and real estate aspects of the Precinct proposals in a number of Precincts.

There is also a lack of appreciation of the nature of the developments proposed, particularly the intended integration of technology based industries and work places with residential and recreational facilities.

There is a requirement for all relevant State Government departments and agencies to be informed of the program and to appreciate that it has implications which are wider than industry development.

There is a particular requirement to ensure that Commonwealth agencies are also fully informed of the Technology Precinct program.

The precincts should be considered as dynamic concepts.

The identification of core technologies has not yet been conducted in a systematic manner.

Technology Precincts will succeed if the standards of science, technology and urban environment are at the highest level. Core technologies and magnet infrastructure must be of a standard that will attract researchers and commercial interests nationally and internationally. This presents a major challenge not only to the Precincts but to the Victorian Government. (Tide International Pty Ltd, 1988: 2.1-2.7)

Whilst the Tide International report was produced only a short time after the technology precincts were designated, it is obvious from the above that there were problems with the TPP and/or the State Government's implementation of the policy that needed attention.

Also in July 1988, the then Ministry for Planning and Environment (MPE) produced a report on the results of a survey regarding the location of "technology intensive firms" in metropolitan Melbourne (MPE, 1988). A copy of a news release regarding this survey is provided in Appendix B. According to the news release, this survey was undertaken as "a complementary exercise" to the Government's TPP.

The above-mentioned survey was developed in conjunction with Dr Edward Blakely and was carried out over the latter half of 1987. It was conducted via a questionnaire that sought to determine the factors which influenced choice of location by technology intensive firms in Melbourne and also assess their accommodation and infrastructure requirements. The survey had a sample size of (only) 49 firms involved in a range of production fields including computer software, scientific instruments, robotics and aerospace.

The news release in Appendix B provides a summary of the survey findings, however, the following comments from the survey report are also important:

The most significant clusters of firms exist in the Cities of Waverley and Oakleigh (in close proximity to Monash University and CSIRO) and the City of Knox.

The preference of firms to locate in the Eastern and Southern regions of Melbourne emphasises the importance of firms' access to skilled labour (the Eastern and Southern regions containing the larger proportion of Melbourne's population and the more affluent suburbs).

Access to research organisations such as Universities, Institutes and CSIRO does not appear to be a major locational determinant for existing high tech firms - in Melbourne.

The survey results suggest that ... there is a greater role for the Government to play to meet the needs of advanced technology firms - through special planning and infrastructure measures.

It will be an important element in further strategic studies to decide how best to relate these existing high tech industrial clusters to the newly designated Technology Precincts.

Many concerns of high-technology industries relate to broader planning policy issues, such as conflict with residential uses and requirements for office space and car parking. (MPE, 1988: 28-30)

[The findings of the MPE survey are generally consistent with those of Newton and O'Connor (1985) who found that HTI activity in Melbourne is concentrated in the central area and the inner to middle south-east corridor. On the other hand, Newton and O'Connor found very little HTI activity in the outer suburban areas of Melbourne whereas the MPE survey found that the City of Knox (an outer-eastern metropolitan municipality) contained a significant cluster of technology intensive firms. However, Newton and O'Connor did state that where HTI locations were found in the outer suburbs of Melbourne, they were in the "middle class" areas (eg. Knox) as opposed to the "working class" areas.]

In April 1989, the MPE released a report titled, "Metropolitan Activity Centres" (MPE, 1989), which included a detailed description of the Government's TPP. Prior to the release

of this report, the details contained in the relevant planning schemes was all that was publicly known about the Governments' TPP. In other words, this was the first formal statement by the Victorian Government on the aims and components of the TPP and it appeared one year after the policy was adopted. This report announced that the overall aims of the precincts are:

To gain an international reputation for high technology development;

To promote technology transfer and enhance productivity potential in the institutes of research and higher education and technology production firms;

To establish specific locations for technology development;

To promote the efficient use of public and private sector resources, including the technology precinct network. (MPE, 1989: 21)

The above-mentioned report also announced that the TPP comprised the following elements:

Each of the designated technology precincts will be developed on as comprehensive a basis as possible, involving collaboration with local councils and business representatives, academic and research staff, and State government. Objectives for each Technology Precinct are contained in the Metropolitan Regional Section of Planning Schemes.

Private sector developments which assist in the implementation of Technology Precinct objectives (eg science and technology parks, 'incubators' and complementary facilities) are encouraged to locate in the Precinct or surrounding sphere of influence.

A statutory planning approach that incorporates objectives, performance standards and design guidelines, rather than detailed provisions, will become the basis on which development proposals are assessed.

Performance zoning methods will, as far as possible, replace any specific height, setback, open space or other general regulation within the precincts.

A complementary 'enhancement strategy', will be developed to upgrade urban amenity, the availability of supporting enterprises (such as hotels, shops and community facilities) and to integrate each of the precincts with their surrounding area. It is critical for those District Centres and other activity centres surrounding the technology precincts to provide the requisite infrastructure required by visitors, the local community and workforce.

State Government departments and agencies will promote infrastructure development (eg research/science parks, technology incubators) within each of the precincts. (MPE, 1989: 22)

A copy of the parts of the Metropolitan Activity Centres report which relate to the technology precincts is provided in Appendix C for further information (this includes details of each Melbourne precinct including their status at the time). A copy of a newspaper article regarding the release of the report is also included in Appendix C as the article focuses on the precincts.

In October 1989, the format of all Victorian planning schemes was revised by the State Government. Prior to this change, all of the provisions relating to the technology precincts in Melbourne were contained within the regional section of all planning schemes in the metropolitan region, with the exception of the specific map provisions which were contained within the local sections of the ten relevant planning schemes (see Appendix A). In October 1989, the provisions formerly in the regional section of all metropolitan planning schemes were moved to the local sections of the ten relevant planning schemes and replaced with a new general clause regarding the five Melbourne precincts. Appendix D

provides a copy of the metropolitan regional section clause introduced in 1989. An example of a local section technology precinct clause introduced in 1989 is also provided in Appendix D. These provisions remain in the planning schemes to this day.

In April 1990, the consultants McLennan Magasanik Associates Pty Ltd, Econsult (Australia) Pty Ltd and Urban Spatial and Economic Consultants Pty Ltd produced a report (titled "Technology Precincts - A Strategic Perspective") for the then Department of Planning and Urban Growth (McLennan Magasanik Associates Pty Ltd et al., 1990). In this report, Blakely's original concept is reviewed against the findings of individual studies (consultancies) into the six precincts. The consultants then made recommendations regarding the future implementation of the TPP. The following comments from the report outline the consultants' main conclusions.

The argument for Technology Precincts rests on three propositions:

- for effective innovation productive interaction among and between enterprises, research and other institutions is essential;
- the conditions for competitive success in the nineties will increase the necessity for successful interaction;
- inasmuch as this interaction is essential at a national and global level (facilitated by electronic technology) it is essential at a local level (facilitated by face-to-face meeting between people). (1990: 17)

...while the Technology Precinct rests on the significance of local interaction, without exception the consultancies found that at present such linkages are largely non-existent in the Precincts.....This is a most important finding and appears to be corroborated by investigations elsewhere. Given that the Precinct idea is nothing if it does not promote interaction, the argument for Precincts rests on something which is not yet proven in Australia. (1990: ii)

The proposition is that the Technology Precincts will offer a context in which the enterprise will be able to develop and interact with its nearby peers and sources of ideas, such as the university and research institutes.....The justification for the Precinct idea then lies in the assertion of the need to foster interaction between enterprises and magnet infrastructure.....Such interaction at present is embryonic, and requires support.....Precinct policy therefore requires intervention to encourage interaction. This should be the prime function of Precinct managements.....Precincts in this sense will likely involve creating supply ahead of demand (this is a likelihood that Blakely recognises). (1990:17)

The case for Technology Precincts is that local interaction is essential to effective innovation and the development of a productive culture. This is the only justification for a spatially-focused policy.....All initiatives should be directed towards increasing the level of interaction. To the extent that this function becomes secondary, then the justification for spatially-focused effort disappears. (1990: ii)

The Precinct idea is one that has to be tested.....Precincts will stand or fall on the energy and commitment of their proponents. (1990: 36)

In mid-1990 the Victorian Government decided to discontinue funding of the TPP and cease responsibility for the development of each precinct. This decision, although prompted by severe budgetary cuts, was also based on the belief that the precincts had all attained effective operation and sufficient momentum to run themselves, under the direction and management of their respective committees. To date, the precincts all remain in place in the relevant planning schemes, despite the change in State Government in October 1992, but they are not receiving as much attention and support as they were in the first few years, contrary to the advice of the consultants' reports.

5.5 SUMMARY

In essence, the TPP can be derived from the Growth Pole Theory and is essentially an expansion of the technology park concept discussed in Section 4.5. However, as was

mentioned in that section, many technology parks do not succeed. Furthermore, the development of the TPP was based primarily on overseas experience and one principle in particular, that HTIs are attracted to locations near universities and the like. However, the importance of these types of research facilities to the location of HTIs is questionable. Furthermore, a survey of technology intensive firms in Melbourne and two consultant studies into the precincts raised serious questions about the relevance or correctness of the TPP and the application of overseas experience to Australian conditions.

It is also significant that, over time, the carriage of the TPP moved from the Government's economic development agency (DITR), to the land-use planning agency (MPE). The strength of town planning agencies is in controlling development, not promoting development.

The development of the policy also did not involve a detailed study into the real or actual locational preferences of HTI in Melbourne or Victoria. It is acknowledged that an important objective of the TPP has been to create supply ahead of demand in the precincts. In this regard, the McLennan Magasanik Associates report reviewed above stated that the precinct concept is one that has to be tested and this will be undertaken in the following chapter.

CHAPTER SIX

HIGH TECHNOLOGY INDUSTRIAL LOCATION IN MELBOURNE

6.1 INTRODUCTION

The previous chapters have set the scene for the major part of this thesis in terms of achieving the thesis aims.

In essence, this chapter examines the locational preferences of HTI in Melbourne and also compares these preferences to the location of the five designated technology precincts. In other words, this chapter will determine where HTI prefers to locate in Melbourne vis-a-vis the precincts. This will establish how accurate and relevant the TPP is and how successful it has been (and will be) in Melbourne.

The short life of the TPP is not a significant problem in terms of the integrity of this thesis. Whilst the precincts have only been in existence for a few years, the major magnet facilities have existed for much longer. Some demand by HTIs for the precinct locations should have existed prior to their designation. Certainly, in the years since the designation of the precincts, there should have been (at least) some tendency for HTIs to be attracted to the magnet facilities in the precincts, if the precinct concept is correct, relevant and successful. If so, this will be confirmed by the data analysed in this chapter. If not, the findings will be able to be used to recommend a more appropriate policy (in Chapter Seven).

Given the limited amount of past research into the HTI location in Melbourne, this chapter is based on primary analysis rather than research using existing data (secondary analysis). This takes the form of an examination and analysis of unpublished data obtained from and produced by the ABS specifically for this thesis.

In Section 6.2 of this chapter, the main components of the primary analysis (empirical) approach are discussed. The primary data is then examined and analysed in detail in Section 6.3. In Section 6.4, the key findings and factors that emerge from the data analysis are discussed.

6.2 COMPONENTS OF EMPIRICAL APPROACH

As stated above, this chapter is based on primary analysis. There are three integral components of the primary analysis approach that warrant explanation and discussion before the data is examined and analysed. These components are the study area, the definition of HTI used and the primary data itself.

6.2.1 The Study Area

The study area is the Melbourne metropolitan area; more particularly, the Melbourne Statistical Division (MSD) as defined by the ABS (see Figure 6.1). The MSD comprises 57 Statistical Local Areas (SLAs) which are identical to the Local Government Areas (LGAs), except as follows. There are 56 LGAs within (or partly within) the MSD. The difference in the number of SLAs and LGAs is because the ABS split the Melbourne LGA into two SLAs: Inner and Remainder. However, for the purpose of this thesis these two SLAs are combined to reflect the LGA and so the total number of SLAs and LGAs within the MSD will be equal. There are also three LGAs that overlap the MSD boundary: Cranbourne, Pakenham and Healesville. The ABS split each of these LGAs into two SLAs: Part A within the MSD and Part B outside the MSD. However, only the parts of these SLAs within the MSD have been included in this study.

In analysing and discussing the primary data, this study will use certain groupings of the SLAs/LGAs ("areas") derived from the metropolitan policy document "Shaping Melbourne's Future" (Victorian Government, 1987a). Details of these groupings are provided in Appendix E. Under these groupings there are five "regions" and five "rings" which overlap to produce sixteen "zones" of metropolitan Melbourne. For example, the municipalities of Williamstown, Footscray and Essendon are located in the Inner Ring and the Western Region and therefore they are located in the Inner-West (IW) Zone of Melbourne.

Figure 6.1: The Melbourne Statistical Division



Source: ABS, 1989.

6.2.2 The High Technology Industry Definition

As was stated at the beginning of Chapter One, there is no universally accepted definition of HTI. There is substantial argument as to what should be regarded as HTI. A very important part of this thesis, therefore, was to find a definition of HTI with a high degree of acceptance and one which would be useable for the purposes of this thesis.

Most people would have a general idea about what a HTI is. On a broad level, understanding what makes an industry a HTI is not very difficult. A HTI is essentially an industry that involves a high level of technology. Since all industries utilise different levels of technology they can, in principle, be arranged in a hierarchy in order of their technological sophistication (DITAC, 1991). Industries at the top of such a hierarchy would be classified as HTIs. Whilst this general concept provides a starting point, what measure(s) should be used to determine the hierarchy and where should the line be drawn between HTIs and non-HTIs within the hierarchy?

A frequently used measure to determine a hierarchy of industries based on their level of technological sophistication is the proportion of technically qualified workers in the total workforce of each different industry. The higher the proportion of technically qualified workers in an industry's total workforce compared to other industries, the higher that industry is placed in the hierarchy of technological sophistication, and vice versa. Industries with a higher than average proportion of technically qualified workers could be classified as HTIs. Another popular approach is to measure the R&D intensity of each industry, by dividing the industry's R&D expenditure by turnover. The higher an industry's R&D intensity compared to other industries, the higher that industry is placed in the hierarchy, and vice versa. Industries with a higher than average R&D intensity could be classified as HTIs. (Markusen et al., 1986; Aydalot and Keeble, 1988a)

Another way of determining a hierarchy of industries, but one not based on technological sophistication, is to measure the rate of change in employment or output experienced by

industries. This method is based on the idea that HTIs are likely to exhibit rapid growth because they are usually new and innovative (Aydalot and Keeble, 1988a). The higher an industry's growth rate compared to other industries the higher that industry is placed in the hierarchy, and vice versa. Industries with a higher than average growth rate could be classified as HTIs.

All of the approaches to the definition of HTI outlined above have their advantages and disadvantages but the first two are the most popular because they are regarded as the most scientific. Markusen, Hall and Glasmeier (1986), in their study that was reviewed in Section 3.3 of this dissertation, used a definition of HTI based on the proportion of skilled scientists, engineers and technicians. The R&D intensity approach, on the other hand, has been adopted and used by the international Organisation for Economic Cooperation and Development (OECD)(DITAC, 1987 & 1991).

On the basis of R&D intensity, the OECD has established groups of industries described as high, medium and low technology, as follows:

High Technology:	Aircraft and Aerospace
	Electronics, Office Machinery and Computers
	Pharmaceuticals
	Scientific and Medical Equipment
	Electrical Machinery
Medium Technology:	Motor Vehicles
	Chemicals (other than Pharmaceuticals)
	Non-Electrical Machinery
	Rubber and Plastics
	Non-Ferrous Metals
	Rail Transport Equipment

Low Technology:	Stone, Clay and Glass
	Food Beverages and Tobacco
	Shipbuilding
	Petrol Refining
	Ferrous Metals
	Fabricated Metal Products
	Paper and Printing
	Wood, Cork and Furniture
	Clothing and Footwear (DITAC, 1991: 1)

The OECD's classification of industries set out above has shown a high degree of stability over the last 20 years (DITAC, 1987: 255). Thus, the classification has been found to be accurate and appropriate around the world. It is also significant that this classification is used by the Australian Government's Department of Industry, Technology and Commerce. DITAC is a national agency concerned with, amongst other things, monitoring Australia's performance in HTI development. Most important, in terms of this thesis, is the fact that DITAC has matched the industries within the OECD's classification with equivalent and specific Australian Standard Industrial Classifications (refer below).

The Australian Standard Industry Classification (ASIC) is a system, produced by the ABS, for classifying "establishments" (eg. individual mines, shops, factories, etc) by industry (ABS, 1983). An industry, in the ASIC, consists of the establishments which have been classified to it. The structure of the ASIC comprises four levels of industry: Divisions (the broadest level); Subdivisions, Groups and Classes (the most specific level). For example, the manufacturing of computers is contained within Division C (Manufacturing), Subdivision 33 (Other Machinery and Equipment), Group 335 (Appliances and Electrical Equipment) and Class 3352 (Electronic Equipment N.E.C.). The ASIC comprises a total of 13 Divisions, 50 Subdivisions, 129 Groups and 466 Classes.

Each ASIC Class is defined in terms of a specified range of primary activities. Similarly, each Group is defined in terms of the activities designated as primary to the Classes within that Group and so on. An establishment that is mainly engaged in activities which have been designated as primary to a particular Class is classified to that Class, whether or not the establishment is also engaged in other (secondary) activities. The ASIC is used by the ABS in the collection, compilation and publication of its industrial data (ABS, 1983).

The industries within the OECD's classification of HTI are listed below in terms of the equivalent ASIC Classes determined and used by DITAC (1987, 1991). A more detailed description of the HTI ASIC Classes is provided in Appendix F.

- ASIC 2763 - Pharmaceutical and Veterinary Products
- ASIC 3244 - Aircraft
- ASIC 3341 - Photographic and Optical Goods
- ASIC 3342 - Photographic Film Processing
- ASIC 3343 - Measuring, Professional and Scientific Equipment N.E.C.
- ASIC 3351 - Radio and TV Receivers; Audio Equipment
- ASIC 3352 - Electronic Equipment N.E.C.
- ASIC 3353 - Refrigerators and Household Appliances
- ASIC 3354 - Water Heating Systems
- ASIC 3355 - Electric and Telephone Cable and Wire
- ASIC 3356 - Batteries
- ASIC 3357 - Electrical Machinery and Equipment N.E.C.

Given that the above definition of HTI has a high degree of acceptance and official use (i.e. it is an OECD classification that is used by DITAC) and it is useable (i.e. in terms of the ABS and the ASIC), this definition was adopted for this thesis.

The following characteristics of the OECD definition of HTI should be noted:

- All of the ASIC Classes within the OECD definition are found within ASIC Division C (Manufacturing). It therefore excludes businesses that provide high technology services, such as communication services. It also excludes research institutions and universities.
- The OECD definition includes some manufacturers that would not commonly be considered HTIs. For example, ASIC 3353 includes manufacturers of refrigerators and lawn mowers.
- The OECD definition excludes some manufacturers that might be considered HTIs. For example, all chemical manufacturers are excluded except for manufacturers of pharmaceutical and veterinary products (ASIC 2763). Motor vehicle manufacturers are also excluded.

The above-mentioned characteristics of the OECD definition of HTI are not serious problems, particularly given the fact that DITAC has found the definition useful. Nevertheless these matters must be recognised.

6.2.3 The Primary Data

The primary data for this thesis was obtained from the ABS. It is unpublished data that was extracted, specifically for this thesis, from an ABS data base called the Integrated Register Information System (IRIS) (also known as the Business Register). The ABS had to undertake specific computer-runs to extract the required data from this data base.

A set of explanatory notes on IRIS data is provided in Appendix G. Amongst other matters, these notes outline the limitations and deficiencies of the Register and its data. In summary, IRIS data is not perfectly accurate. Nevertheless, the ABS Integrated Register

was seen as the most comprehensive source of data for this thesis. Furthermore, the limitations and deficiencies of IRIS data are not considered to be a major issue in this case.

The limitations and deficiencies of IRIS data are not a major issue in respect of this thesis for a number of reasons. Firstly, data relating to only one industrial sector (i.e. manufacturing) has been used in this thesis so the problems associated with inconsistencies in data quality across sectors have been avoided. Secondly, the Register's manufacturing sector data is updated relatively frequently (at least once every year) compared to the data regarding the other industrial sectors, thus reducing the problems associated with the cyclic manner by which the Register is updated. As the explanatory notes state, the Register's manufacturing sector data "is regarded as 'complete' in that it meets requirements for general statistical purposes". It should also be noted that the data obtained for this thesis is not affected by any changes to classifications or statistical units definitions. Despite these points, the limitations and deficiencies of the primary data must be recognised.

To obtain the required data, the ABS staff were advised of the twelve ASIC Classes that make up the OECD/DITAC definition of HTI. They were then asked to provide certain data with respect to each of these ASIC Classes within the MSD. The data requested was the number and employment size of individual sites within each SLA of the MSD occupied by the each class of industry. It should be noted in this regard that, in the context of the Integrated Register, the ABS use the word "location" instead of "site". However, the explanatory notes in Appendix G define a location as "an unbroken physical area or site occupied by an establishment where it engages in productive activity on a relatively permanent basis". As the word "location" is commonly used to refer to a wider area, for the purposes of this dissertation the word "site" will be used instead. Employment is defined as, "Number of employees and working proprietors or partners". Five employment size categories will be used: less than 5, 5 to 19, 20 to 99, 100+ and not known (N/K).

The data for this thesis was obtained for four dates at roughly two year intervals: May 1986 (nearly two years prior to the designation of the technology precincts), August 1988, July 1990 and August 1992 (over four years after the designation of the precincts). The two year intervals between the dates of the data should reduce any problems associated with the cyclic manner by which the Integrated Register is updated.

The ABS provided the required data in a raw form only. Such data was then transformed and manipulated by the author to produce various tables and figures of data which could be more easily analysed and which demonstrate the geographical orientation and locational preferences of HTI within the MSD. As the data is quite recent, any patterns that emerge from it should still be applicable.

6.3 ANALYSIS OF DATA

According to the data obtained for this thesis from the ABS, the MSD as a whole contained a total of 839 HTI sites in 1986, 1024 in 1988, 924 in 1990 and 1082 in 1992; an average total of 967 sites and an increase of 243 or 29% over the 1986-92 period.

To achieve the thesis aims, the primary data will be analysed in a number of ways, as outlined below.

In Section 6.3.1, the distribution of HTI sites in the MSD by region and ring between 1986 and 1992 is discussed to gain a broad understanding of the locational preferences of HTIs in Melbourne. The distribution of HTI sites within the MSD by zone is then discussed and because there are 16 zones of Melbourne this provides a more specific understanding of the locational preferences of HTIs in Melbourne (between 1986 and 1992).

Section 6.3.2 focuses on the twelve ASIC Classes of HTI. It begins by discussing the overall number of HTI sites within the MSD between 1986 and 1992 by ASIC Class. This provides an understanding of the number, and change in number, of HTI sites of each

class in Melbourne between 1986 and 1992. Data regarding the preferred zones of the different HTI classes is then examined and from this locational patterns for some types of HTIs emerge.

Section 6.3.3 focuses on the employment size categories of HTI sites. In the first part of this section, data regarding the number of HTI sites within the MSD by employment size category is discussed. This provides an understanding of the number, and change in number, of HTI sites of each employment size category in Melbourne between 1986 and 1992. Data regarding the preferred zones of HTI sites of the different employment sizes is then discussed to establish whether there are locational patterns for various sizes of HTIs in Melbourne.

In Section 6.3.4, the primary data is analysed and discussed in terms of the seven zones and ten SLAs of the MSD that contain the designated technology precincts. This section will determine the significance of these precinct zones and areas including what affect the precincts have had on the relevant parts of Melbourne.

Due to the limitations and deficiencies of IRIS data and the large amount of data to be discussed, commentary on each section will generally be restricted to the broad trends, patterns and issues, and averages over the 1986-92 period will often be used. Also, all of the numbers and percentages used are rounded to the nearest whole.

6.3.1 The Preferred Regions, Rings and Zones

Table 6.1: Number of HTI Sites in the MSD by Region; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
REG.	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CTR.	153	18%	186	18%	136	15%	163	15%	160	16%	10	4%
WST.	67	8%	80	8%	80	9%	104	10%	83	9%	37	15%
NTH.	112	13%	150	15%	137	15%	156	14%	139	14%	44	18%
EAST	217	26%	294	29%	281	30%	322	30%	279	29%	105	43%
STH.	290	35%	314	31%	290	31%	337	31%	308	32%	47	19%
MSD	839	100%	1024	100%	924	100%	1082	100%	967	100%	243	100%
AVG.	168	20%	205	20%	185	20%	216	20%	193	20%	49	20%

REG. = Region. AVG. = Average. CHG. = Change. NO. = Number. Refer Appendix E for Region details.

Table 6.1 presents the number of HTI sites within each region of the MSD between 1986 and 1992. During this period, the Southern Region contained the highest average number of HTI sites, that being 308, or 32% of the average MSD total for the period (967). The Eastern Region closely followed with an average of 279 HTI sites or 29% of the average MSD total. The Western Region was the least preferred region - it contained the lowest number of sites with an average of only 83 or 9% of the average MSD total for the period.

In terms of change between 1986 and 1992, the Eastern Region experienced by far the greatest increase of all the regions in that it gained 105 sites which accounted for 43% of the total MSD increase (243). All of the other regions also experienced increases but all were below the average increase of 49 sites. The Central Region experienced the lowest increase (just 10 sites or 4% of the total MSD increase).

Table 6.2: Number of HTI Sites in the MSD by Ring; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
RING	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
COR.	153	18%	186	18%	136	15%	163	15%	160	16%	10	4%
INN.	117	14%	159	16%	109	12%	138	13%	131	14%	21	9%
MID.	303	36%	322	31%	297	32%	307	28%	307	32%	4	2%
OUT.	207	25%	278	27%	292	32%	364	34%	285	29%	157	65%
FRG.	59	7%	79	8%	90	10%	110	10%	85	9%	51	21%
MSD	839	100%	1024	100%	924	100%	1082	100%	967	100%	243	100%
AVG.	168	20%	205	20%	185	20%	216	20%	193	20%	49	20%

Refer Appendix E for Ring details.

Table 6.2 shows the number of HTI sites within each ring of the MSD between 1986 and 1992. The Middle Ring of the MSD contained an average of 307 HTI sites over the 1986-92 period (32% of the average MSD total), the highest of all the rings. The Outer Ring contained the next highest average number of sites: 285 or 29% of the average MSD total. All of the other three rings contained less than the average number of sites (193), particularly the Fringe Ring which contained an average of only 85 HTI sites between 1986 and 1992.

The Outer Ring experienced the greatest increase between 1986 and 1992 in that it gained 157 HTI sites, 65% of the overall increase. While the Middle Ring contained the highest average number of sites between 1986 and 1992, it experienced an increase of only 4 sites over this period, well below the average (49). In fact, only the Outer and Fringe Rings experienced above average changes in number of HTI sites between 1986 and 1992.

Table 6.3: Number of HTI Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZONE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC*	153	18%	186	18%	136	15%	163	15%	160	16%	10	4%
IW	17	2%	25	2%	20	2%	28	3%	23	2%	11	5%
IN	39	5%	52	5%	34	4%	41	4%	42	4%	2	1%
IE	26	3%	39	4%	23	2%	31	3%	30	3%	5	2%
IS	35	4%	43	4%	32	3%	38	4%	37	4%	3	1%
MN*	37	4%	50	5%	45	5%	41	4%	43	4%	4	2%
ME*	110	13%	125	12%	121	13%	121	11%	119	12%	11	5%
MS*	156	19%	147	14%	131	14%	145	13%	145	15%	-11	-5%
OW	45	5%	45	4%	50	5%	65	6%	51	5%	20	8%
ON*	18	2%	29	3%	35	4%	44	4%	32	3%	26	11%
OE	64	8%	106	10%	107	12%	138	13%	104	11%	74	30%
OS	80	10%	98	10%	100	11%	117	11%	99	10%	37	15%
FW*	5	1%	10	1%	10	1%	11	1%	9	1%	6	2%
FN*	18	2%	19	2%	23	2%	30	3%	23	2%	12	5%
FE	17	2%	24	2%	30	3%	32	3%	26	3%	15	6%
FS	19	2%	26	3%	27	3%	37	3%	27	3%	18	7%
MSD	839	100%	1024	100%	924	100%	1082	100%	967	100%	243	100%
AVG.	52	6%	64	6%	58	6%	68	6%	60	6%	15	6%

CC = Core-Central, IW = Inner-West, etc. Refer Appendix E for Zone details.

* These zones contain the designated technology precincts - refer Section 6.3.4.

Table 6.3 sets out the number of HTI sites within each zone of the MSD between 1986 and 1992 (refer also Figures 6.3 and 6.4). On average, the Core-Central (CC) Zone contained the most HTI sites of all the zones in the MSD: 160 or 16% of the average MSD total for the period (967). The Middle-South (MS) Zone contained the second highest average number of sites between 1986 and 1992: 145 or 15% of the average MSD total. The Middle-East, Outer-East and Outer-South Zones also contained relatively high numbers of HTI sites. In fact, all of the other zones contained below average (60) numbers of HTI sites between 1986 and 1992, the lowest being the Fringe-West Zone.

The greatest increase in the number of HTI sites between 1986 and 1992 occurred in the Outer-East Zone which gained 74 sites being 30% of the total MSD increase of 243 sites. The Outer-North and Outer-South Zones also experienced significant increases. The Middle-South Zone, on the other hand, lost 11 HTI sites between 1986 and 1992 when the average was an increase of 15 sites.

6.3.2 The ASIC Classes

Table 6.4: Number of HTI Sites in the MSD by ASIC Class; 1986-92

ASIC	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
2763	52	6%	54	5%	33	4%	38	4%	44	5%	-14	-6%
3244	29	3%	39	4%	39	4%	57	5%	41	4%	28	12%
3341	20	2%	25	2%	15	2%	34	3%	24	2%	14	6%
3342	90	11%	173	17%	175	19%	163	15%	150	16%	73	30%
3343	81	10%	74	7%	69	7%	94	9%	80	8%	13	5%
3351	25	3%	27	3%	22	2%	30	3%	26	3%	5	2%
3352	144	17%	207	20%	200	22%	249	23%	200	21%	105	43%
3353	94	11%	101	10%	81	9%	105	10%	95	10%	11	5%
3354	13	2%	12	1%	13	1%	21	2%	15	2%	8	3%
3355	16	2%	19	2%	15	2%	25	2%	19	2%	9	4%
3356	11	1%	10	1%	3	0%	1	0%	6	1%	-10	-4%
3357	264	31%	283	28%	259	28%	265	24%	268	28%	1	0%
MSD	839	100%	1024	100%	924	100%	1082	100%	967	100%	243	100%
AVG.	70	8%	85	8%	77	8%	90	8%	81	8%	20	8%

Note: A description of each ASIC Class is provided in Appendix F.

Table 6.4 (above) shows the number of HTI sites in the MSD between 1986 and 1992 by each HTI ASIC Class. Over this period, ASIC Class 3357 (Electrical Machinery and Equipment N.E.C.) sites were the most common of all the HTI sites within the MSD. This class had an average of 268 sites over the 1986-92 period or 28% of the average MSD total (967). Other common classes of HTI sites within the MSD between 1986 and 1992 were 3342 (Photographic Film Processing), 3352 (Electronic Equipment N.E.C.) and 3353 (Refrigerators and Household Appliances). In fact, on average over the 1986-92 period, the four most common classes of HTI sites comprised nearly three-quarters of the average MSD total for the period. The least common HTI class within the MSD was ASIC 3356 (Batteries) which averaged only 6 sites between 1986 and 1992 or 1% of the average MSD total. In fact, in 1992 there was only one Batteries site in the MSD.

In terms of change between 1986 and 1992, the class that experienced the greatest increase in number of sites was ASIC 3352 (Electronic Equipment N.E.C.) which gained

105 and this accounted for 43% of the total MSD increase (243). It is interesting to note that ASIC Class 3352 includes establishments engaged in manufacturing calculating machines, computers and data processors. ASIC Class 3342 (Photographic Film Processing) also gained a significant number of sites. The class that experienced the most significant decrease was ASIC 2763 (Pharmaceutical and Veterinary Products) which lost 14 sites between 1986 and 1992. The Batteries class decreased from 11 sites in 1986 to one site in 1992.

Table 6.5: Above Average Zones by ASIC Class; 1986-92

ASIC	SECTION 1: 1986-92 AVERAGE		SECTION 2: 1986-92 CHANGE	
	AVG	ABOVE AVERAGE ZONES	AVG	ABOVE AVERAGE ZONES
2763	3	CC, ME, MS*, OE, OS	-1	ON, OS+, FS
3244	3	CC, MS, OW*	2	IW, OW+, FS
3341	1	CC, IN, IE, ME*, MS, OE, OS	1	CC, ME+, OE, OS
3342	9	CC*, ME, MS, OS	5	CC+, IE, IS, ME, OE
3343	5	CC, IS, ME*, MS, OE, OS	1	IN, IE, MS, OE, OS+, FE, FS
3351	2	CC*, IN, MS, OS	0	CC+, IN, ME, OE, FE
3352	13	CC*, ME*, MS, OE, OS	7	IE, IS, ME, MS+, ON, OS
3353	6	CC, IN, MN, ME, MS*, OE, OS	1	IW, MN, ON, OE+, OS, FE
3354	1	ME, MS*, OW, OE, OS	1	MN+, MS+
3355	1	IN, ME, MS, OW, OE, OS*	1	CC+, IN, ON, OE+
3356	0	CC*, IW, IS, ME, OW	-1	#
3357	17	CC, MN, ME, MS*, OE, OS	0	OW, ON, OE+, OS, FW, FE, FS

AVG = Average number and average change in number of HTI sites of each ASIC Class within all zones of the MSD between 1986 and 1992.

* These zones contained the highest average number of sites of the relevant ASIC Class between 1986 and 1992 compared to all of the other zones.

+ These zones gained the highest number of sites of the relevant ASIC Class between 1986 and 1992 compared to all of the other zones.

No zone gained any ASIC 3356 sites between 1986 and 1992.

Note: Refer also Tables H.1 to H.12 in Appendix H.

The above table summarises the most significant data from Tables H.1 to H.12 found in Appendix H. The tables in Appendix H provide the detailed data for each individual HTI ASIC Class, that is, the number of HTI sites of each class within the MSD between 1986 and 1992, by zone. Rather than discuss each of these tables individually, Table 6.5 sets out, for each ASIC Class, the zones which contained an above average number of the relevant sites between 1986 and 1992 (Section 1), plus the zones which gained an above average number of the relevant sites over the 1986-92 period (Section 2). Table 6.5 therefore gives an overall understanding of the zones preferred by each HTI class.

In general, Section 1 of Table 6.5 shows that, for all but one class of HTI, there were at least four zones in the MSD which contained an above average number of the relevant sites between 1986 and 1992. This indicates that, in most cases, the sites of each class of HTI were not very concentrated or clustered in one particular location in Melbourne between 1986 and 1992.

The only class of HTI which had an above average number of sites in less than four zones between 1986 and 1992 was ASIC Class 3244 (Aircraft). Between 1986 and 1992 there were only three zones which contained an above average number of Aircraft sites: the Core-Central, Middle-South and Outer-West Zones. However, upon closer examination (see Table H.2), the Middle-South and Outer-West Zones contained much higher average numbers of sites of this class than the Core-Central Zone. On average over the 1986-92 period, the Middle-South and Outer-West Zones combined contained 23 sites of this class which was 55% of the average MSD total for the period (41).

Whilst there were four zones which contained above average numbers of ASIC Class 3342 (Photographic Film Processing) sites between 1986 and 1992, the Core-Central Zone was by far the most significant (refer Table H.4). In fact, the Core-Central Zone contained more of these sites over the 1986-92 period than the other three above average zones combined. It contained an average of 49 sites of this class or 33% of the average MSD total for the period (150).

It should also be noted that the Core-Central Zone contained above average numbers of sites in ten out of the twelve classes. Furthermore, the Middle-East, Middle-South, Outer-East and Outer-South Zones, also contained above average numbers of most of the classes of sites, and it is notable that these four zones are clustered together in Melbourne's south-east. In general, there was not much difference between the zones preferred by the various classes of HTIs between 1986 and 1992.

In terms of change over the 1986-92 period, Section 2 of Table 6.5 shows that, for all but one of the HTI classes, there were at least three zones which gained above average numbers of the relevant sites. In no case are all of the relevant zones clustered together. This indicates that the growth of most of the different classes of HTI in Melbourne between 1986 and 1992 was dispersed rather than concentrated in any one particular location.

The only HTI class which experienced above average growth in number of sites in less than three zones between 1986 and 1992 was ASIC Class 3354 (Water Heating Systems). The Middle-North and Middle-South Zones were the only zones to experience above average increases in numbers of sites of this class (refer Table H.9). Combined, these two zones gained only four ASIC Class 3354 sites between 1986 and 1992 but this accounted for 50% of the total MSD increase in number of sites of this class for the period. However, these two zones are not located adjacent to each other.

There was one notable exception in terms of a class of HTI that gained sites mostly in one location between 1986 and 1992. Two out of the three above average zones in terms of the growth of ASIC Class 3244 (Aircraft) sites in Melbourne between 1986 and 1992 were the Inner-West and Outer-West Zones, which are located adjacent to each other in the Western Region. These two zones accounted for 57% of the total increase in number of ASIC Class 3244 sites across the whole MSD between 1986 and 1992 (refer Table H.2).

It is also significant that 43% of the total MSD increase in the number of ASIC Class 3341 (Photographic and Optical Goods) sites occurred in one zone: the Middle-East Zone.

It should also be noted that the outer and fringe zones were important in terms of the growth of most of the HTI classes, particularly ASIC Classes 2763 (Pharmaceutical and Veterinary Products) and 3357 (Electrical Machinery and Equipment N.E.C.).

ASIC Class 3357 (Electrical Machinery and Equipment N.E.C.) sites were the most common in the MSD between 1986 and 1992 compared to all of the other HTI ASIC

Classes (refer Table 6.4). In fact, on average, sites of this class accounted for 28% of all the HTI sites in the MSD over the 1986-92 period. For this reason, a detailed analysis of the location of these sites within the MSD is warranted.

The relevant table in Appendix H concerning the number of ASIC 3357 sites in the MSD by zone (Table H.12) shows that the Middle-South Zone contained the highest average number of sites of this class between 1986 and 1992; it accommodated an average of 43 of these sites or 16% of the average MSD total for the period (268). The Outer-East and Core-Central Zones also contained relatively high numbers of sites within this class. In terms of change between 1986 and 1992, the whole MSD only gained one site within this ASIC Class. Many zones experienced decreases in their number of these sites, especially the Middle-East and Core-Central Zones. In fact, of the eight Core, Inner and Middle Zones, all experienced decreases except the Middle-North Zone which did not change. The Outer-East Zone, on the other hand, gained 32 sites of this class over the 1986-92 period (3,200% of the total MSD increase) when the average change was zero. The Outer-West and Outer-South Zones experienced the next highest increases in that they both gained 7 sites of this class between 1986 and 1992.

6.3.3 The Employment Size Categories

Table 6.6: Number of HTI Sites in the MSD by Employment Size Category; 1986-92

ESC	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
<5	269	32%	433	42%	351	38%	532	49%	396	41%	263	108%
5-19	207	25%	269	26%	296	32%	344	32%	279	29%	137	56%
20-99	127	15%	134	13%	154	17%	142	13%	139	14%	15	6%
100+	66	8%	86	8%	70	8%	64	6%	72	7%	-2	-1%
N/K	170	20%	102	10%	53	6%	0	0%	81	8%	-170	-70%
MSD	839	100%	1024	100%	924	100%	1082	100%	967	100%	243	100%
AVG.	168	20%	205	20%	185	20%	216	20%	193	20%	49	20%

ESC = Employment Size Category. N/K = Not Known.

Table 6.6 (above) sets out the number of HTI sites within the MSD between 1986 and 1992 by employment size (ES) category. On average, nearly half of the HTI sites within the MSD between 1986 and 1992 had an ES below 5 and over two thirds had an ES below 20. In other words, most HTI sites were small in respect of employment size.

In terms of change between 1986 and 1992, by far the greatest increase in the number of HTI sites was in the <5 ES category which gained 263 locations (108% of the total MSD change). It should be noted, however, that the substantial decrease between 1986 and 1992 in the number of sites with an unknown ES would account for a high proportion of the increase in the <5 ES category (and a lesser amount of the increase in the other categories). This is because, according to the IRIS data notes in Appendix G, sites with an unknown ES usually have an ES of less than four.

Table 6.7: Above Average Zones by Employment Size Category; 1986-92

ESC	SECTION 1: 1986-92 AVERAGE		SECTION 2: 1986-92 CHANGE	
	AVG	ABOVE AVERAGE ZONES	AVG	ABOVE AVERAGE ZONES
<5	25	CC*, ME, MS, OE, OS	16	CC, ME, OE+, OS
5-19	17	CC, ME, MS*, OE, OS	9	ME, MS, ON, OE+, OS
20-99	9	CC*, IN, ME, MS, OE, OS	1	CC, MN, OW+, ON, OE, FW
100+	4	CC, IW, IN, MN, ME, MS*, OE, OS	0	CC+, IW, IN, ME, OS, FE, FS

ESC = Employment Size Category.
AVG = Average number and average change in number of HTI sites of each ESC within all zones of the MSD between 1986-92.
* These zones contained the highest average number of HTI sites of the relevant ESC between 1986 and 1992 compared to all of the other zones.
+ These zones gained the highest number of HTI sites of the relevant ESC between 1986 and 1992 compared to all of the other zones.
Note: Refer also Tables J.1 to J.4 in Appendix J.

The above table summarises the most significant data from Tables J.1 to J.4 in Appendix J. The tables in Appendix J provide detailed locational data for each individual employment size (ES) category of HTI sites, that is, the number of sites of each category within the MSD between 1986 and 1992, by zone. Rather than discuss each of these tables individually, Table 6.7 sets out, for each ES category, the zones which contained an above average number of the relevant sites between 1986 and 1992 (Section 1), plus the

zones which gained an above average number of the relevant sites over the 1986-92 period (Section 2). Table 6.7 therefore provides an overall understanding of the zones in Melbourne preferred by each size of HTI site.

In general, Section 1 of Table 6.7 reveals that the zones which contained above average numbers of sites of each employment size between 1986 and 1992 were mostly the same. The Core-Central, Middle-East, Middle-South, Outer-East and Outer-South Zones contained above average numbers of all the different sizes of sites. The only difference between the ES categories was that, in addition to the other five zones, the Inner-North Zone contained an above average number of sites with 20-99 employees and the Inner-North, Inner-West and Middle-North Zones contained above average numbers of sites with 100+ employees.

Of all the zones, the Core-Central Zone contained the highest average number of sites with <5 and 20-99 employees and the Middle-South Zone contained the highest average number of sites with 5-19 and 100+ employees (between 1986 and 1992).

In terms of change over the 1986-92 period, Section 2 of Table 6.7 shows that, for all of the ES categories, there were a range of zones which experienced above average growth in number of sites of each size. However, the outer zones were significant in terms of the growth in the number of sites of all the ES categories, particularly sites with less than 100 employees.

HTI sites with an ES of <5 were by far the most common size of HTI site in the MSD between 1986 and 1992 compared to the other ES categories (refer Table 6.6). On average, sites of this size accounted for 41% of all the HTI sites in the MSD over the 1986-92 period. For this reason, the details regarding this ES category deserve special attention.

Table J.1 in Appendix J sets out the data regarding the number of HTI sites with an employment size of less than 5 within each zone of the MSD between 1986 and 1992. This shows that of all the zones in the MSD the Core-Central Zone contained the highest average number of HTI sites of this size over the 1986-92 period with an average of 63 (16% of the average MSD total). The Middle-East, Middle-South, Outer-East and Outer-South Zones also contained relatively high numbers of sites of this size. The most significant increase in number of sites within this ES category occurred in the Outer-East Zone which gained 46 sites between 1986 and 1992 (17% of the total MSD increase of 263). The Core-Central, Middle-East and Outer-South Zones also gained relatively high numbers of sites of this size.

6.3.4 The Precinct Zones and Areas

Table 6.8: Number of HTI Sites in the Precinct Zones; 1986-92

ZONE	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	153	18%	186	18%	136	15%	163	15%	160	16%	10	4%
MN	37	4%	50	5%	45	5%	41	4%	43	4%	4	2%
ME	110	13%	125	12%	121	13%	121	11%	119	12%	11	5%
MS	156	19%	147	14%	131	14%	145	13%	145	15%	-11	-5%
ON	18	2%	29	3%	35	4%	44	4%	32	3%	26	11%
FW	5	1%	10	1%	10	1%	11	1%	9	1%	6	2%
FN	18	2%	19	2%	23	2%	30	3%	23	2%	12	5%
SUM	497	59%	566	55%	501	54%	555	51%	530	55%	58	24%
AVG.	71	8%	81	8%	72	8%	79	7%	76	8%	8	3%
MSD	839	100%	1024	100%	924	100%	1082	100%	967	100%	243	100%
M.A.	52	6%	64	6%	58	6%	68	6%	60	6%	15	6%

M.A. = MSD Average (the average number of HTI sites per zone of the MSD).

Note: The Core-Central Zone contains both the Knowledge Precinct and the Port/South Melbourne Precinct. The Middle-North, Outer-North and Fringe-North Zones contain the La Trobe Precinct. The Middle-East and Middle-South Zones contain the Monash Precinct. The Fringe-West Zone contains the Werribee Precinct.

In respect of the zones which contain the designated technology precincts, only three out of the seven such zones contained an above average number of HTI sites between 1986 and 1992. They were the Core-Central, Middle-East and Middle-South Zones which contain the Port/South Melbourne, Knowledge and Monash Precincts. On average, each

Precinct Zone contained 76 sites between 1986 and 1992, slightly higher than the average for all 16 zones within the MSD (60). Overall, the Precinct Zones contained an average of 530 HTI sites over the 1986-92 period which was 55% of the average MSD total (967).

Only one Precinct Zone, the Outer-North Zone, experienced an above MSD average change in number of sites over the 1986-92 period. (The Outer-North Zone contains part of the La Trobe Precinct.) It gained 26 sites when the average increase for all of the MSD zones was 15 sites. The Middle-South Zone, which contains part of the Monash Precinct, lost 11 HTI sites between 1986 and 1992. On average, each Precinct Zone gained only eight sites (below the MSD average). Overall, the precinct zones gained 58 sites over the 1986-92 period which accounted for only 24% of the total MSD increase.

Table 6.9: Number of HTI Sites in the Precinct Areas; 1986-92

AREA	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
MEL.	46	5%	54	5%	32	3%	36	3%	42	4%	-10	-4%
PRE	24	3%	31	3%	23	2%	21	2%	25	3%	-3	-1%
HEID	13	2%	19	2%	22	2%	20	2%	19	2%	7	3%
D.V.	3	0%	7	1%	5	1%	5	0%	5	1%	2	1%
WHI	15	2%	14	1%	16	2%	19	2%	16	2%	4	2%
OAK.	50	6%	38	4%	36	4%	38	4%	41	4%	-12	-5%
WAV.	44	5%	51	5%	48	5%	46	4%	47	5%	2	1%
P.M.	4	0%	6	1%	5	1%	10	1%	6	1%	6	2%
S.M.	30	4%	38	4%	28	3%	32	3%	32	3%	2	1%
WER	4	0%	6	1%	7	1%	7	1%	6	1%	3	1%
SUM	233	28%	264	26%	222	24%	234	22%	238	25%	1	0%
AVG.	23	3%	26	3%	22	2%	23	2%	24	2%	0	0%
MSD	839	100%	1024	100%	924	100%	1082	100%	967	100%	243	100%
M.A.	15	2%	18	2%	17	2%	19	2%	17	2%	4	2%

M.A. = MSD Average (the average number of HTI sites per area of the MSD).

Note: The City of Melbourne contains the Knowledge Precinct. The Cities of Preston and Heidelberg and Shires of Diamond Valley and Whittlesea contain the La Trobe Precinct. The Cities of Oakleigh and Waverley contain the Monash Precinct. The Cities of Port Melbourne and South Melbourne contain the Port/South Melbourne Precinct. The City of Werribee contains the Werribee Precinct.

Table 6.9 above shows the number of HTI sites that existed between 1986 and 1992 within the ten SLAs that contain the designated technology precincts. This table shows that only six of the ten Precinct Areas contained an above average number of HTI sites

between 1986 and 1992. They were Melbourne, Preston, Heidelberg, Oakleigh, Waverley and South Melbourne which contain, or contain parts of, the Port/South Melbourne, Knowledge, La Trobe and Monash Precincts. On average, each Precinct Area contained an average of 24 sites between 1986 and 1992, only seven sites higher than the average for all the SLAs within the MSD. Overall, the Precinct Areas contained an average of 238 HTI sites over the 1986-92 period which accounted for 25% of the average MSD total (967).

It should be noted that the two most significant areas in terms of HTI sites between 1986 and 1992 do not contain a precinct, or part of one. They were Moorabbin and Knox which contained 85 and 70 HTI sites respectively between 1986 and 1992, much higher than any of the Precinct Areas.

Only two Precinct Areas, Heidelberg and Port Melbourne, experienced an above MSD average change in number of sites over the 1986-92 period. (The City of Heidelberg contains part of the La Trobe Precinct and the City of Port Melbourne contains part of the Port/South Melbourne Precinct.) They gained seven and six sites respectively when the average increase for all of the MSD areas was four sites. Three Precinct Areas actually lost HTI sites between 1986 and 1992: the Cities of Melbourne, Preston and Oakleigh which contain, or contain parts of the Knowledge, La Trobe and Monash Precincts. The average change for all of the precinct areas was zero (below the MSD average). Overall, the Precinct Areas gained only one HTI site over the 1986-92 period which accounted for only 0.4% of the total MSD increase (243).

6.4 KEY FINDINGS AND FACTORS

The key findings from Section 6.3 and the factors that probably explain those findings will be discussed below. Whilst it is not possible to identify the definitive factors, it is possible to conclude from the findings and other data the most likely factors.

In Section 6.3.1, the primary data revealed that the Southern Region and the Middle Ring of Melbourne were significant HTI locations between 1986 and 1992 but both experienced only a small amount of growth in this regard. The most significant growth in HTI sites occurred in the Eastern Region and the Outer Ring. The findings regarding the zones of Melbourne preferred by HTIs were consistent with the findings with respect the regions and rings. The Core-Central and Middle-South Zones contained the highest numbers of HTI sites between 1986 and 1992. The Middle-East, Middle-South, Outer-East and Outer-South Zones, which are clustered together in Melbourne's south-east, accounted for nearly one half of the HTI sites in the MSD between 1986 and 1992. The most significant growth in HTI sites occurred in the Outer-East Zone and, to a lesser extent, in the Outer-North and Outer-South Zones. In general, it can be concluded that the Southern Region and Middle Ring, and more specifically, the Core-Central and Middle-South Zones, are established HTI locations in Melbourne. However, the Eastern Region and the Outer Ring, and particularly the Outer-East Zone, appear to be the new HTI growth areas of the future. (The Outer-East Zone comprises the Cities of Croydon, Knox and Ringwood.)

Given the above, it is clear that the Eastern and Southern Regions of Melbourne are very important in terms of HTI development in Melbourne. The significance of these regions can be explained by a number of factors. In general, the Eastern and Southern Regions contain nearly two thirds of Melbourne's population and residential growth is also high, particularly in the Fringe-South Zone. It is also significant that the suburb of Mt. Waverley, in the City of Waverley and Middle-East Zone, is located at the centre of the urban area of Melbourne according to a study by the Melbourne and Metropolitan Board of Works undertaken in 1989 (Schwartz, 1989). This means that firms located in or around this zone are centrally located in terms of access to suppliers, markets, labour, services and facilities in Melbourne.

More specifically, labour supply and residential amenities are considered to be the most important ingredients in the success of Melbourne's Eastern and Southern Regions in terms of HTI development. (The importance of these factors to HTIs was discussed in

Sections 3.2.2 and 3.2.3 respectively.) In terms of labour supply, most of Melbourne's highly qualified people, managers, administrators and professionals live in the Eastern and Southern Regions. In fact, in 1991, 72% of persons with a Bachelor Degree or higher, 66% of managers and administrators, and 60% of professionals living in the MSD lived in this part of Melbourne (ABS, 1991). The residential amenities of the Eastern and Southern Regions are generally better than the other regions of Melbourne (O'Connor, Maher & Rapson, 1993), particularly in terms of good schools, quality housing and shopping facilities. For example, these regions contain most of the affluent suburbs of Melbourne such as Camberwell, Kew, Box Hill, Brighton, Caulfield and Templestowe (MPE, VGPO & ABS, 1989). In 1991, 65% of households in the MSD with an annual income of over \$80,000 were found within this part of Melbourne (ABS, 1991).

Accessibility and transportation facilities in the Eastern and Southern Regions are also relatively good due to major roads such as the Eastern Freeway, South-Eastern Arterial, Maroondah Highway, Burwood Highway, Princes Highway and the Nepean Highway. However, these roads are becoming more and more congested and another problem is that there is no major airport located in these regions.

It should be noted that the findings of both the MPE survey (MPE, 1988) and the research done by Newton and O'Connor (1985) which were discussed in Section 5.4, also found high concentrations of HTI development in the Eastern and Southern Regions of Melbourne, for basically the same reasons outlined above.

The concentration of HTI sites in particular zones, especially the Core-Central and Middle-South Zones, suggests that agglomeration economies, particularly localisation economies, is another important locational factor for HTIs in Melbourne. (This factor was discussed in Section 3.2.4.)

In terms of the high growth in number of HTI sites in the Eastern Region and the Outer Ring, and particularly the Outer-East Zone, it is considered that the Regional Cycle Theory

is very relevant (refer Section 2.2.4). It appears from the data that the established or core HTI locations (ie. the Southern Region and Middle Ring and the Core-Central and Middle-South Zones) are nearing, or may have reached maturity and new cheaper locations (eg. the Outer-East Zone) are beginning to become more attractive. (This is supported by the fact that there was a decrease in number of HTI sites in the Middle-South Zone between 1986 and 1992.) For example, land prices, rent and rates in the outer areas are likely to be less than in the inner and middle ring areas. Also, industrial buildings in the outer areas are likely to be more modern than in the inner and middle ring areas. In this regard, Searle states that "industrial activities using advanced technology to a significant degree in production and organisation will select specially developed new sites and accommodation. Many existing buildings could be rendered obsolete" (1992: 74). Furthermore, advances in information and communications technology means that nowadays many firms need not be centrally located within urban areas. According to Churbuck and Young (1993: 66), in the USA "Companies are deserting expensive urban real estate and moving to the fringes as electronics changes the business world".

The Product Cycle Theory discussed in Section 3.2.5 could also help explain the high growth in number of HTI sites in the Eastern Region and the Outer Ring, and particularly the Outer-East Zone. Mature firms may be moving from the established areas to the more low-cost peripheral locations. This trend was a significant finding of the USA study undertaken by Markusen, Hall and Glasmeier (1986) discussed in Section 3.3.

In Section 6.3.2, the data showed that, between 1986 and 1992, most HTI sites in Melbourne fell within a small number of ASIC Classes. Over two thirds of the sites fell within three out of the twelve HTI ASIC Classes: 3342 (Photographic Film Processing), 3352 (Electronic Equipment N.E.C.) and 3357 (Electrical Machinery and Equipment N.E.C.). Nearly one half of the new HTI sites that appeared in the MSD between 1986 and 1992 were ASIC Class 3352 (Electronic Equipment N.E.C.) sites and this class includes establishments engaged in manufacturing computers and the like.

In terms of the zones preferred by the various classes of HTI, the data analysis revealed that none of the classes of HTI sites was concentrated in any one particular location (zone) within Melbourne between 1986 and 1992. It also revealed no major difference between any of the classes in terms of locational preferences. Overall, the Core-Central, Middle-East, Middle-South, Outer-East and Outer-South Zones contained above average numbers of most of the classes of sites. It is notable that the latter four zones are clustered together in Melbourne's south-east and this finding reiterates the importance of this location and agglomeration economies.

Whilst the data revealed no class of HTI sites being concentrated in one particular location, it did reveal that ASIC Class 3244 (Aircraft) sites were concentrated in two separate zones: the Middle-South and Outer-West Zones. The high number of Aircraft sites in the Middle-South Zone would be due to the existence of the Moorabbin airport within this zone. The high number of such sites in the Outer-West Zone can be explained by the existence of the Melbourne and Essendon Airports near this zone and possibly the Avalon Airport and the Laverton and Point Cook RAAF Bases which are also located nearby. In essence, access and agglomeration factors can explain the concentrations of this class of HTI in Melbourne.

The most significant concentration of a class of HTI sites in one zone was ASIC Class 3342 (Photographic Film Processing). On average, between 1986 and 1992, 33% of the sites of this class within the MSD were located in the Core-Central Zone. It is difficult to explain this finding except for the fact that the Core-Central Zone contains the CBD of Melbourne where a large number of photographic film processing firms would naturally be located due to its size, population catchment area and accessibility. Localisation economies could also be a factor.

The primary data also revealed that the growth of most of the different classes of HTI (in terms of number of sites) was also dispersed rather than concentrated in any one particular location within Melbourne. The most significant exception was the growth of

ASIC Class 3244 (Aircraft) sites in Melbourne between 1986 and 1992 which was concentrated in two adjoining zones in the Western Region: the Inner-West and Outer-West Zones (the Cities of Williamstown, Footscray, Essendon, Altona, Sunshine and Keilor). These two zones accounted for 57% of the total increase in number of ASIC Class 3244 sites across the whole MSD between 1986 and 1992. This finding can be explained by the existence of the nearby aircraft facilities previously mentioned.

It was also found that the growth in number of ASIC Class 3354 (Water Heating Systems) sites was concentrated in two separate zones. The Middle-North and Middle-South Zones were the only zones to experience above average increases in numbers of sites of this class. It is also notable that 43% of the total MSD increase in the number of ASIC Class 3341 (Photographic and Optical Goods) sites occurred in one zone: the Middle-East Zone. Localisation economies would almost certainly be an important factor in these findings.

In general, the outer and fringe zones were important in terms of the growth of most of the HTI classes, particularly ASIC Classes 2763 (Pharmaceutical and Veterinary Products) and 3357 (Electrical Machinery and Equipment N.E.C.). This emphasises the relevance of the Regional and Product Cycle Theories.

In Section 6.3.3, the data revealed that, between 1986 and 1992, most HTI sites in Melbourne were relatively small in terms of employment size. On average, over two thirds of the HTI sites in the MSD had an employment size of less than 20. Furthermore, over the 1986-92 period, the number of HTI sites with less than 20 employees grew significantly.

In terms of the zones preferred by the various employment size categories of HTI sites, the primary data revealed little evidence of much difference between the categories between 1986 and 1992. HTI sites of all sizes preferred five main zones: the Core-Central, Middle-East, Middle-South, Outer-East and Outer-South Zones. (These zones were also those preferred by most of the HTI classes.) One might have expected some difference, such as

the smaller sites preferring the inner and middle zones and the larger sites preferring the outer and fringe zones, but this was not the case according to the data analysis.

For all of the employment size categories of HTI sites, there were a range of zones which experienced above average growth in number of sites of each size. No significant locational difference in terms of the growth of the different employment size categories of HTI sites emerged. However, the outer zones were significant in terms of the growth in the number of sites of all the categories, particularly sites with less than 100 employees.

Perhaps the most important part of the data analysis was Section 6.3.4 which examined the data in terms of the zones and areas that contain the designated technology precincts. Whilst it was not possible to determine the number, and change in number, of HTI sites within the actual technology precincts over the 1986-92 period, the Precinct Zones and Precinct Areas data enables a general assessment of the precincts' relevance and success to be undertaken.

The first part of Section 6.3.4 revealed that, overall, the Precinct Zones did contain a significant proportion of the HTI sites within the MSD over the 1986-92 period (an average of 55%). However, individually, only three out of the seven Precinct Zones contained an above average number of HTI sites between 1986 and 1992. They were the Core-Central, Middle-East and Middle-South Zones which contain the Port/South Melbourne, Knowledge and Monash Precincts. Only one Precinct Zone, the Outer-North Zone, experienced an above MSD average change in number of sites over the 1986-92 period. (The Outer-North Zone contains part of the La Trobe Precinct.) Furthermore, the Precinct Zones overall accounted for less than one quarter of the total increase in number of HTI sites within the MSD between 1986 and 1992.

Due to the large size of the zones compared to the size of the precincts themselves, the findings with respect to the Precinct Zones could be misleading. That is why data regarding the smaller SLAs (areas) was also examined. The Precinct Areas data provides

the best indication of the precincts' relevance and success because such areas would generally correspond with the sphere of influence of the precincts.

The Precinct Areas contained one quarter of all the HTI sites within the MSD over the 1986-92 period. However, individually, only six out of the ten Precinct Areas contained an above average number of HTI sites between 1986 and 1992. They were Melbourne, Preston, Heidelberg, Oakleigh, Waverley and South Melbourne which contain, wholly or in part, the Port/South Melbourne, Knowledge, La Trobe and Monash Precincts. Perhaps more important was the fact that only two Precinct Areas, Heidelberg and Port Melbourne, experienced an above MSD average change in number of sites over the 1986-92 period. (The City of Heidelberg contains part of the La Trobe Precinct and the City of Port Melbourne contains part of the Port/South Melbourne Precinct.) Overall, the Precinct Areas accounted for only 0.4% of the total increase in number of HTI sites within the MSD between 1986 and 1992.

It can be concluded from the data analysed in Section 6.3.4 that the Knowledge and Monash Precincts and, to a lesser extent, the Port/South Melbourne Precinct, are located in areas which, between 1986 and 1992 were relatively important HTI locations. The fact that these precincts were of some importance in terms of HTI development could be due to the "magnet facilities" in the precincts but it could be due to other factors. However, the fact that other areas (ie. Moorabbin and Knox), which do not contain a precinct or part of one, contained much higher numbers of HTI sites between 1986 and 1992, compared to the Precinct Areas, indicates that the magnet facilities, and the precincts generally, were not significant factors. Furthermore, only the La Trobe and Port/South Melbourne Precincts are located in areas where, between 1986 and 1992, HTI development was increasing above average, but in both cases the growth was only marginally above average. This means that the precincts were not a significant stimulus for new technology firm creation between 1986 and 1992.

The fact that the Werribee Precinct proved to be relatively unsuccessful in terms of HTI development between 1986 and 1992 supports the earlier conclusions regarding the significance of the Eastern and Southern Regions. This is because the Werribee Precinct is located in an area which does not have the labour supply and amenity attributes that HTIs require, particularly when compared to the Eastern and Southern Regions of Melbourne (KPMG Peat Marwick Hungerfords Management Consultants, 1989).

It should be noted that the above finding of this thesis is consistent with the findings of the study by Markusen, Hall and Glasmeier (1986) who found that university R&D was not very important in explaining the distribution of HTIs in the USA. It is also consistent with the findings of the MPE survey (1988) and the study by McLennan Magasanik Associates Pty Ltd, Econsult (Australia) Pty Ltd and Urban Spatial and Economic Consultants Pty Ltd (1990) which both found that access to universities and research institutes was not a major locational determinant for existing HTIs in Melbourne.

6.5 SUMMARY

In summary, the primary analysis set out in this chapter has shown that, for the most part, HTIs prefer the Southern Region and Middle Ring of Melbourne. In terms of zones, HTIs prefer the Core-Central and Middle-South Zones of Melbourne. However, the Eastern Region and the Outer-Ring, and particularly the Outer-East Zone, appear to be the new HTI growth areas of the future.

In respect of the various classes of HTI, the most significant finding was that HTIs within the aircraft manufacturing class tend to strongly concentrate in a limited number of locations near airport facilities. For the most part, the other classes were not found to be particularly concentrated. In terms of the different employment size categories of HTIs, no significant locational patterns emerged.

From the data analysis it was concluded that a range of factors influence the geographical orientation of HTIs in Melbourne. Labour supply, amenities, access, infrastructure and agglomeration economies appear to be the most significant locational determinants. No one factor stands out as much stronger than the others. The Regional and Product Cycle Theories, and particularly cost factors, are also applicable in terms of explaining where HTI is growing and where it is declining in Melbourne.

In respect to the designated technology precincts, this chapter showed that they were not significant factors in terms of HTI development in metropolitan Melbourne. This is because the precincts do not reflect the real factors that influence the location of HTIs in Melbourne. The precincts are based around higher education institutions and scientific resources but the data analysis did not find these to be a significant influence on the location of HTIs in Melbourne. Whilst an important objective of the TPP has been to create supply ahead of demand, the data analysis has shown that the envisaged demand has not yet eventuated, and may never eventuate.

CHAPTER SEVEN
SUMMARY AND CONCLUSIONS

7.1 INTRODUCTION

This chapter will finalise the thesis. It will provide a summary of the main findings and will then draw conclusions from those findings in terms of the development of HTI in metropolitan Melbourne.

7.2 HIGH TECHNOLOGY INDUSTRIAL LOCATION IN MELBOURNE

The previous chapter revealed that, for the most part, HTIs prefer the Southern Region and Middle Ring of Melbourne. In terms of zones, HTIs tend to prefer the Core-Central and Middle-South Zones of Melbourne. However, there is evidence that HTI is declining in the Middle-South Zone whereas the Eastern Region and the Outer-Ring, and particularly the Outer-East Zone, are the locations where HTI is growing the most.

In terms of the various classes of HTI, the most significant finding was that HTIs within the aircraft manufacturing class tend to strongly concentrate in a limited number of locations near airport facilities. The other classes were not found to be particularly concentrated. In terms of the different employment size categories of HTIs, no significant locational patterns emerged.

A range of factors, rather than one or two factors, influence the geographical orientation of HTIs in Melbourne and they appear to be labour supply, amenities, access, infrastructure and agglomeration. This is consistent with the literature reviewed in Chapter Three. The Regional and Product Cycle Theories, and particularly cost factors, are also applicable in terms of explaining where HTI is growing and where it is declining in Melbourne.

Probably the most important finding of this thesis has been that the geographical orientation of HTIs in Melbourne is changing. In fact, the trend is consistent with what Chapman and Walker refer to as "the present 'crisis of capitalism'...the displacement of manufacturing jobs from the metropolitan core toward the rural periphery" (1991: 28). Hall

refers to this process as the "deconcentration of people and jobs from central cities to suburbs" (1990: 2). This emphasises the relevance of the Regional Cycle Theory which argues that regional economic growth is always in a state of flux.

These findings have important policy implications which will be discussed in Section 7.4.

7.3 THE TECHNOLOGY PRECINCTS POLICY

It is clear that the TPP is not relevant, accurate or successful. This is because the precincts do not reflect and are not consistent with the actual geographical orientation and locational preferences of HTIs in Melbourne. The precincts are based around higher education institutions and scientific resources but the data analysis (and other studies) did not find these to be a significant influence on the location of HTIs in Melbourne. Whilst an important objective of the TPP has been to create supply ahead of demand, the data analysis showed that the planned demand has not yet eventuated, and may never eventuate.

In general, there are three basic problems with the TPP. Firstly, it is too location-specific for a city the size of Melbourne in which there are numerous locations where HTIs might and do develop. Secondly, the precincts are essentially just an extension of the technology park concept but the factors that influence the development and location of HTIs are much more complex. This is supported by the fact that technology parks are rarely very successful (refer Section 4.5). The third problem is that the precincts rest on something (local interaction between HTI firms and research institutions) which this and other studies, have found to be largely non-existent both in Australia and overseas (Markusen et al., 1986; MPE, 1988; McLennan Magasanik Associates Pty Ltd et al., 1990).

The State Government must not be aware of the problems with the TPP because the five technology precincts still remain as metropolitan planning policy in the regional section of all metropolitan planning schemes and in the local sections of the ten relevant schemes.

7.4 CONCLUSIONS

To re-quote Macdonald's statement cited in Chapter One, "If high technology is important, then it is also important that high technology policy be correct - rather than simply highly visible - if opportunities are not to be missed and resources wasted" (1985: 7). Section 4.1 showed that HTI is very important in terms of economic and industrial development. The new Victorian Government has made it clear, through recent policy announcements, that it intends to encourage HTI development in Victoria via broadly targeted measures (refer Section 4.4). However, this raises several questions. Should the broadly-targeted measures be the Government's only approach? What should happen to the TPP? Should the Victorian Government adopt a new spatial HTI development policy and if so, what form should it take?

There is no doubt that broadly-targeted HTI development measures are very important but some spatial-focus is necessary where it will be most effective. However, whilst a spatially-focussed HTI development policy is considered necessary, a highly spatially-focussed policy, like the TPP, is not the correct form of policy. As was stated in Section 7.3, the technology precincts are too much like technology parks, many of which have not been very successful. In this regard, Falk, Russell and Parker state:

It seems likely that the disappointing performance of the technology park strategy is precisely because, for the strategy to be successful it would have to anticipate and provide the necessary complex web of circumstances, rather than relying on it somehow arising organically around firms, which would innovate and prosper in supposedly natural clusters. (Falk et al., 1992: 79)

In regard to the MFP, a larger form of location-specific HTI development measure, Falk, Russell and Parker state, "One is...entitled to some scepticism toward the plans advanced so far, especially as they give little indication of how the complex and subtle chains of interactions and alliances, which develop organically in successful industrial clusters, are to be created here (Falk et al., 1992: 80).

Consider Silicon Valley, the most successful area in the world in terms of HTI development. Silicon Valley grew organically over many years as a result of a complex range of factors and circumstances. As Macdonald states, "Silicon Valley was planned by no one" (1985: 11-12). Furthermore, Silicon Valley is not a small area, in fact it covers an area 90 kilometres long by 35 kilometres wide at its widest point (Blakely, 1988: 4).

In terms of HTI development in general, Falk, Russell and Parker argue that, "The above suggests the possibility that enhanced technology strategy at the level of the city, but taking more account of the organic nature of cities and technological development, may well be productive" (Falk et al., 1992: 80).

7.4.1 Melbourne Metropolitan Technopolis Policy

Having regard to the above, the Victorian Government should formulate and adopt a clear policy regarding the development of HTI in the Melbourne metropolitan area. Melbourne contains approximately 70% of Victoria's population and accounts for just over 70% of the State's manufacturing labour force and over 90% of its manufacturing output (Victorian Government, 1990). Melbourne is obviously very important to Victoria's economy, particularly in terms of manufacturing.

In developing a policy on HTI development in Melbourne, the State Government should recognise the organic nature of cities and adopt the structural approach to industrial location (refer Section 2.3.5). That is, it should see HTI location in Melbourne within an all-embracing perspective of the totality of economic, political and social processes. It should acknowledge the individual choice of HTIs and the pursuit of new opportunities rather than seek a specific outcome in a particular spatial order. This is particularly important given the range of factors that have been found to influence the location of HTIs in Melbourne, and the changing nature of HTI location in Melbourne.

Within this policy approach, some focus on specific areas (or zones) within Melbourne would be appropriate, if the circumstances so require, to ensure that resources are directed to the most appropriate locations. For example, as a result of the findings in Chapter Six, the Inner-West and Outer-West Zones deserve special attention and support in terms of aircraft HTIs. Another area of focus could be the Outer-East Zone, where HTI is growing significantly. However, any location-specific focus should not be “set in stone”, it should be a flexible, metropolitan policy which recognises change.

The recommended city-wide HTI development policy for Melbourne would involve a range of measures and initiatives, not unlike Japan’s Technopolis Policy (refer Section 4.2.1) which focuses on developing regions, rather than small areas, by utilising and enhancing resources all over each region. Its goal would be an economic and urban environment in Melbourne which encourages innovation and HTI development.

In general, the policy would not involve initiatives and measures that are very new or unusual, but they would fall within the ambit of a number of different agencies of the State Government. An important aspect of the recommended policy, therefore, would be the integration of all relevant actions of the Government to produce an integrated and concerted approach to the development of HTI within Melbourne. Given the importance of HTI to economic and industrial development, all efforts towards its development should be employed and co-ordinated to ensure that opportunities are not missed and resources wasted.

The actual policy initiatives and measures would, of course, have to be determined by the State Government after appropriate consideration, investigation and consultation. However, some examples and suggestions are outlined below.

Many of the initiatives announced in the Government’s industry strategy “Doing Business in Victoria”, which was discussed in Section 4.4, would be appropriate components of the recommended policy. For example, the financial and other assistance that is being

provided to HTIs would be a valuable ingredient for the policy. Government assistance is important given the fact that this thesis found that most HTI sites in Melbourne between 1986 and 1992 were small in terms of employment size and such sites were increasing. Small firms need support to survive. The Strategic Industry Research Foundation could also form part of the policy. Whilst this and other studies have found that R&D is not a major determinant of HTI location in Melbourne, it is an essential ingredient of innovation in general and should therefore be encouraged across Melbourne.

The study by Markusen, Hall and Glasmeier, discussed in Section 3.3, found that one of the most significant factors that influenced the distribution of HTIs in the USA was the presence of specialised business services. Another initiative of the recommended policy, therefore, could be a survey of HTI firms in Melbourne to establish whether there are any such services which they are lacking. The Government could then assist in the provision of any services that HTIs may require, in the appropriate location.

Town planning and infrastructure measures would also be an integral part of the recommended policy to help create a better urban environment for the growth of HTIs. As the following quote shows, this is something that the MPE recognised in 1988 after its survey of technology intensive firms in Melbourne.

The survey results suggest that, given the increasing complexity of the Australian and international markets - opening up a more diversified range of products and industries - there is a greater role for Government to play to meet the needs of advanced technology firms - through special planning and infrastructure measures. (MPE, 1988: 29)

In regard to town planning measures, the MPE survey found that, "Many concerns of high-technology industries relate to broader planning issues, such as conflict with residential uses and requirements for office space and car parking" (1988: 30). Town planning schemes should be reviewed to ensure that they recognise the specific requirements of HTIs. Furthermore, existing planning schemes in Melbourne do not specifically recognise

HTI but they recognise other types of industry such as Light Industry, Offensive Industry and Extractive Industry. One town planning measure that should be investigated is the amendment of planning schemes to include HTI as a specific category of industry and associated provisions that facilitate its development. Because HTIs are generally innocuous, the use of land for the purpose of HTI could be made an as-of-right use in industrial zones, and perhaps commercial zones, subject to conditions. This would facilitate the development of HTI by providing certainty to prospective developers of HTIs in Melbourne.

In regard to infrastructure measures, the general aim of the policy would be to improve those elements of Melbourne's urban environment which are known to support the development of HTIs. This would be appropriate particularly where HTIs are known to concentrate or are increasing in number. (One form of assistance being provided to HTIs by the Department of Business and Employment is grants to offset the provision of infrastructure which emphasises the need for the recommended policy, to ensure that all measures are co-ordinated.)

Specific infrastructure measures would include improving amenities, accessibility and transportation facilities. The possibility of a major airport in Melbourne's south-east, foreshadowed by the previous State Government, should be pursued. Communications infrastructure should also be enhanced because of the importance of information to HTIs (Macdonald, 1985). In this regard, Searle states:

New telecommunications infrastructure is introduced sequentially between locations, rather than instantaneously across all areas. In addition, not all locations will necessarily receive such advanced infrastructure even in the long term, because of insufficient demand (unless cross-subsidised by other areas). (1992: 75)

The above reiterates the need for a co-ordinated and systematic HTI development policy for Melbourne as a whole, one which links industry and town planning strategies.

7.4.2 Policy Implementation

The main ingredient in the implementation of the recommended HTI development policy for Melbourne would be multi-level co-operation. For example, Japan's Technopolis Policy involves, amongst other authorities, both the Ministry of Land and the Ministry of International Trade and Industry (MITI). MITI recognises the spatial context and views regions as the vessel for HTI development.

The State Government's first initiative toward the recommended policy outlined above should be the establishment of a HTI development advisory group comprising representatives of both the public and private sectors. It should include officers of the Department of Business and Employment and the Department of Planning and Development, high technology industrialists and relevant academics. The first purpose of this group would be to advise the Government on the formulation of the policy details, and then its on-going implementation.

As part of the Government's industry strategy, the Minister for Industry and Employment has established a number of "Sector Industry Groups" for the food, telecommunications, chemicals and automotive sectors, and several other such groups are planned. These groups "will play a major role in the development of strategies for the key sectors" (Minister for Industry and Employment, 1993: 37). The recommended HTI development advisory group could be an additional Sector Industry Group. This group could also be linked to the Planning Advisory Council, established by the Minister for Planning to advise the Government on the formulation of strategic planning policy and the reform of the planning system. However, the carriage of the policy should be the responsibility of the Minister for Industry and Employment.

An important aspect of the on-going implementation of the recommended policy would be the regular monitoring of the ABS' IRIS data, as was done in Chapter Six. This would ensure that the policy's measures recognise the current status and locational preferences

of HTI in Melbourne. A regular survey, like the survey undertaken by the MPE in 1988, would also be appropriate to monitor the needs of HTI firms.

As was stated in Section 4.4, the Minister for Planning has announced that the Government intends to review and revise the urban development strategies for Melbourne and Victoria. The previous State government's urban development strategies contained some HTI development measures but these were limited and disjointed. The new urban development strategies, particularly the strategy for metropolitan Melbourne, will provide a valuable opportunity to properly address the issue of HTI development in Melbourne and could also be used to formalise the recommended policy.

In addition to including the recommended policy in the urban development strategies, it would also be appropriate for the metropolitan policies in the regional section of Melbourne's planning schemes (Clause 14) to be amended to reflect the town planning and infrastructure elements of the policy. Alternatively, a new metropolitan policy could be added specifically relating to the development of HTI as outlined above.

7.4.3 Review of the TPP

Whether or not the State Government chooses to adopt the type of HTI development policy recommended above, it should undertake a detailed review the TPP, particularly given its current lack of support for this policy. Without strong government support, no HTI development policy will succeed.

As already stated, the five Melbourne technology precincts still remain as metropolitan planning policy in the regional section of all the metropolitan planning schemes (Clause 14-8, see Appendix D) and in the local sections of the ten relevant planning schemes. Given the problems with the TPP outlined in Section 7.3, serious consideration should be given to withdrawing the metropolitan policy regarding the technology precincts from Melbourne's planning schemes, particularly if the recommended new policy is to be

incorporated. This would still leave the local section overlay controls in the relevant planning schemes.

In regard to the overlay controls in the local sections of the ten relevant planning schemes, the Department of Planning and Development should consult each individual precinct advisory committee and relevant local government authority (or authorities) regarding the future of such provisions on a case by case basis. If it is decided that the overlay control is still of value in a particular case there is no reason why it could not remain in the relevant planning scheme(s). However, if one or more of the precincts remain, it or they should be integrated with the city-wide policy recommended above as just one of the policy's HTI development measures. Retaining the precincts could protect long-term opportunities.

The Werribee City Council has found problems with the overlay control relating to the Werribee Precinct mainly because it provides very little certainty regarding the future development of the precinct. The Council is therefore proposing to replace it with a site specific zone in the Werribee Planning Scheme to be called the Werribee Technology Zone which would provide more certainty, particularly for HTI developers. This is an option that the parties involved in the other precincts should investigate.

Another option that should be investigated is the re-designation of the precincts as places for R&D, particularly public sector R&D establishments. R&D establishments often agglomerate so they can communicate easily and share resources. Furthermore, most of the designated precincts are based on existing R&D resources. In fact, under the original precinct concept, three of the precincts (Monash, La Trobe and Knowledge) were to be R&D oriented but this was never strongly pursued. All of the precincts became a focus for HTI development which is reflected in the metropolitan policy regarding the precincts (see Appendix D). As R&D is an essential ingredient of innovation, any measures to increase R&D activity in Melbourne should be investigated. If it could be demonstrated that precincts for R&D establishments would increase R&D activity, then such precincts would be a valuable component of the recommended HTI development policy for Melbourne.

APPENDIX A

METROPOLITAN REGION

AMENDMENT NO. RL 4

EXPLANATORY REPORT

The location and development of High Technology and associated activities is an important part of the State Economic Strategy. The Government believes, based on research conducted over the last year that growth of these activities will be enhanced by selecting specific precincts associated with major educational and research institutions in Victoria.

This amendment identifies and designates 5 areas in Metropolitan Melbourne which appear to have appropriate attributes to be successfully developed as centres for High Technology activities. These are :

- . Knowledge High Technology Precinct - City of Melbourne
- . Latrobe High Technology Precinct - Cities of Preston, Heidelberg, Shires of Diamond Valley and Whittlesea
- . Monash High Technology Precinct - Cities of Oakleigh and Waverley
- . Port/South Melbourne High Technology Precinct - Cities of Port Melbourne and South Melbourne
- . Werribee High Technology Precinct - City of Werribee

This amendment is the first stage of the High Technology programme. It includes objectives for each of the designated areas which the Responsible Authority must have regard to when considering applications for development and use of land within those precincts. Subsequent stages will involve studies of the precincts and their environs to develop detailed plans which reflect the particular opportunities available in each precinct.

Precinct Advisory Committees will be established for each precinct soon after the introduction of this amendment. These committees, based on existing groups where appropriate will be responsible for guiding the development of the precinct. Their membership will include representatives of State and Local Government plus representatives of Tertiary Education establishments and Industry where appropriate.

The amendment does not change the existing permit controls which apply to the areas and it will not have any significant environmental effects.

METROPOLITAN REGION

AMENDMENT NO. RL4

The Planning Authority for this amendment is the Minister for Planning and Environment.

1. The Regional Section of all planning schemes in the Metropolitan Region is amended as follows -

After Clause 23G insert the following additional clause -

"23H. (1) The objectives of this clause are -

- (a) to designate specific areas in which it would be appropriate to attract the establishment of technology intensive enterprises; and
 - (b) to ensure that the use and development of those designated areas will not prejudice the options for the future establishment of new technology based enterprises.
- (2) (a) Each Technology Precinct is designated on the Planning Scheme Map by means of a black outline with black "HT" and black numeral superimposed.
 - (b) Each area designated in the manner described in Column 1 of the Table to this paragraph is referred to by the name included in Column 2 of the Table.

COLUMN 1	COLUMN 2
HT 1	Knowledge High Technology Precinct
HT 2	Latrobe High Technology Precinct
HT 3	Monash High Technology Precinct
HT 4	Port Melbourne/South Melbourne High Technology Precinct
HT 5	Werribee High Technology Precinct

- (3) The objectives of the Knowledge High Technology Precinct are -

- (a) To promote the precinct as a primary focus for -
 - (i) the establishment of technology intensive research and development enterprises associated with the University of Melbourne, the Royal Melbourne Institute of Technology and other tertiary institutions; and
 - (ii) the establishment of appropriate facilities and services which support technology and research and development enterprises.
- (b) To ensure that the future use and the density, scale and character of future development -
 - (i) is compatible with the landscape and built form environment and contributes to the maintenance and development of a high quality urban environment;
 - (ii) is compatible with and does not detract from the amenity of the area;
 - (iii) is appropriate considering the existing and any proposed change to the road and public transport systems in the area or its links with areas outside the precinct;
 - (iv) does not create problems of traffic congestion of the local road network;

- (v) will not prejudice or adversely affect the health and safety of persons in the precinct and nearby areas;
 - (vi) provides for appropriate inter industry linkages;
 - (vii) maintains the current balance and mixture of landuse activities in the area;
 - (viii) encourages the redevelopment of existing commercial and industrial sites; and
 - (ix) encourages the retention of existing residential areas;
- (c) To ensure that expansion of the major institutes does not conflict with the objectives stated in paragraphs (vii), (viii) and (ix) above.
- (4) The objectives for the Werribee High Technology Precinct are -
- (a) To promote the precinct as a primary focus for -
 - (i) the development of enterprises specialising in the research and application of biotechnology;
 - (ii) technology and research enterprises which can extend and re-inforce the linkages between the precinct and educational research establishments; and
 - (iii) the establishment of appropriate facilities and services which support technology and research and development enterprises.
 - (b) To ensure that the future use and the density, scale and character of future development -
 - (i) is compatible with the landscape and built form environment and contributes to the maintenance and development of a high quality urban environment both within the precinct and its environs;
 - (ii) is compatible with and does not detract from the amenity of the area;
 - (iii) will not create problems of traffic congestion within the precinct and nearby areas;
 - (iv) will ensure efficient movement within the precinct, and re-inforce transport linkages with surrounding areas; and
 - (v) will adversely affect the amenity, health and safety of persons in the precinct and nearby areas.
- (5) The objectives for the Monash High Technology Precinct are -
- (a) To promote the precinct as a primary focus for -
 - (i) technology and research enterprises which can extend and re-inforce the linkages between the precinct and Monash University, Monash Medical Centre and other tertiary and research institutes; and
 - (ii) the establishment of appropriate facilities and services which support technology and research and development enterprises.
 - (b) To ensure that the future use and the density, scale and character of future development -
 - (i) is compatible with the landscape and built form environment and contributes to the maintenance and development of a high quality urban environment both within the precinct and its environs;
 - (ii) will not create problems of traffic congestion within the precinct and nearby areas;
 - (iii) will ensure efficient movement within the precinct and re-inforce transport linkages with surrounding areas; and
 - (iv) will not adversely affect the amenity, health and safety of persons in the precinct and nearby areas.

(6) The objectives for the Port Melbourne/South Melbourne High Technology Precinct are -

(a) To promote the precinct as a primary focus for -

- (i) the development of enterprises with an industrial and trading focus on new electronic, computer and telecommunications technologies;
- (ii) the establishment of appropriate facilities and services which support technology and research and development enterprises; and
- (iii) technology and research enterprises which can extend and re-inforce the linkages between the precinct and educational research establishments.

(b) To ensure that the use, density, scale and character of future use and development of land -

- (i) are compatible with the landscape and built form environment and contribute to the maintenance and development of a high quality urban environment both within the precinct and its environs;
- (ii) will not create problems of traffic congestion within the precinct and nearby areas;
- (iii) will ensure efficient movement within the precinct and re-inforce transport linkages with surrounding areas;
- (iv) will not adversely affect the amenity, health and safety of persons in the precinct and nearby areas;
- (v) will contribute to the incremental establishment of an attractive landscaped environment which provides opportunities for future new development.

(7) The objectives for the Latrobe High Technology Precinct are -

(a) To promote the precinct as a primary focus for -

- (i) technology and research enterprises which can extend and re-inforce the linkages between the precinct and Latrobe University and other tertiary institutions; and
- (ii) the establishment of appropriate facilities and services which support technology and research and development enterprises.

(b) To ensure that the future use and the density, scale and character of future development -

- (i) is compatible with the landscape and built form environment and contribute to the maintenance and development of a high quality urban environment both within the precinct and its environs;
- (ii) will not create problems of traffic congestion within the precinct and nearby areas;
- (iii) will ensure efficient movement within the precinct and re-inforce transport linkages with surrounding areas;
- (iv) preserves the amenity, health and safety of persons in the precinct and nearby areas; and
- (v) will provide for the preservation of views along and into the Plenty River Valley and the rivers general environments.

(8) The responsible authority in determining whether or not permission should be granted to use or develop any land within a Technology Precinct under any provision of this Ordinance must have regard to the objectives of this clause and of the relevant technology precinct.

2. The Local Sections of the following planning schemes are amended as set out after the name of each scheme -

Diamond Valley Planning Scheme

For the expression "(b) those maps which are also marked with the suffix "RA"." substitute the expression "(b) those maps which are also marked with the suffix "RA or "HI"."

Heidelberg Planning Scheme

For the expression "(b) those maps which are also marked with any of the suffixes "UC" or "MG" substitute the expression "(b) those maps which are also marked with any of the suffixes "UC", "MG" or "HT"."

Melbourne Planning Scheme

For the expression "(b) together with those maps which are also marked with any of the suffixes "HC", "UC", "FM" or "SA" substitute the expression "(b) those maps which are also marked with any of the suffixes "HC", "UC", "FM", "SA" or "HT"."

Oakleigh Planning Scheme

Delete the expression appearing after the expression "This local section includes -" and insert the following -

- "(a) the maps marked Oakleigh Planning Scheme which are numbered 57, 58, 68 and 69 and which are marked with the suffix "A" or the suffix "B"; and
- (b) those maps which are also marked with the suffix "HT"."

Port Melbourne Planning Scheme

For the expression "(b) those maps which are also marked with the suffix "UC" substitute the following expression "(b) those maps which are also marked with the suffix "UC or "HT"."

Preston Planning Scheme

Delete the expression appearing after the expression "This local section includes -" and insert the following -

- "(a) the maps marked Preston Planning Scheme which are numbered 36, 37, 38, 43, 44, 45 and 53 and which are marked with the suffix "A" or the suffix "B"; and
- (b) those maps which are also marked with the suffix "HT"."

South Melbourne Planning Scheme

For the expression "(b) those maps which are also marked with any of the suffixes "HC", "UC", "SB" or "Additional Urban Conservation Areas." substitute the expression "(b) those maps which are also marked with any of the suffixes "HC", "UC", "SB", "HT" or "Additional Urban Conservation Areas"."

Waverley Planning Scheme

After the expression "This local section includes -"

- (a) in paragraph (a) delete the word "and" where last appearing;
- (b) renumber paragraph (b) to paragraph (c); and
- (c) after paragraph (a) insert the following new paragraph "(b) those maps which are also marked with the suffix "HT"; and".

Werribee Planning Scheme

Delete the expression appearing after the expression "This local section includes -" and insert the following -

- "(a) the maps marked Werribee Planning Scheme which are numbered 4, 5, 10, 11, 12, 13, 19, 20, 21, 2013, 2032, 2033, 2034, 2052, 2053, 2054, 26.2, 36.1, 36.2, 36.3 and 36.4 and which are marked with the suffix "A" or the suffix "B"; and
- (b) those maps which are also marked with the suffix "HT"."

Whittlesea Planning Scheme

For the expression "(b) those maps which are also marked with the suffix "RA" substitute the following "(b) those maps which are also marked with the suffix "RA" or "HT"."

This amendment was approved by the Minister for Planning and Environment on 11 March 1988.

I CERTIFY THAT THIS IS A TRUE COPY OF THE
AMENDMENT APPROVED BY THE MINISTER FOR
PLANNING AND ENVIRONMENT ON

11 MAR 1988

wednesday 16th March.

'HI-TECH' PLAN FOR VICTORIA

The State Government today announced details of a planning scheme aimed at drawing millions of dollars worth of private investment into the State's high technology industries over the next five years.

Under new planning schemes which come into effect today six high technology precincts will be established, five in the metropolitan area , and one in Bendigo.

The technology precincts were declared under the Planning and Environment Act , and will boost Victoria's role as Australia's leading 'technology State'.

Thousands of new jobs will be created in the six technology precincts and hundreds of companies are expected to locate in the new 'hi-tech areas'.

Companies producing goods and services in fields such as biotechnology, genetics, material sciences, fibre optics, geomechanics, geophysics, computer science and telecommunications, electronics, pharmaceuticals, ceramics, veterinary science and a wide range of research and development support industries will be encouraged to locate in the precincts.

The Minister for Industry, Technology and Resources, Robert Fordham, and the Minister for Planning and Environment, Tom Roper, released the Technology Precincts plan today.

Mr Fordham said that the strategy could help generate tens of millions of dollars in new export earnings. Australia currently exports some \$800 million of high technology products.

"These precincts will play an important part of the State Government's technology strategy which targets the biotechnology, materials science, information technology and advanced manufacturing technology areas for major development and commercialisation.

"The group of precincts will provide 'nurturing areas ' for the State's rapidly expanding high technology industries. The precincts will be established near major research and tertiary institutions to encourage research in related technology fields," he said.

The Minister for Planning and Environment , Tom Roper said he had approved amendments to the Planning Scheme which would permit the development of the technology precincts.

"The six areas were chosen for their suitability for accommodating the growth of high technology and their proximity to, or association with, tertiary institutions.

"They will also attract complimentary activities such as hotels and commercial services."

Mr Roper said the precincts would be planned to blend in with the existing environment and would attract employment and development especially a skilled workforce and support services.



APPENDIX B

Minister for Planning and Environment

NEWS RELEASE

21 November 1988

SURVEY HIGHLIGHTS GOVERNMENT'S ROLE IN HIGH-TECH DEVELOPMENT

The State Government can play a greater role in meeting the needs of advanced technology firms through special planning and infrastructure measures a recent survey revealed.

The survey identified a number of high technology centres where the Government's technology precinct program could reinforce or develop operations.

It also revealed that Melbourne's three most popular locations for technology-intensive firms are the cities of Knox, Melbourne, and Oakleigh.

The survey, conducted by the Ministry for Planning and Environment, sought information on which factors influenced technology-intensive firms in their choice of location.

It also examined the links between location and a range of considerations such as workforce availability, company expansion, and infrastructure requirements.

The Ministry undertook the study as a complementary exercise to the Government's technology precinct program.

Releasing the results of survey today the Minister for Planning and Environment, Tom Roper, said it would play an important role in ascertaining areas where Government action could encourage the growth of high-technology industry in Victoria.

"The development of high-technology industries is vital if Victoria is to make important technological and economic gains," he said.

"The Government has identified six technology precincts in Victoria, which will be oriented towards high-technology development.

"Work is already underway in identifying the environmental and infrastructure needs in these areas. They are located near the Melbourne, Latrobe, and Monash Universities, and in Port/South Melbourne, Werribee and Bendigo."

The forty-nine firms surveyed specialised in computer software, micro-electronics, scientific instruments, biotechnology, aerospace, ceramics, robotics, solar and fibre optics industries.

Most firms thought the Government could stimulate the growth and development of high-technology industries by providing support facilities and telecommunications infrastructure.

The survey showed that universities and industries had limited working relationships.

"Stronger links need to be fostered between research organisations and institutes, particularly universities, with technology-oriented firms," Mr Roper said.

"Much of the responsibility for this lies with those organisations to communicate and collaborate further."

Out of forty-nine high-technology firms surveyed, eight were located in Knox, five each in the Cities of Melbourne and Oakleigh and four each in the Cities of Waverley and Heidelberg. The remainder were dispersed throughout the metropolitan area.

The survey showed that computer software firms tended to locate close to Central Melbourne because of their association with office-oriented activity.

Microelectronics firms preferred the eastern and southern metropolitan regions, particularly Waverley and Oakleigh, and scientific instrument firms showed a preference for the eastern region, particularly Knox.

Skilled labour was considered the most important locational requirement. Proximity to the city centre and attractive working conditions were also considered important.

More than half of the firms surveyed felt that a pleasant environment, access to skilled labour and the facilities provided in a suburban centre were important enough to warrant relocation.

Most of the companies surveyed were locally owned and had been operational for less than six years.

The survey was designed by Prof Edward Blakley from the University of California and Cameron McNamara, Consultants, Sydney, in consultation with the Ministry for Planning and Environment and the Department of Industry, Technology and Resources.

Copies of the study, *Survey of Technology Intensive Firms in metropolitan Melbourne*, are available from the Ministry for Planning and Environment, 477 Collins Street, Melbourne.

Wendy Miller, Ministry for Planning and Environment, 628 5032
John Miner, Vic Govt Media Unit, 651 5043

APPENDIX C

TECHNOLOGY PRECINCTS

In April 1987 the Government published a review of its economic strategy entitled *Victoria - The Next Decade*, and announced that it would incorporate locational strategies in its Technology Development Program. This locational emphasis was recommended in a report by Professor Ed Blakely, *Infrastructure for Technology and Innovation*, February 1987, which was commissioned by the Department of Industry, Technology and Resources. The report found that innovation and technology development was tied very closely to particular locations. These locations possessed certain strengths and characteristics that facilitated the growth and expansion of technology industries. By promoting these areas as centres of high technology and related industries that have export potential, job generation in Victoria could be maximised.

The report also recommended that:

- the Government should provide sustained support for specific technological developments to make them competitive by world standards;
- Government and industry should collaborate to strengthen the technology infrastructure in various regions.

In December 1987 the Government approved the designation of six Technology Precincts in Victoria, gazetted as Amendment RL4, which were incorporated in the relevant planning schemes. The five Melbourne precincts are shown in Figure 5. Maps of the designated areas are in Appendix 4.

Three of the precincts have been designated for research and development. Each is centred on a university and, with other education and research institutions, provides 'nurturing' areas for the State's rapidly expanding high technology industries. They are:

Monash University and environs

La Trobe University and environs

The Knowledge Precinct and environs (including the University of Melbourne, Royal Melbourne Institute of Technology, hospitals and research institutions).

New commercial development in specific technology fields will be encouraged in these precincts, which will become a focus for new technology-intensive firms. The other three areas will be production precincts, which offer scope for production/research activities. They are:

South/Port Melbourne Precinct and environs (to be associated with the Knowledge Precinct);

Werribee Precinct and environs (to be associated with Melbourne University and RMIT);

Bendigo Precinct and environs (to be associated with Bendigo College of Advanced Education).

Werribee is centred on the biotechnology institutes. South/Port Melbourne adjoins a major industrial area, Southbank, the Central City and World Trade and Congress Centres. These two precincts will promote the development and application of technology and science to new and existing firms, and disseminate information about scientific and technological advances throughout Melbourne. The emphasis in Werribee will be on biotechnology and natural sciences, and in South/Port Melbourne on advanced manufacturing, communications and computer software.

The overall aims of the precincts are:

- to gain an international reputation for high technology development;
- to promote technology transfer and enhance productivity potential in the institutes of research and higher education and technology production firms;
- to establish specific locations for technology development;
- to promote the efficient use of public and private sector resources, including the technology precinct network.

It is hoped that the precincts will generate tens of millions of dollars in new export earnings and extend Victoria's world class scientific base. The Government is committed to providing the environment that will attract firms to the six precincts and to facilitate the commercial application of advances in technology.

Development in each of the precincts may place extra pressures on services, communications and transport systems within the region. These facilities will be reviewed by consultants who are or will be undertaking land use and development strategy studies in each of the precincts. This will ensure that adequate and efficient facilities are available.

Technology-intensive industries have some of the same locational requirements as the traditional manufacturing industries, such as market proximity, skilled labour, minimised transport costs etc. They also require special support systems and services. Technology will be generating new forms of urban development and activities that do not correspond to standard land use classifications.

Each of the designated precincts will emphasise selected core research technologies (see Appendix 4). It is intended in time to link all precincts by dedicated optic fibre communications systems and other networks. Their planning and development will be undertaken jointly by government, the institutions and councils concerned, and industry and private developers.

The Ministry has incorporated objectives for the precincts in Amendment RL4, and the responsible authorities must have regard to these objectives when considering applications for the development and use of land within the precincts. The local council is the responsible authority in each case.

A Precinct Advisory Committee has been established in each precinct to formulate and implement technology development and land use management plans for the precincts. The boundaries of each of precinct will be reviewed by the Committees in association with the Ministry for Planning and Environment and Department of Industry, Technology and Resources. The main role of the Committees is to co-ordinate and facilitate the development of activities within the designated areas. The Committees will be consulted on all major land use proposals for large-scale projects and technology developments in their regions.

Each Committee will:

- designate a land use pattern within the precinct;
- develop target industry plans for the precinct;
- target industrial land and develop ways of controlling and managing it;
- advise the Ministry for Planning and Environment on appropriate land use;
- recognise technology projects and facilities in the precinct and its sphere of influence;
- mount a marketing campaign to attract new companies and to strengthen existing ones.

The Committee in each precinct will include representatives from:

MPE

DITR

the university or educational institute nominated

local government

local industry

local technology/development organisations

and any other representation deemed necessary.

The encouragement of appropriate land uses, environmental improvement and the creation of regulatory processes are an important part of the precinct program and must be designated to meet the economic objectives of the State Technology Statement.

Technology Precincts Policies

- Each of the designated technology precincts will be developed on as comprehensive a basis as possible, involving collaboration with local councils and business representatives, academic and research staff, and State government. Objectives for each Technology Precinct are contained in the Metropolitan Regional Section of Planning Schemes.
- Private sector developments which assist in the implementation of Technology Precinct objectives (e.g science and technology parks, 'incubators' and complementary facilities) are encouraged to locate in the Precinct or surrounding sphere of influence.
- A statutory planning approach that incorporates objectives, performance standards and design guidelines, rather than detailed provisions, will become the basis on which development proposals are assessed.
- Performance zoning methods will, as far as possible, replace any specific height, setback, open space or other general regulation within the precincts.
- A complementary 'enhancement strategy', will be developed to upgrade urban amenity, the availability of supporting enterprises (such as hotels, shops and community facilities) and to integrate each of the precincts with their surrounding area. It is critical for those District Centres and other activity centres surrounding the technology precincts to provide the requisite infrastructure required by visitors, the local community and workforce.
- State Government departments and agencies will promote infrastructure development (e.g. research/science parks, technology incubators) within each of the precincts.

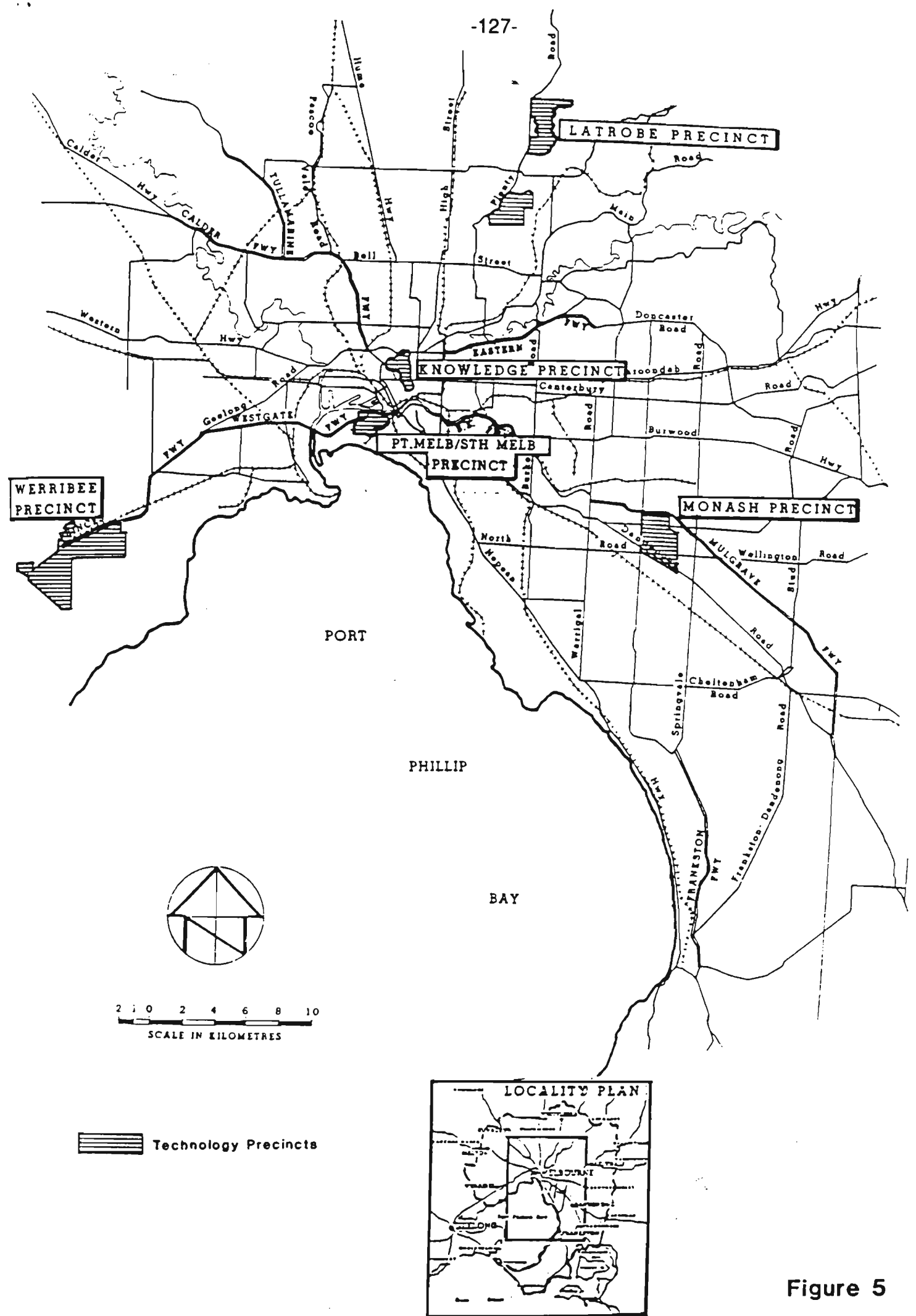


Figure 5

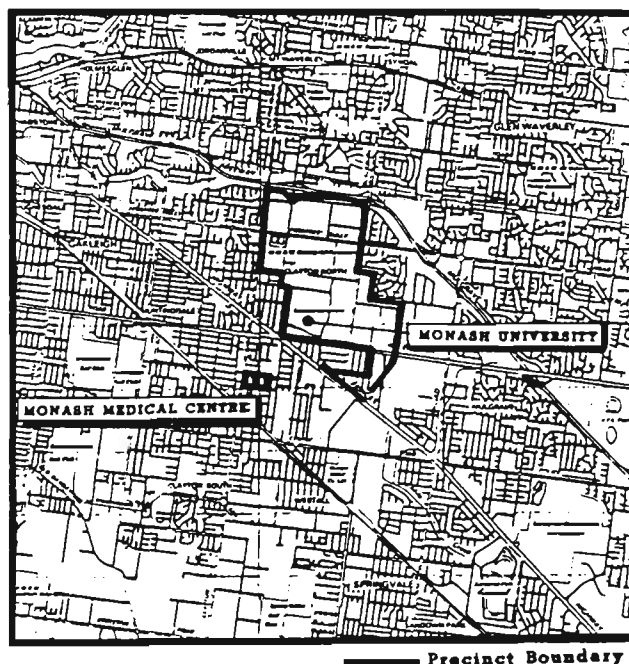
DESIGNATED AREAS FOR THE DEVELOPMENT OF RESEARCH AND TECHNOLOGY

APPENDIX 4

BOUNDARIES AND FEATURES OF DESIGNATED AREAS FOR THE DEVELOPMENT OF RESEARCH AND TECHNOLOGY

- A. Monash Technology Precinct
- B. La Trobe Technology Precinct
- C. Knowledge Technology Precinct (University of Melbourne/RMIT).
- D. South/Port Melbourne Technology Precinct.
- E. Werribee Technology Precinct.

A. MONASH TECHNOLOGY PRECINCT



The precinct will be a focus for:

- technology and research enterprises that can extend and reinforce the linkages between the precinct and Monash University, Monash Medical Centre and other tertiary and research institutes;
- facilities and services that support technology and research and development enterprises.

Core technologies

Molecular biology and genetics
Geomechanics/geophysics
Biotechnology and genetics
Chemical process technology and materials science
Information technology and electronics
Civil and electrical engineering
Computer science and telecommunication

Current development

The university has established a consultant and technology transfer company, Montech, for interaction with industry. A consultant's study of the technology development potential within the precinct and its surrounding 'sphere of influence' is being completed.

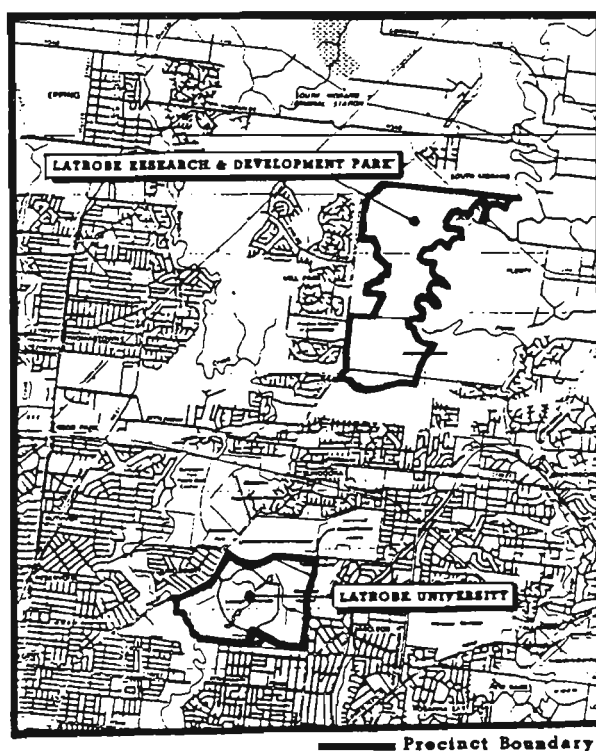
Special infrastructure development and other precinct requirements

- Science park - roads and services now being installed.
- Montech building - to include general facilities and administration and laboratory space.
- Ceramics centre
- Telecommunications research centre
- Medical Centre - development of overall plan to integrate the Medical Centre with the precinct

Precinct Advisory Committee

A working group comprising university, council and State government representation has been established. This group will be expanded to create the Precinct Advisory Committee.

B. LA TROBE TECHNOLOGY PRECINCT



The precinct will be a focus for:

- technology and research enterprises that can extend and reinforce the linkages between the precinct and La Trobe University and other tertiary institutions;
- facilities and services that support technology and research and development enterprises.

Core technologies

Computer science and electronics
Agricultural science
Space and atmospheric sciences
Physics - surface science
Health and forensic science
Brain research

Current development

La Trobe University is developing, and will be managing its on-campus 22 ha Research and Development Park, and is seeking tenants who will have close research and development links with the university for immediate occupation.

The commercially operated La Trobe University Research and Development Estate of approximately 50 ha is part of a major 243 ha private real estate development about 6 km north of the university. Tenants in the estate will need to demonstrate research and development operations - though not necessarily associated with the university.

A La Trobe Technology Precinct study, to be completed in October 1988, will examine the capacity for and requirements of technology development.

Specific infrastructure development and other precinct requirements

- Major improvements in urban design, transport linkages and community facilities/services to integrate the university and other knowledge based institutions within the surrounding region more closely.
- Evaluation of scope for developing a 'polyclinic' - a multi-purpose health service and delivery system founded on the regional hospitals and School of Health Sciences.
- Canvassing of scope for advanced manufacturing technology development and the involvement of the Phillip Institute of Technology (PIT).

Precinct Advisory Committee

Nominations for this committee, including State and local government, university, research and industry representation have been sent to the Minister. Sub-committees will also be established.

C. KNOWLEDGE TECHNOLOGY PRECINCT



The precinct will be a focus for:

- technology intensive research and development enterprises associated with the University of Melbourne, the Royal Melbourne Institute of Technology and other tertiary institutions;
- facilities and services that support technology and research and development enterprises.

Core technologies

Computer/intelligence systems
Biomedical systems and products
Advanced engineering and materials
Food technology
Industrial design and management sciences
Fashion design and development
Information technology

Current development

A working group chaired by RMIT has been examining ways and means of realising the research potential of the precinct.

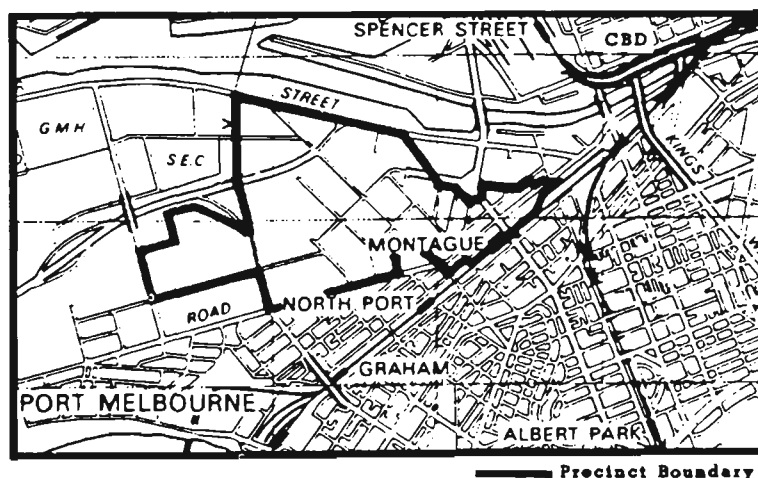
Special infrastructure development and other precinct requirements

- A small, compact executive organisation to give direction to marketing, finance, promotional and networking needs for future commercial development of the precinct.
- Infrastructure to integrate the many technology resources. This might include a computer and information service centre, an incubator facility, health technology centre and industrial design centre. A precinct office and support staff are needed to establish operations.
- Operational links with the South/Port Melbourne and Werribee Technology Precincts.
- A technology transfer/land management study during the latter half of 1988, possibly in association with the South/Port Technology Precinct.

Precinct Advisory Committee

An expanded working group is operating as the Interim Advisory Committee until the management and operational structure of the precinct is finalised.

D. SOUTH/PORT MELBOURNE TECHNOLOGY PRECINCT



The precinct will be a focus for:

- technology and research enterprises that can extend and reinforce the linkages between the precinct and educational research establishments;
- enterprises with an industrial and trading focus on new electronic, computer and telecommunications technologies;
- facilities and services that support technology and research and development enterprises.

Core technologies

Computer science and telecommunication
Aerospace
Information technology
Advanced materials

Current development

The Victorian Technology Centre has been established in Port Melbourne to promote and commercialise technology. It provides the foundation for attracting and assisting future technology development within the precinct.

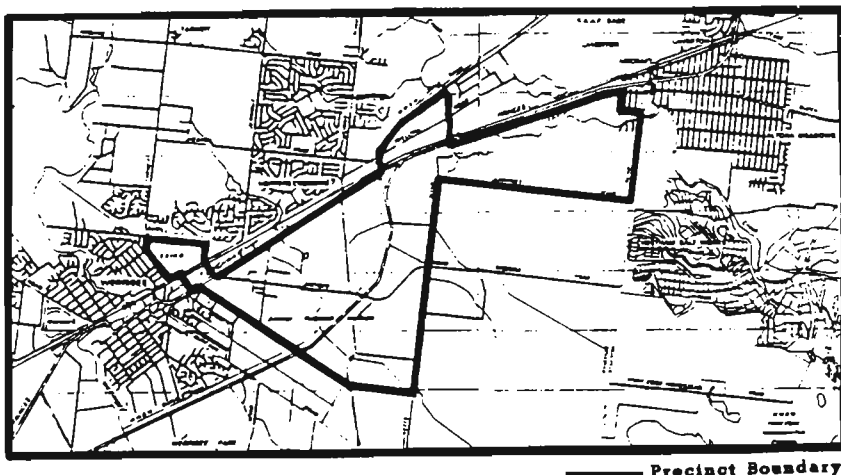
Special infrastructure development and other precinct requirements

- A co-ordinated approach with regard to the role of surplus Crown Land in the region, and the linkages with the CBD, the Bayside development and Docklands.
- A Technology Centre that accommodates new business incubators, and commercial services including legal, financial, business planning etc.
- Development of an international teleport.
- An advanced manufacturing centre, linked with RMIT and Melbourne University, that includes display and interactive facilities.
- An international software centre.
- A small technology park; mixed office/incubator site; serviced apartment complex.
- A technology development/land marketing study during the latter half of 1988, possibly in association with the Knowledge Precinct.

Precinct Advisory Committee

Nominations for this committee, including representation from State and local government, industry, tertiary and research institutions have been forwarded to the Minister. The Victorian Technology Centre is acting as secretariat.

E. WERRIBEE TECHNOLOGY PRECINCT



The precinct will be a focus for:

- technology and research enterprises that can extend and reinforce the linkages between the precinct and educational research establishments;
- enterprises specialising in the research and application of biotechnology;
- facilities and services that support technology and research and development enterprises.

Core technology

Biotechnology
Pharmaceuticals
Agricultural and animal research

Current development

An economic development and biotechnical industry study for Werribee Shire completed in February 1986 will provide basis for Commonwealth, State and local government support. The council has established an Economic Development Unit. Consultants are working on a study of technology development opportunities and infrastructure/civic design requirements.

Specific infrastructure development and other requirements

- . Affiliation of the Footscray Institute of Technology.
- . Development of a conference centre and hotel.
- . Development of high quality residential areas.
- . Improvement in quality of the shopping centre.
- . Development of Western Gardens Research Park, including provision of an overpass and interchange.
- . Location of the Western Institute, and headquarters of the Wheat Board within Werribee.
- . Development of a telecommunications and biotechnology park in liaison with Telecom.
- . Development of Department of Agriculture and Rural Affairs land for technology uses.

Precinct Advisory Committee

It is proposed to establish a working group of key participants. An advisory sub-group could be established from the council's Economic Development Unit and Area Development Committee.

Ministry flags plan for development in 1990s

The Ministry for Planning and the Environment has released more specific guidelines for its technology precincts policy, including the establishment of advisory committees.

The ministry also announced more flexible guidelines for industrial and office developments.

The refinements to the State Government's district centres policy are contained in a policy statement, *Metroplan Activity Centres*.

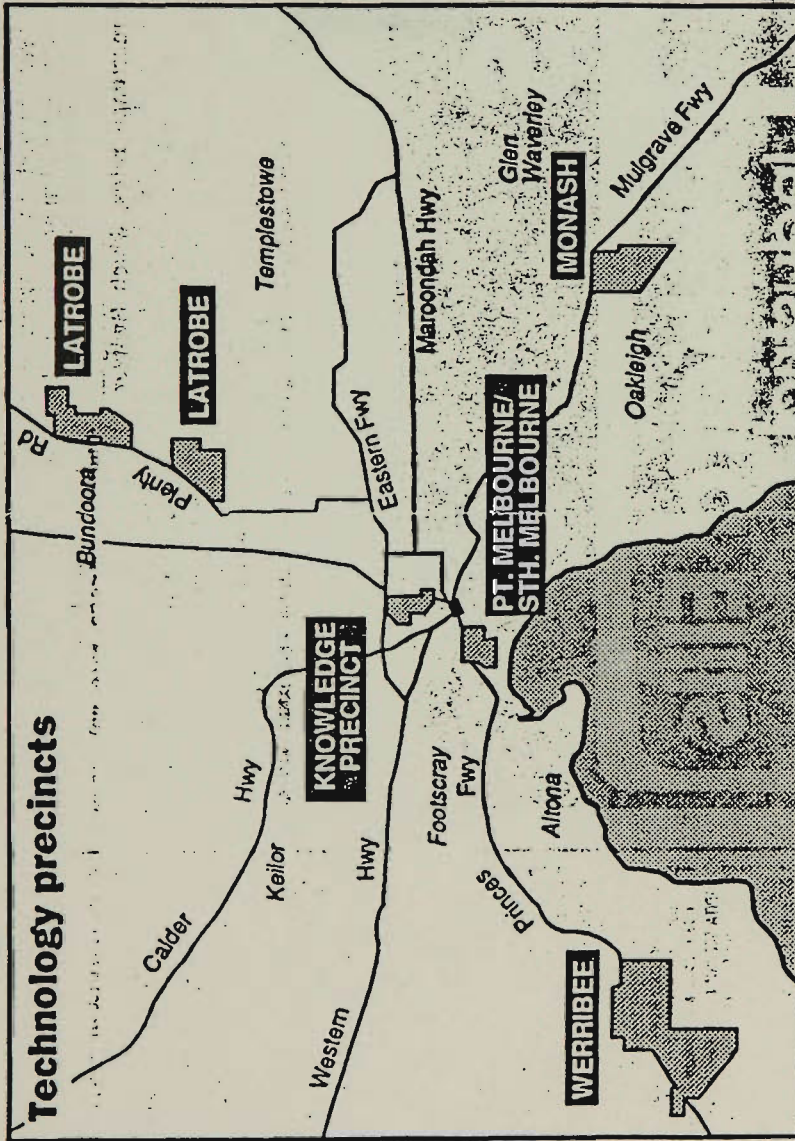
The advisory committees will "co-ordinate and facilitate" activities in the precincts and will be consulted on all major proposals, the statement said.

The committees are made up of representatives of state and local government departments, universities or nominated educational institutions, local industry and local technology organisations.

The Planning Minister, Mr Roper, said the statement outlined how development will be managed around Melbourne through the 1990s.

"One key purpose of the statement is to set out clearly where, and in what circumstances, commercial development will be encouraged," Mr Roper said.

Of the six technology precincts, three — Monash, Latrobe and the Knowledge precinct — have been designated for research and development.



development.

"Each is centred on a university and, with other educational and research institutions, provides nurturing areas for the State's rapidly expanding high technology industries," the statement says.

The Knowledge precinct takes in Melbourne University, RMIT, hospitals and research institutions.

The three other precincts —

South/Port Melbourne, Werribee and Bendigo — will be production precincts which offer scope for production and research activities.

The Bendigo precinct is associated with the Bendigo College of Advanced Education.

"Werribee is centred on the biotechnology institutes," South/Port Melbourne ad-

joins a major industrial area. Southbank, the central city and the World Trade and Congress centres," it says.

"These two precincts will promote the development and application of technology and science to new and existing firms, and disseminate information about scientific and technological advances throughout Melbourne," it says.

Werribee would concentrate on biotechnology and natural resources and the South/Port area on advanced manufacturing, communications and computer software.

"It is intended in time to link all precincts by dedicated optic fibre communications systems and other networks," the statement says.

"Their planning and development will be undertaken jointly by government, the institutions and councils concerned, industry and private developers."

The statement says that land zoned for industrial use is a critical issue.

In some areas there was competition for industrial land for both office and industrial use.

"Examples include parts of the inner urban region, particularly in the east, and some locations in the south eastern suburbs, including Knox and Waverley," it says.

The statement says urban consolidation policy in the inner-urban region aims to reduce the loss of residential population, a factor most likely to be achieved by the rezoning of some industrially zoned land.

"If this is to be achieved it seems likely that some industrially zoned land will be required for residential development," the statement says.

APPENDIX D

14-8

Technology precincts

Technological development benefits from locations close to tertiary institutions. The promotion of such locations will assist the development of new firms in technology-intensive and research-oriented industry.

It is metropolitan policy that:

- * Technology precincts are to be developed in the areas shown in Figure 3.
- * Technology precincts are to be developed and occupied by high technology industries which, among others, may include industries producing goods and services in the fields of biotechnology, genetics, material sciences, fibre optics, geomechanics, geophysics, computer science, telecommunications, electronics, pharmaceuticals, ceramics, veterinary science and research and development support. Ancillary uses such as conference, social and entertainment facilities should be provided in and around high technology precincts.

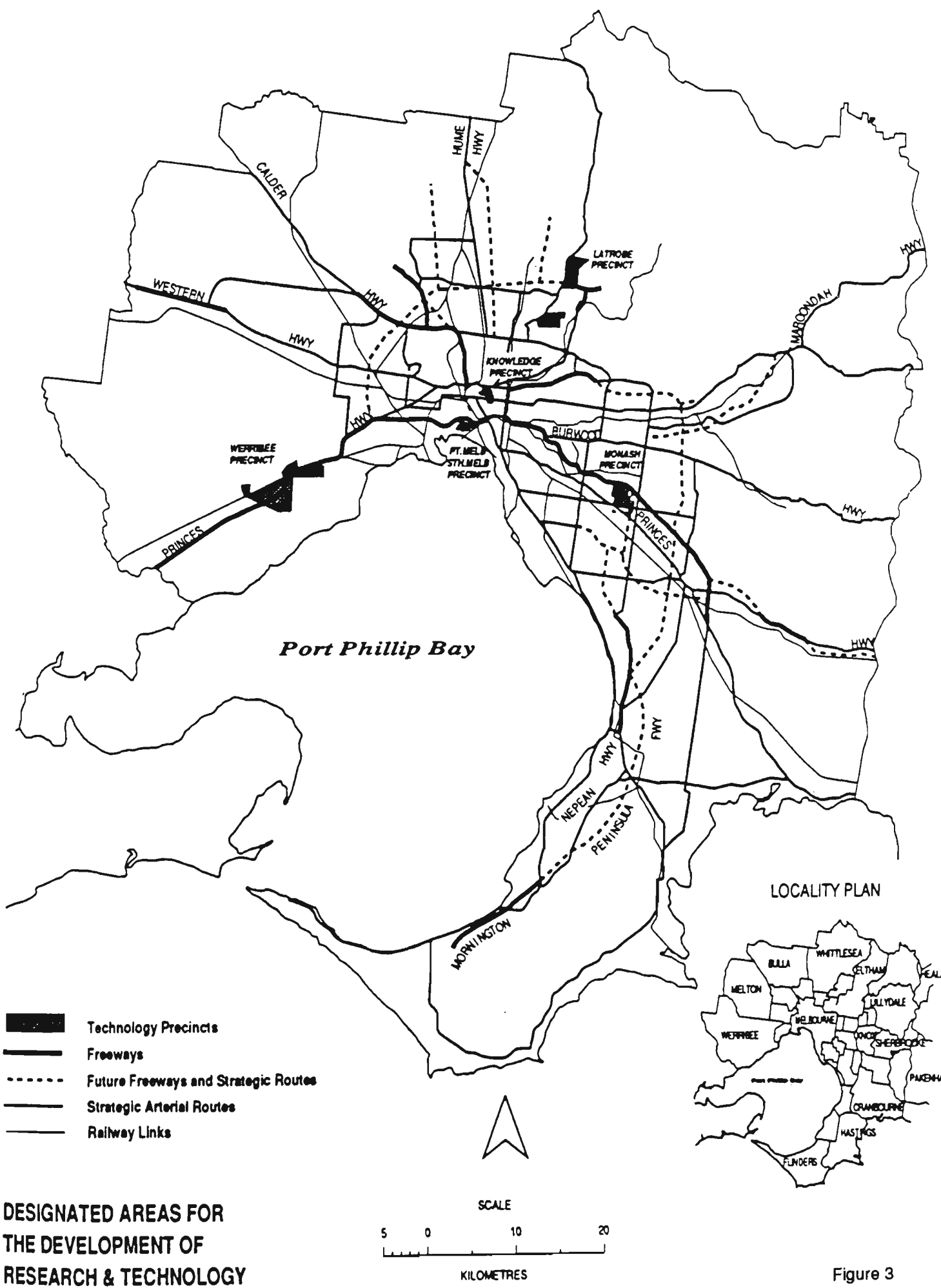


Figure 3

145

TECHNOLOGY PRECINCT

Planning Scheme Map: Marked HT5.

Purpose

- * To designate areas appropriate to the establishment of technology intensive enterprises.
- * To ensure that the use and development of those designated areas will not prejudice the options for the future establishment of new technology based enterprises.

145-1

Specific purpose of the Werribee high technology precinct

- * To promote the precinct as a primary focus for:
 - . The development of enterprises specialising in the research and application of biotechnology.
 - . Technology and research enterprises which can extend and reinforce the linkages between the precinct and educational research establishments.
 - . The establishment of appropriate facilities and services which support technology and research development enterprises.
- * To ensure that the future use and the density, scale and character of future development:
 - . Is compatible with the landscape and built form environment and contributes to the maintenance and development of a high quality urban environment both within the precinct and its environs.
 - . Is compatible with and does not detract from the amenity of the area.
 - . Will not create problems of traffic congestion within the precinct and nearby areas.
 - . Will ensure efficient movement within the precinct, and re-inforce transport linkages with surrounding areas.
 - . Will not adversely affect the amenity, health and safety of persons in the precinct and nearby areas.

145-2

Guidelines for permit

Before deciding on an application to use or develop land in the precinct, the responsible authority must consider the specific purpose of the technology precinct.

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APPENDIX E

	Core	Inner	Middle	Outer	Fringe
CENTRAL	1 South Melbourne 2 Port Melbourne 3 Melbourne 4 Fitzroy 5 Collingwood 6 Richmond 7 Prahran 8 St Kilda				
WEST		9 Williamstown 10 Footscray 11 Essendon	**	31 Altona 32 Sunshine 33 Keilor	44 Werribee 45 Melton
NORTH		12 Brunswick 13 Coburg 14 Northcote	22 Preston 23 Heidelberg	34 Broadmeadows 35 Diamond Valley 36 Eltham	46 Whittlesea 47 Bulla
EAST		15 Kew 16 Hawthorn 17 Camberwell	24 Box Hill 25 Doncaster & Templestowe 26 Waverley 27 Nunawading	37 Croydon 38 Knox 39 Ringwood	48 Healesville 49 Lillydale 50 Sherbrooke
SOUTH		18 Malvern 19 Caulfield 20 Brighton 21 Sandringham	28 Oakleigh 29 Moorabbin 30 Mordialloc	40 Dandenong 41 Springvale 42 Frankston 43 Chelsea	51 Berwick 52 Pakenham 53 Cranbourne 54 Mornington 55 Flinders 56 Hastings

**see outer west

REGIONS & RINGS — L.G.A. COMPARISON

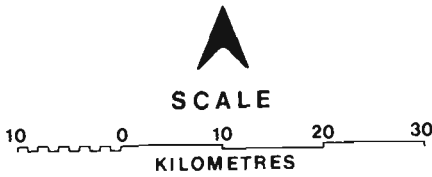
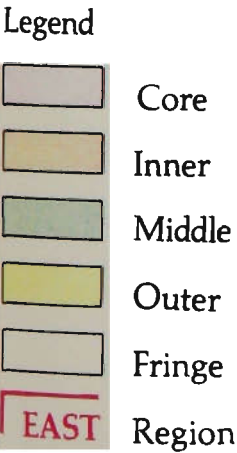
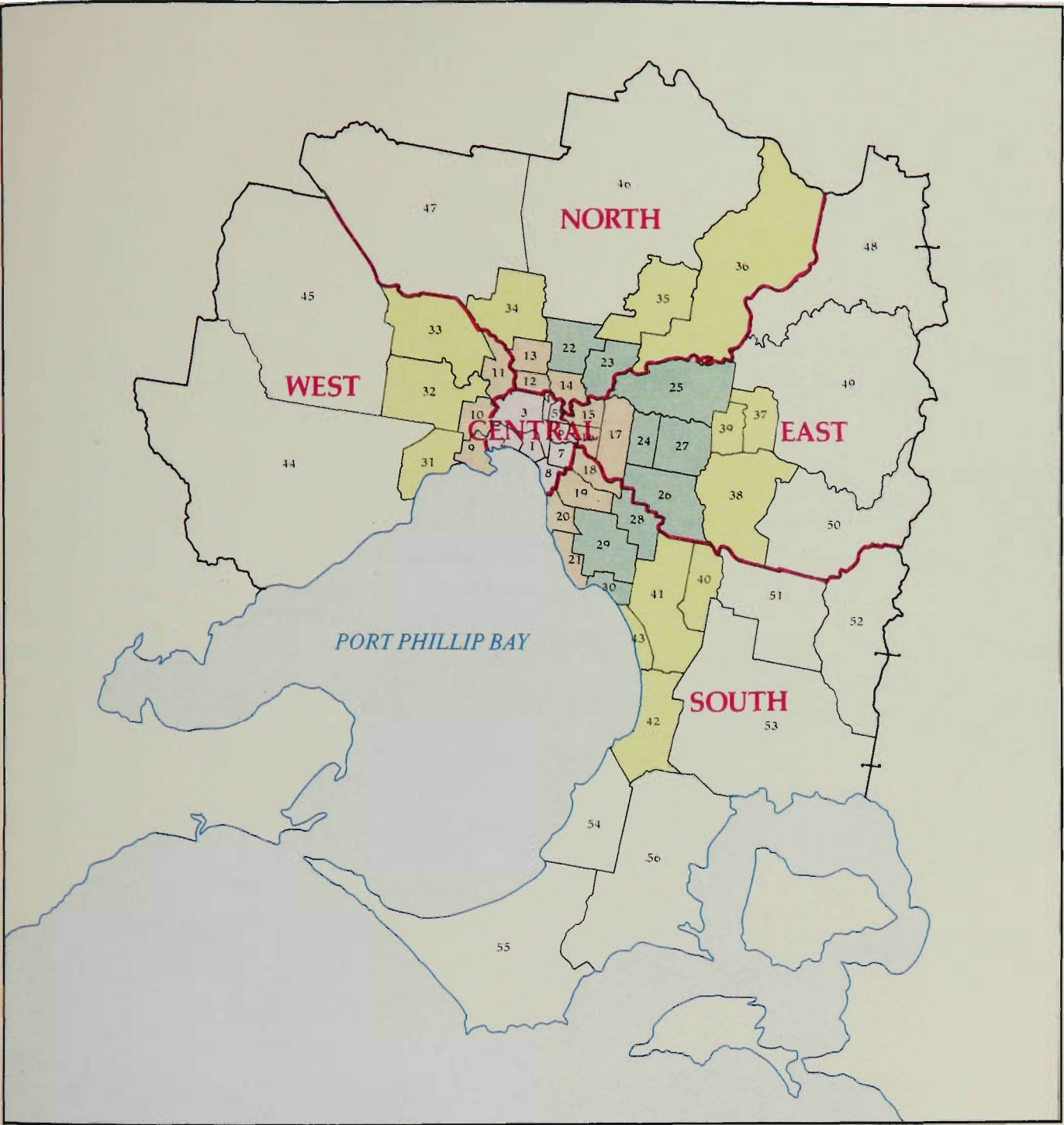


FIG. 1
REGIONS AND RINGS

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APPENDIX F

ASIC 2763 - Pharmaceutical and Veterinary Products. "This class consists of establishments mainly engaged in manufacturing drugs, medicinal chemicals or other pharmaceutical products for human or veterinary use" (ABS, 1983: 246).

ASIC 3244 - Aircraft. "This class consists of establishments mainly engaged in the building, assembly or repair of aircraft, or aircraft engines or parts" (ABS, 1983: 293).

ASIC 3341 - Photographic and Optical Goods. "This class consists of establishments mainly engaged in manufacturing photographic equipment or supplies (including sensitised photographic paper or chemicals) or optical instruments or equipment, or in grinding optical lenses" (ABS, 1983: 295).

ASIC 3342 - Photographic Film Processing. "This class consists of establishments mainly engaged in developing, printing or other processing of motion picture or other photographic film" (ABS, 1983: 296).

ASIC 3343 - Measuring, Professional and Scientific Equipment N.E.C. "This class consists of establishments mainly engaged in manufacturing measuring, draughting, meteorological, surveying, medical, surgical, dental or other professional or scientific instruments or equipment n.e.c., or watches, clocks or other timing instruments" (ABS, 1983: 296).

ASIC 3351 - Radio and TV Receivers; Audio Equipment. "This class consists of establishments mainly engaged in manufacturing radio receiving sets (except radio transceivers or radio telegraphic or telephonic receivers), television receiving sets, sound reproducing and/or recording equipment, headphones, hearing aids, phonographic records or pre-recorded magnetic tapes" (ABS, 1983: 298).

ASIC 3352 - Electronic Equipment N.E.C. "This class consists of establishments mainly engaged in manufacturing communication, broadcasting or other electronic equipment or parts n.e.c." (ABS, 1983: 299).

ASIC 3353 - Refrigerators and Household Appliances. "This class consists of establishments mainly engaged in manufacturing refrigerators (including commercial refrigeration equipment), household appliances, room air conditioners or lawn mowers" (ABS, 1983: 300).

ASIC 3354 - Water Heating Systems. "This class consists of establishments mainly engaged in manufacturing industrial, commercial or household water heating systems, bath heaters, sink heaters or urns" (ABS, 1983: 302).

ASIC 3355 - Electric and Telephone Cable and Wire. "This class consists of establishments mainly engaged in manufacturing electric or telephone cable, wire or strip, including stranded, braided or insulated non-ferrous wire, cable or strip" (ABS, 1983: 303).

ASIC 3356 - Batteries. "This class consists of establishments mainly engaged in manufacturing electric wet or dry cell storage batteries" (ABS, 1983: 303).

ASIC 3357 - Electrical Machinery and Equipment N.E.C. "This class consists of establishments mainly engaged in manufacturing electric motors, generators, light bulbs, tubes or fittings, electricity transmission or distribution equipment, switchgear, transformers or other electrical machinery, equipment, supplies or components n.e.c. This class also includes establishments mainly engaged in manufacturing powder, paste or crystal soldering or welding flux" (ABS, 1983: 304).

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APPENDIX G

EXPLANATORY NOTES ON IRIS DATA

The information in these tables has been extracted from the ABS register of businesses (known as the Integrated Register). The prime purpose of this Register is to provide mailing information for economic units selected in ABS censuses and surveys rather than detailed statistical data about the structure of the economy.

SCOPE

In broad terms, the Integrated Register is limited to all businesses that employ staff or have agricultural operations with an estimated value of over \$5000. Therefore, it excludes sole proprietors, partnerships and other non employing businesses.

COVERAGE

Coverage of businesses classified to ASIC Subdivision 01 (Agriculture), Divisions B (Mining) and C (Manufacturing), and large businesses (groups employing over 500 staff) is regarded as "complete" in that it meets requirements for general statistical purposes.

The coverage for other ASIC Divisions will vary because of the cyclic nature of ABS surveys and, currently, coverage of the public sector is regarded as deficient.

TIMING

Continuous updating of all segments of the Register is not required nor has this been economically feasible. Thus, the number of units recorded at any date may not represent the number of units actually operational in the economy at that time. The main variations arise because:

- i. units which have ceased operation may not be identified as deaths on the Register for some time, if at all
- ii. small businesses in some more "volatile" industry sectors, (such as transport and construction), are only included in the Register periodically in preparation for particular ABS surveys.

The following industry sectors were last comprehensively updated in:-

Subdivision 63	Business Services	1988
Subdivision 92	Restaurants, Hotels & Clubs	1987
Subdivision 93(part)	Laundries & Hairdressers	1987
Subdivision 48	Retail Trade	1986
Division E	Construction	1985
Division G	Transport	1984

EMPLOYMENT

Employment data is recorded on the Register as a sizing variable rather than as a way of producing definitive employment statistics. This data is obtained from various sources at various times during the year. It is recorded at location level and derived for the higher statistical units of establishment and management unit. There are a large number of locations for which employment is unknown (although, in these cases, employment will usually be less than 4) hence the derivation is inaccurate. Given this and other deficiencies, employment data should be used as a rough guide only.

Agricultural units are sized by Estimated Value of Agricultural Operations (EVAO) rather than Employment/Employees Size. Therefore, where tables are split up by Employment/Employees Size, only totals are given for Agricultural units.

COMPARISON WITH OTHER DATA

Due to the deficiencies and qualifications outlined above, comparisons with other data published by the ABS is not recommended. In particular, definitions (e.g. employment) and timing used in some series may differ from those used in compiling the Integrated Register. Comparison of Integrated Register data should also be avoided -

- (i) from one industrial sector to another due to inconsistencies in data quality across sectors
- (ii) from one period to another due to the cyclic nature of Register updating and changes to classifications and statistical units definitions.

CONFIDENTIALITY

As a general rule, aggregate Employment and EVAO data is not released except in broad level tables (e.g. State totals).

Aggregate Employment and EVAO data is confidential if less than 6 units contribute to any given cell. Where this occurs that particular cell is suppressed before release. Where totals are supplied, it may also be necessary to consequently suppress the next smallest cell in that row or column.

CLASSIFICATIONS

The industry groups referred to in these tables are described in the 1983 Australian Standard Industrial Classification (ASIC) - ABS Catalogue No. 1201.0.

Area classifications are described in the Australian Standard Geographical Classification (ASGC) - ABS Catalogue No. 1216.0.

STATISTICAL UNITS

The statistical units for which the data is tabulated are MANAGEMENT UNITS, ESTABLISHMENTS and LOCATIONS.

The MANAGEMENT UNIT equates, in most cases, with the largest type of management accounting unit within an enterprise group. The term 'management accounting unit' is largely self-defining and refers to an operational entity of the enterprise group (e.g. a division) which is separately managed and in respect of which management accounts are kept. It consists of one or more establishments.

The ESTABLISHMENT is the smallest type of accounting unit within a management unit and controls its productive activity. It consists, in most industries, of one or more locations in a State/Territory of Australia at or from which it operates.

The LOCATION usually consists of an unbroken physical area or site occupied by an establishment where it engages in productive activity on a relatively permanent basis.

From January 1990 the Register has progressively converted from ENTERPRISES (the operations of a single company or legal entity) to MANAGEMENT UNITS (the operations of a discrete division grouped for management/accounting purposes). While ENTERPRISES and MANAGEMENT UNITS are identical for the majority of records, this change will reduce the number of units for larger businesses.

BUSINESS REGISTER STATISTICAL OUTPUT EXPLANATION OF KEY WORDS

The following are descriptions of key words used in IRIS tables and the accompanying explanatory notes.

ASIC Australian Standard Industrial Classification

System for classifying establishments by industry. The structure comprises four levels, namely Divisions (the broadest level), Subdivisions, Groups and Classes.

EMPLOYMENT

Number of employees and working proprietors or partners.

EMPLOYEES

Number of persons usually employed either full-time and part-time.

ASGC Australian Standard Geographical Classification

System for the classification of statistical units, such as households and establishments, by geographical area.

SD Statistical Division

Consists of one or more SSDs and is used as a large, general purpose regional type spatial unit.

SSD Statistical Sub-Division

Consists of one or more SLAs and is used as an intermediate level, general purpose regional type spatial unit.

SLA Statistical Local Area

Geographic area based on local government area (ie. Legal LGA) and in some cases part LGAs.

COUNT OF ASGC UNITS

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	TOTAL
SD	13	13	12	9	10	5	3	2	67
SSD	43	19	31	21	26	9	12	7	168
SLA	187	235	413	143	146	64	57	100	1345

TOLO Type of Legal Organisation

A code used to indicate the type of Legal Entity which owns or operates the business eg. a sole proprietor, partnership, registered company, etc..

APPENDIX H

Table H.1: Number of ASIC 2763 (Pharmaceutical and Veterinary Products) Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO-NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	9	17%	12	22%	7	21%	4	11%	8	18%	-5	36%
IW	1	2%	1	2%	1	3%	2	5%	1	3%	1	-7%
IN	5	10%	4	7%	1	3%	1	3%	3	6%	-4	29%
IE	2	4%	5	9%	1	3%	1	3%	2	5%	-1	7%
IS	3	6%	1	2%	0	0%	1	3%	1	3%	-2	14%
MN	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
ME	6	12%	6	11%	4	12%	4	11%	5	11%	-2	14%
MS	14	27%	11	20%	8	24%	3	8%	9	20%	-11	79%
OW	0	0%	0	0%	0	0%	1	3%	0	1%	1	-7%
ON	0	0%	0	0%	1	3%	2	5%	1	2%	2	-14%
OE	4	8%	5	9%	5	15%	5	13%	5	11%	1	-7%
OS	5	10%	6	11%	4	12%	10	26%	6	14%	5	-36%
FW	2	4%	1	2%	1	3%	1	3%	1	3%	-1	7%
FN	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
FE	0	0%	1	2%	0	0%	0	0%	0	1%	0	0%
FS	1	2%	1	2%	0	0%	3	8%	1	3%	2	-14%
MSD	52	100%	54	100%	33	100%	38	100%	44	100%	-14	100%
AVG.	3	6%	3	6%	2	6%	2	6%	3	6%	-1	6%

Table H.2: Number of ASIC 3244 (Aircraft) Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO-NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	3	10%	5	13%	3	8%	4	7%	4	9%	1	4%
IW	1	3%	1	3%	2	5%	4	7%	2	5%	3	11%
IN	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
IE	0	0%	1	3%	0	0%	0	0%	0	1%	0	0%
IS	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
MN	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
ME	1	3%	0	0%	0	0%	2	4%	1	2%	1	4%
MS	9	31%	12	31%	10	26%	11	19%	11	26%	2	7%
OW	6	21%	11	28%	12	31%	19	33%	12	29%	13	46%
ON	2	7%	2	5%	3	8%	2	4%	2	5%	0	0%
OE	0	0%	1	3%	1	3%	2	4%	1	2%	2	7%
OS	2	7%	2	5%	2	5%	2	4%	2	5%	0	0%
FW	1	3%	1	3%	1	3%	1	2%	1	2%	0	0%
FN	2	7%	2	5%	3	8%	4	7%	3	7%	2	7%
FE	1	3%	1	3%	1	3%	1	2%	1	2%	0	0%
FS	1	3%	0	0%	1	3%	5	9%	2	4%	4	14%
MSD	29	100%	39	100%	39	100%	57	100%	41	100%	28	100%
AVG.	2	6%	2	6%	2	6%	4	6%	3	6%	2	6%

Table H.3: Number of ASIC 3341 (Photographic and Optical Goods) Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO- NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	2	10%	3	12%	1	7%	6	18%	3	13%	4	29%
IW	0	0%	1	4%	0	0%	0	0%	0	1%	0	0%
IN	2	10%	3	12%	2	13%	1	3%	2	9%	-1	-7%
IE	3	15%	5	20%	3	20%	2	6%	3	14%	-1	-7%
IS	1	5%	1	4%	0	0%	1	3%	1	3%	0	0%
MN	0	0%	0	0%	0	0%	1	3%	0	1%	1	7%
ME	2	10%	2	8%	4	27%	8	24%	4	17%	6	43%
MS	5	25%	2	8%	1	7%	6	18%	4	15%	1	7%
OW	1	5%	1	4%	1	7%	1	3%	1	4%	0	0%
ON	0	0%	1	4%	1	7%	1	3%	1	3%	1	7%
OE	1	5%	3	12%	1	7%	3	9%	2	9%	2	14%
OS	1	5%	2	8%	1	7%	3	9%	2	7%	2	14%
FW	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
FN	1	5%	1	4%	0	0%	0	0%	1	2%	-1	-7%
FE	1	5%	0	0%	0	0%	0	0%	0	1%	-1	-7%
FS	0	0%	0	0%	0	0%	1	3%	0	1%	1	7%
MSD	20	100%	25	100%	15	100%	34	100%	24	100%	14	100%
AVG.	1	6%	2	6%	1	6%	2	6%	1	6%	1	6%

Table H.4: Number of ASIC 3342 (Photographic Film Processing) Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO- NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	37	41%	56	32%	46	26%	57	35%	49	33%	20	27%
IW	1	1%	3	2%	3	2%	5	3%	3	2%	4	5%
IN	3	3%	7	4%	5	3%	3	2%	5	3%	0	0%
IE	3	3%	9	5%	9	5%	9	6%	8	5%	6	8%
IS	3	3%	8	5%	10	6%	9	6%	8	5%	6	8%
MN	0	0%	6	3%	6	3%	1	1%	3	2%	1	1%
ME	8	9%	21	12%	22	13%	20	12%	18	12%	12	16%
MS	10	11%	13	8%	14	8%	9	6%	12	8%	-1	-1%
OW	7	8%	9	5%	8	5%	6	4%	8	5%	-1	-1%
ON	1	1%	5	3%	7	4%	5	3%	5	3%	4	5%
OE	2	2%	8	5%	12	7%	12	7%	9	6%	10	14%
OS	9	10%	14	8%	14	8%	11	7%	12	8%	2	3%
FW	1	1%	2	1%	3	2%	4	2%	3	2%	3	4%
FN	0	0%	1	1%	3	2%	3	2%	2	1%	3	4%
FE	3	3%	5	3%	5	3%	3	2%	4	3%	0	0%
FS	2	2%	6	3%	8	5%	6	4%	6	4%	4	5%
MSD	90	100%	173	100%	175	100%	163	100%	150	100%	73	100%
AVG.	6	6%	11	6%	11	6%	10	6%	9	6%	5	6%

Table H.5: Number of ASIC 3343 (Measuring, Professional and Scientific Equipment N.E.C.) Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO- NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	13	16%	12	16%	10	14%	12	13%	12	15%	-1	-8%
IW	1	1%	0	0%	0	0%	2	2%	1	1%	1	8%
IN	3	4%	4	5%	4	6%	6	6%	4	5%	3	23%
IE	2	2%	3	4%	1	1%	5	5%	3	3%	3	23%
IS	8	10%	7	9%	4	6%	3	3%	6	7%	-5	-38%
MN	2	2%	2	3%	1	1%	2	2%	2	2%	0	0%
ME	12	15%	16	22%	14	20%	10	11%	13	16%	-2	-15%
MS	9	11%	8	11%	9	13%	12	13%	10	12%	3	23%
OW	7	9%	6	8%	4	6%	4	4%	5	7%	-3	-23%
ON	3	4%	0	0%	2	3%	2	2%	2	2%	-1	-8%
OE	10	12%	6	8%	6	9%	12	13%	9	11%	2	15%
OS	7	9%	5	7%	8	12%	13	14%	8	10%	6	46%
FW	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
FN	2	2%	1	1%	2	3%	3	3%	2	3%	1	8%
FE	1	1%	1	1%	3	4%	5	5%	3	3%	4	31%
FS	1	1%	3	4%	1	1%	3	3%	2	3%	2	15%
MSD	81	100%	74	100%	69	100%	94	100%	80	100%	13	100%
AVG.	5	6%	5	6%	4	6%	6	6%	5	6%	1	6%

Table H.6: Number of ASIC 3351 (Radio and TV Receivers; Audio Equipment) Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO- NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	4	16%	4	15%	7	32%	10	33%	6	24%	6	120%
IW	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
IN	3	12%	4	15%	3	14%	4	13%	4	13%	1	20%
IE	1	4%	1	4%	0	0%	0	0%	1	2%	-1	-20%
IS	3	12%	3	11%	0	0%	0	0%	2	6%	-3	-60%
MN	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
ME	1	4%	1	4%	1	5%	5	17%	2	8%	4	80%
MS	5	20%	5	19%	3	14%	5	17%	5	17%	0	0%
OW	0	0%	0	0%	1	5%	0	0%	0	1%	0	0%
ON	0	0%	0	0%	1	5%	0	0%	0	1%	0	0%
OE	1	4%	2	7%	1	5%	2	7%	2	6%	1	20%
OS	6	24%	5	19%	2	9%	2	7%	4	14%	-4	-80%
FW	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
FN	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
FE	1	4%	2	7%	3	14%	2	7%	2	8%	1	20%
FS	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
MSD	25	100%	27	100%	22	100%	30	100%	26	100%	5	100%
AVG.	2	6%	2	6%	1	6%	2	6%	2	6%	0	6%

Table H.7: Number of ASIC 3352 (Electronic Equipment N.E.C.) Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO- NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	31	22%	41	20%	28	14%	32	13%	33	17%	1	1%
IW	0	0%	4	2%	5	3%	6	2%	4	2%	6	6%
IN	3	2%	6	3%	5	3%	9	4%	6	3%	6	6%
IE	2	1%	9	4%	6	3%	10	4%	7	3%	8	8%
IS	3	2%	4	2%	7	4%	12	5%	7	3%	9	9%
MN	6	4%	11	5%	6	3%	5	2%	7	4%	-1	-1%
ME	26	18%	34	16%	36	18%	37	15%	33	17%	11	10%
MS	18	13%	28	14%	25	13%	34	14%	26	13%	16	15%
OW	4	3%	3	1%	5	3%	9	4%	5	3%	5	5%
ON	6	4%	10	5%	12	6%	16	6%	11	6%	10	10%
OE	23	16%	27	13%	23	12%	30	12%	26	13%	7	7%
OS	14	10%	17	8%	19	10%	24	10%	19	9%	10	10%
FW	0	0%	1	0%	1	1%	0	0%	1	0%	0	0%
FN	3	2%	2	1%	7	4%	10	4%	6	3%	7	7%
FE	3	2%	6	3%	8	4%	10	4%	7	3%	7	7%
FS	2	1%	4	2%	7	4%	5	2%	5	2%	3	3%
MSD	144	100%	207	100%	200	100%	249	100%	200	100%	105	100%
AVG.	9	6%	13	6%	13	6%	16	6%	13	6%	7	6%

Table H.8: Number of ASIC 3353 (Refrigerators and Household Appliances) Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO- NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	12	13%	10	10%	4	5%	6	6%	8	8%	-6	-55%
IW	1	1%	3	3%	3	4%	4	4%	3	3%	3	27%
IN	9	10%	11	11%	3	4%	8	8%	8	8%	-1	-9%
IE	4	4%	2	2%	2	2%	1	1%	2	2%	-3	-27%
IS	2	2%	3	3%	1	1%	3	3%	2	2%	1	9%
MN	7	7%	9	9%	11	14%	10	10%	9	10%	3	27%
ME	11	12%	7	7%	4	5%	6	6%	7	7%	-5	-45%
MS	27	29%	22	22%	17	21%	16	15%	21	22%	-11	-100
OW	2	2%	3	3%	3	4%	3	3%	3	3%	1	9%
ON	0	0%	0	0%	1	1%	4	4%	1	1%	4	36%
OE	5	5%	11	11%	15	19%	18	17%	12	13%	13	118%
OS	10	11%	12	12%	14	17%	19	18%	14	14%	9	82%
FW	0	0%	0	0%	0	0%	1	1%	0	0%	1	9%
FN	2	2%	6	6%	2	2%	2	2%	3	3%	0	0%
FE	0	0%	1	1%	0	0%	2	2%	1	1%	2	18%
FS	2	2%	1	1%	1	1%	2	2%	2	2%	0	0%
MSD	94	100%	101	100%	81	100%	105	100%	95	100%	11	100%
AVG.	6	6%	6	6%	5	6%	7	6%	6	6%	1	6%

Table H.9: Number of ASIC 3354 (Water Heating Systems) Sites in the MSD by Zone; 1986-92

ZO-NE	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	1	8%	0	0%	0	0%	1	5%	1	3%	0	0%
IW	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
IN	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
IE	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
IS	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
MN	0	0%	0	0%	1	8%	2	10%	1	5%	2	25%
ME	3	23%	3	25%	2	15%	3	14%	3	19%	0	0%
MS	3	23%	2	17%	4	31%	5	24%	4	24%	2	25%
OW	2	15%	1	8%	2	15%	2	10%	2	12%	0	0%
ON	0	0%	0	0%	0	0%	1	5%	0	2%	1	13%
OE	1	8%	2	17%	1	8%	2	10%	2	10%	1	13%
OS	2	15%	3	25%	2	15%	3	14%	3	17%	1	13%
FW	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
FN	0	0%	0	0%	0	0%	1	5%	0	2%	1	13%
FE	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
FS	1	8%	1	8%	1	8%	1	5%	1	7%	0	0%
MSD	13	100%	12	100%	13	100%	21	100%	15	100%	8	100%
AVG.	1	6%	1	6%	1	6%	1	6%	1	6%	1	6%

Table H.10: Number of ASIC 3355 (Electric and Telephone Cable and Wire) Sites in the MSD by Zone; 1986-92

ZO-NE	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	0	0%	1	5%	0	0%	3	12%	1	5%	3	33%
IW	0	0%	1	5%	0	0%	1	4%	1	3%	1	11%
IN	0	0%	3	16%	1	7%	2	8%	2	8%	2	22%
IE	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
IS	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
MN	2	13%	0	0%	0	0%	0	0%	1	3%	-2	-22%
ME	2	13%	1	5%	2	13%	3	12%	2	11%	1	11%
MS	4	25%	3	16%	1	7%	2	8%	3	13%	-2	-22%
OW	3	19%	1	5%	2	13%	3	12%	2	12%	0	0%
ON	0	0%	0	0%	1	7%	2	8%	1	4%	2	22%
OE	1	6%	1	5%	1	7%	4	16%	2	9%	3	33%
OS	3	19%	4	21%	4	27%	2	8%	3	17%	-1	-11%
FW	0	0%	2	11%	1	7%	1	4%	1	5%	1	11%
FN	0	0%	1	5%	0	0%	0	0%	0	1%	0	0%
FE	1	6%	1	5%	1	7%	1	4%	1	5%	0	0%
FS	0	0%	0	0%	1	7%	1	4%	1	3%	1	11%
MSD	16	100%	19	100%	15	100%	25	100%	19	100%	9	100%
AVG.	1	6%	1	6%	1	6%	2	6%	1	6%	1	6%

Table H.11: Number of ASIC 3356 (Batteries) Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO- NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	2	18%	2	20%	1	33%	1	100%	2	24%	-1	10%
IW	2	18%	2	20%	0	0%	0	0%	1	16%	-2	20%
IN	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
IE	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
IS	1	9%	2	20%	0	0%	0	0%	1	12%	-1	10%
MN	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
ME	2	18%	2	20%	1	33%	0	0%	1	20%	-2	20%
MS	1	9%	0	0%	0	0%	0	0%	0	4%	-1	10%
OW	3	27%	1	10%	0	0%	0	0%	1	16%	-3	30%
ON	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
OE	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
OS	0	0%	1	10%	0	0%	0	0%	0	4%	0	0%
FW	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
FN	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
FE	0	0%	0	0%	1	33%	0	0%	0	4%	0	0%
FS	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
MSD	11	100%	10	100%	3	100%	1	100%	6	100%	-10	100%
AVG.	1	6%	1	6%	0	6%	0	6%	0	6%	-1	6%

Table H.12: Number of ASIC 3357 (Electrical Machinery and Equipment N.E.C.) Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO- NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	39	15%	40	14%	29	11%	27	10%	34	13%	-12	-1200
IW	10	4%	9	3%	6	2%	4	2%	7	3%	-6	-600
IN	11	4%	10	4%	10	4%	7	3%	10	4%	-4	-400
IE	9	3%	4	1%	1	0%	3	1%	4	2%	-6	-600
IS	11	4%	14	5%	10	4%	9	3%	11	4%	-2	-200
MN	20	8%	22	8%	20	8%	20	8%	21	8%	0	0%
ME	36	14%	32	11%	31	12%	23	9%	31	11%	-13	-1300
MS	51	19%	41	14%	39	15%	42	16%	43	16%	-9	-900
OW	10	4%	9	3%	12	5%	17	6%	12	4%	7	700%
ON	6	2%	11	4%	6	2%	9	3%	8	3%	3	300%
OE	16	6%	40	14%	41	16%	48	18%	36	14%	32	3200
OS	21	8%	27	10%	30	12%	28	11%	27	10%	7	700%
FW	1	0%	3	1%	3	1%	3	1%	3	1%	2	200%
FN	8	3%	5	2%	6	2%	7	3%	7	2%	-1	-100
FE	6	2%	6	2%	8	3%	8	3%	7	3%	2	200%
FS	9	3%	10	4%	7	3%	10	4%	9	3%	1	100%
MSD	264	100%	283	100%	259	100%	265	100%	268	100%	1	100%
AVG.	17	6%	18	6%	16	6%	17	6%	17	6%	0	6%

APPENDIX J

Table J.1: Number of <5 Employment Size HTI Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO- NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	50	19%	79	18%	45	13%	78	15%	63	16%	28	11%
IW	7	3%	12	3%	8	2%	16	3%	11	3%	9	3%
IN	9	3%	14	3%	11	3%	13	2%	12	3%	4	2%
IE	9	3%	21	5%	14	4%	23	4%	17	4%	14	5%
IS	18	7%	22	5%	22	6%	27	5%	22	6%	9	3%
MN	7	3%	14	3%	13	4%	15	3%	12	3%	8	3%
ME	35	13%	61	14%	48	14%	64	12%	52	13%	29	11%
MS	45	17%	51	12%	39	11%	55	10%	48	12%	10	4%
OW	13	5%	18	4%	21	6%	29	5%	20	5%	16	6%
ON	9	3%	16	4%	17	5%	25	5%	17	4%	16	6%
OE	20	7%	43	10%	39	11%	66	12%	42	11%	46	17%
OS	24	9%	46	11%	39	11%	53	10%	41	10%	29	11%
FW	1	0%	4	1%	4	1%	8	2%	4	1%	7	3%
FN	6	2%	8	2%	10	3%	18	3%	11	3%	12	5%
FE	8	3%	13	3%	11	3%	21	4%	13	3%	13	5%
FS	8	3%	11	3%	10	3%	21	4%	13	3%	13	5%
MSD	269	100%	433	100%	351	100%	532	100%	396	100%	263	100%
AVG.	17	6%	27	6%	22	6%	33	6%	25	6%	16	6%

Table J.2: Number of 5-19 Employment Size HTI Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO- NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	43	21%	52	19%	54	18%	52	15%	50	18%	9	7%
IW	3	1%	4	1%	3	1%	6	2%	4	1%	3	2%
IN	8	4%	12	4%	9	3%	14	4%	11	4%	6	4%
IE	8	4%	6	2%	6	2%	7	2%	7	2%	-1	-1%
IS	2	1%	9	3%	4	1%	6	2%	5	2%	4	3%
MN	14	7%	16	6%	18	6%	14	4%	16	6%	0	0%
ME	22	11%	35	13%	37	13%	34	10%	32	11%	12	9%
MS	53	26%	51	19%	52	18%	65	19%	55	20%	12	9%
OW	12	6%	16	6%	15	5%	20	6%	16	6%	8	6%
ON	1	0%	6	2%	8	3%	13	4%	7	3%	12	9%
OE	17	8%	30	11%	35	12%	50	15%	33	12%	33	24%
OS	14	7%	17	6%	30	10%	42	12%	26	9%	28	20%
FW	1	0%	2	1%	2	1%	0	0%	1	0%	-1	-1%
FN	4	2%	3	1%	6	2%	8	2%	5	2%	4	3%
FE	1	0%	4	1%	9	3%	5	1%	5	2%	4	3%
FS	4	2%	6	2%	8	3%	8	2%	7	2%	4	3%
MSD	207	100%	269	100%	296	100%	344	100%	279	100%	137	100%
AVG.	13	6%	17	6%	19	6%	22	6%	17	6%	9	6%

Table J.3: Number of 20-99 Employment Size HTI Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO- NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	19	15%	18	13%	18	12%	23	16%	20	14%	4	27%
IW	0	0%	1	1%	2	1%	1	1%	1	1%	1	7%
IN	13	10%	14	10%	11	7%	8	6%	12	8%	-5	-33%
IE	4	3%	5	4%	3	2%	1	1%	3	2%	-3	-20%
IS	6	5%	6	4%	4	3%	5	4%	5	4%	-1	-7%
MN	5	4%	8	6%	10	6%	7	5%	8	5%	2	13%
ME	17	13%	13	10%	15	10%	14	10%	15	11%	-3	-20%
MS	16	13%	15	11%	26	17%	16	11%	18	13%	0	0%
OW	5	4%	3	2%	6	4%	14	10%	7	5%	9	60%
ON	0	0%	1	1%	5	3%	3	2%	2	2%	3	20%
OE	13	10%	17	13%	20	13%	18	13%	17	12%	5	33%
OS	16	13%	21	16%	20	13%	16	11%	18	13%	0	0%
FW	0	0%	3	2%	3	2%	3	2%	2	2%	3	20%
FN	3	2%	3	2%	3	2%	3	2%	3	2%	0	0%
FE	4	3%	1	1%	2	1%	3	2%	3	2%	-1	-7%
FS	6	5%	5	4%	6	4%	7	5%	6	4%	1	7%
MSD	127	100%	134	100%	154	100%	142	100%	139	100%	15	100%
AVG.	8	6%	8	6%	10	6%	9	6%	9	6%	1	6%

Table J.4: Number of 100+ Employment Size HTI Sites in the MSD by Zone; 1986-92

	1986		1988		1990		1992		1986-92 AVG.		1986-92 CHG.	
ZO- NE	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD	NO.	% MSD
CC	6	9%	10	12%	8	11%	10	16%	9	12%	4	-200
IW	4	6%	5	6%	4	6%	5	8%	5	6%	1	-50%
IN	4	6%	7	8%	3	4%	6	9%	5	7%	2	-100
IE	1	2%	0	0%	0	0%	0	0%	0	0%	-1	50%
IS	1	2%	2	2%	1	1%	0	0%	1	1%	-1	50%
MN	7	11%	8	9%	4	6%	5	8%	6	8%	-2	100%
ME	8	12%	10	12%	12	17%	9	14%	10	14%	1	-50%
MS	15	23%	13	15%	10	14%	9	14%	12	16%	-6	300%
OW	5	8%	4	5%	4	6%	2	3%	4	5%	-3	150%
ON	4	6%	4	5%	4	6%	3	5%	4	5%	-1	50%
OE	4	6%	9	10%	8	11%	4	6%	6	9%	0	0%
OS	3	5%	4	5%	6	9%	6	9%	5	7%	3	-150
FW	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
FN	2	3%	4	5%	2	3%	1	2%	2	3%	-1	50%
FE	2	3%	5	6%	4	6%	3	5%	4	5%	1	-50%
FS	0	0%	1	1%	0	0%	1	2%	1	1%	1	-50%
MSD	66	100%	86	100%	70	100%	64	100%	72	100%	-2	100%
AVG.	4	6%	5	6%	4	6%	4	6%	4	6%	0	6%

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