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REHABILITATION ASSESSMENT OF THE PRETORIA STATE GARAGE TO FIT THE PRETORIA TECHNOLOGY PARK

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GIFT PHALATSE SETSHEDI

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Candidate: **Gift Phalatse Setshedi**

Supervisor: **Alta Steenkamp**
Co-supervisor: **Finzi Saidi**

Master of Architecture
Department of Architecture
University of Pretoria

INTRODUCTION

This research investigates the assessment for the rehabilitation of the Pretoria State Garage (PSG) for the purpose of accommodating the Pretoria Technology Park (PTP). The Pretoria State Garage courtyard is comprised of industrial type of buildings, most of which stand obsolete due to a shift in the manufacturing process. These buildings are structurally sound and historically significant. They offer a major opportunity for conversion to attract business through providing relatively inexpensive commercial and industrial spaces to small and medium sized companies. The site is located in the southwest quadrant of Pretoria Central in which a number of sites and buildings are currently being downgraded in the urban revitalisation process, due to preferred, other technologies of construction.

The assessment for the rehabilitation of the site evaluates the spatial qualities and the physical forms of buildings in relation to the new user, while the establishment of the PTP focuses on maintaining, elongating and innovating the industrial manufacturing tradition of the site. The incorporation of the PTP on the PSG site is implemented through the fitting process.

RESEARCH AREAS

The research focuses on the three main areas dealing with:

- Programming and planning of the Pretoria Technology Park
- Rehabilitation assessment of the Pretoria State Garage
- Architectural fitting process

1. Programming and planning of the Pretoria Technology Park

The development methodology is employed for the establishment of a sustainable Pretoria Technology Park, which stems from local technology demand, supply and transfer. As a result, different centres are established to provide accommodation and services to major activities of the park dealing with administration, provision of advanced technology services and accommodation for technology-based firms. Individual centres are discussed according to their envisaged spatial qualities and design specifications.

2. Rehabilitation assessment of the Pretoria State Garage

The rehabilitation assessment explores the historic significance and architectural values of the PSG. The outcome of the rehabilitation assessment defines the manner and the degree in which various rehabilitation interventions could be executed. The process includes proposals for the demolition of unwanted structures and elements, investigating the long-term resilience of buildings to be retained and assessing negative physical features of the site.

3. Architectural fitting process

Specific dimensions and spatial requirements of both the PSG (physical) and the PTP (intellectual) respectively are compared for the purpose of mutual fitting.

KEY TERMS

- Pretoria Technology Park
- Pretoria State Garage
- Building rehabilitation
- Industrial building
- Restoration of brick-work
- Technology transfer
- Science park
- Incubator
- High technology manufacturing
- Small and medium enterprises

WAARDEBEPALING TEN OPSIGTE VAN DIE REHABILITASIE VAN DIE PRETORIA STAATSGARAGE OM BY DIE PRETORIA TEGNOLOGIEPARK IN TE PAS

Kandidaat: **Gift Phalatse Setshedi**

Studieleier: **Alta Steenkamp**
Mede-studieleier: **Finzi Saidi**

Meester in Argitektuur
Departement van Argitektuur
Universiteit van Pretoria

INLEIDING

Hierdie navorsing ondersoek die waardebepaling ten opsigte van die rehabilitasie van die Pretoria Staatsgarage (PSG), met die doel om die Pretoria Tegnologiepark (PTP) te akkommodeer. Die binnehof van die Pretoria Staatsgarage bevat industriële geboue, waarvan meeste in onbruik is as gevolg van die verskuiwing van vervaardigingsprosesse na ander gebiede. Hierdie geboue is struktureel ongeskonde en histories waardevol, en bied 'n belangrike geleentheid om omgebou te word en sodoende besigheidsgeleenthede te lok deur bekostigbare kommersiële en industriële ruimtes aan klein en medium maatskappye te verskaf. Die terrein is in die suidwestelike kwadrant van Sentraal Pretoria geleë, waar verskeie terreine en geboue tans in die proses van stedelike herlewing laer gegradeer word, omdat daar aan alternatiewe konstruksietegnologieë voorkeur gegee word.

Die waardebepaling vir die rehabilitasie van die terrein evalueer die ruimtelike aspekte en die fisiese vorms van die geboue in terme van die nuwe gebruiker, terwyl die vestiging van die PTP op die instandhouding, voortsetting en vernuwing van die industriële vervaardigingstradisie van die terrein fokus. Die inlywing van die PTP by die PSG-terrein word deur die passingsproses geïmplementeer.

NAVORSINGSGEBIEDE

Die navorsing fokus op drie hoofgebiede wat die volgende behels:

- Programmering en beplanning van die Pretoria Tegnologiepark
- Waardebepaling ten opsigte van die rehabilitasie van die Pretoria Staatsgarage
- Die argitektoniese inskakelingsproses

1. Programmering en beplanning van die Pretoria Tegnologiepark

Die ontwikkelingsmetodologie word vir die vestiging van 'n volhoubare Pretoria Tegnologiepark aangewend, wat uit die plaaslike aanvraag na en verskaffing en oordrag van tegnologie voortspruit. Gevolglik word verskillende sentra gevestig om akkommodasie en dienste aan belangrike aktiwiteite van die park te voorsien, wat op administrasie, verskaffing van gevorderde tegnologiese dienste en akkommodasie vir tegnologie-gebaseerde firmas fokus. Individuele sentra word volgens hulle beoogde ruimtelike eienskappe en ontwerpspesifikasies behandel.

2. Waardebepaling ten opsigte van die rehabilitasie van die Pretoria Staatsgarage

Die waardebepaling ten opsigte van die rehabilitasie verken die historiese belang en argitektoniese waarde van die PSG. Die resultaat van die waardebepaling definieër die manier waarop en die mate waartoe die verskeie rehabilitasie-ingrypings uitgevoer kan word. Die proses sluit voorstelle vir die sloping van ongewenste strukture en elemente in, en ondersoek die langtermyn lewensvatbaarheid van die geboue wat behou gaan word, en die waardebepaling van negatiewe fisiese kenmerke van die terrein.

3. Die argitektoniese passingsproses

Spesifieke afmetings en ruimtelike vereistes van die PSG (fisies) en die PTP (intellektueel) onderskeidelik word vir die doel van wedersydse inskakeling vergelyk.

SLEUTELTERME

- Pretoria Tegnologiepark
- Pretoria Staatsgarage
- Rehabilitasie van geboue
- Nywerheidsgeboue
- Restourasie van steenwerk
- Oordrag van tegnologie
- Wetenskappark
- Inkubator
- Hoë-tegnologie vervaardiging
- Klein en medium ondernemings

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List of Abbreviations

SME: Small and Medium Enterprises/Companies

CSIR: Council of Scientific and Industrial Research

DTI: Department of Trade and Industry

UP: University of Pretoria

UKSPA: United Kingdom Science Park Association

HEI: Higher Educational Institution

IASP: International Organisation of Science Parks

ISDN: Integrated Services Digital Network

SERA: Southern Educational Research Alliance

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INTRODUCTION

1.1 Background

Developing technologies in the field of manufacturing have an impact on industrial location, servicing and the architectural design framework, which in some cases result in the decaying of industrial sites. Rehabilitation of old industrial buildings indicates the commitment towards conservation of architectural heritage and recognition of manufacturing traditions. Rehabilitation of old industrial buildings for the purpose of accommodating activities of technological innovation realises the need to revitalise decaying industrial sites and promote innovation for industrial manufacturing.

The rehabilitation of old industrial buildings is now an established approach (Eley and Worthington, 1984:3), acting as a tool for preserving the heritage from the industrial building era (Marsh, 1983:3). There is a need for further analysis and evaluation of both private and public owned old industrial buildings in South Africa, which if rehabilitated could revitalise local economies. Rehabilitation of old industrial building can also be an essential ingredient in sustaining a healthy economy because a healthy and sustainable economy relies on the efficiency of the working environment.

This study investigates the rehabilitation assessment of the Pretoria State Garage for the purpose of accommodating the Pretoria Technology Park. The rehabilitation process and the technology park programming and planning address the physical form and the intellectual context of the project respectively. The rehabilitating assessment of the State Garage recognizes the potential re-use of existing structures by new industrial and commercial activities, which are vital to community growth. The site contains obsolete and redundant buildings that are structurally sound and could be converted into a major opportunity to attract business through providing inexpensive commercial and industrial spaces.

The technology park development methodology is incorporated to complement the rehabilitation assessment of the Pretoria Technology Park. It is significant for the establishment of a technology transfer network, design specifications and macro-planning strategies of the park. The design of the park should fit within the existing physical forms of the State Garage and offer intellectual (know-how) and physical infrastructure to tenant companies.

1.2 Scope of Project

1.2.1 Relevance of the study

The rehabilitation assessment will benefit the revival process of the State Garage and also provide intellectual framework for the sustainability of the State Garage. Pretoria and specifically the southwest quadrant will also maintain one of its historically significant sites that once contributed to the socio-economic sector of the city.

The establishment of the Pretoria Technology Park will contribute to the innovation program for small and medium sized enterprises and enhance links between institutions of higher education, research and manufacturing industries.

1.2.2 Problem context

The two issues relating to the salvation of the Pretoria State Garage buildings and the establishment of a sustainable technology park inform the study.

1. Pretoria contains a considerable surplus of obsolete and abandoned buildings and sites, which, in most cases, are relegated to positions of obscurity due to highly preferred new construction. The Pretoria State Garage in Pretoria stands obsolete and consequently redundant due to a shift in the field of industrial manufacturing. The current use and architectural composition of buildings on site does not promote any sustainable activity or development that can salvage the site from possible demolition. The challenge lies in the architectural fitting process of the site for possible use by the Pretoria Technology Park, which is anticipated to restore and innovate the industrial manufacturing tradition of the site. The location of the site is also ideal because of its proximity to the target group (small and medium companies already in the vicinity).

2. A number of science and technology parks were initiated in South Africa, including Pretoria, without success as compared to similar developments in Europe, Asia and United States of America. The sustainability of the Pretoria Technology Park relies highly on the park's relevance to local technology supply and demands to research communities and user groups respectively. As a result it is important to develop a methodology for the establishment of a locally appropriate size and type of park that can also fit within the existing physical forms of the Pretoria State Garage.

1.2.3 Statement of the problem

This study proposes the development of the Pretoria Technology Park, which incorporates the development of an operational framework that is to be fitted within the existing site of the Pretoria State Garage.

1.2.4 Limitations of the study

This study is limited to the rehabilitation assessment of the Pretoria State Garage, which incorporates the technology park development methodology for the Pretoria Technology Park.

- The Pretoria Technology Park development methodology focuses on the establishment of a technology transfer centre for local small and medium sized enterprises in the manufacturing sector. It is assumed that the park is small and will be situated in areas with an industrial history that is oriented towards providing technology innovation to small and medium sized companies.
- This study does not conduct the actual survey of the local technology demand and supply but relies on the already existing statistics and programs from the Department of Trade and Industry, University of Pretoria and CSIR.
- The assessment for the rehabilitation analyses the architectural, cultural and spatial qualities of the Pretoria State Garage and its capacity to accommodate the Pretoria Technology Park.
- Issues relating to cost, implementation and technical aspects of building rehabilitation are not covered.

1.2.5 Objectives of the study

There are three main objectives that are based on the three main areas of concern in the study: programming and planning of the Pretoria Technology Park, rehabilitation assessment of the Pretoria State Garage and the fit process.

1.2.5.1 Programming and planning of the Pretoria Technology Park

This section describes and analyses basic characteristics of local productive systems promoting research and development for the purpose of establishing a technology transfer mechanism for the Pretoria Technology Park. It also investigates precedents from European science parks that are relevant to this establishment.

1.2.5.2 Rehabilitation assessment of the Pretoria State Garage

The rehabilitation assessment explores the history and the architecture, including industrial, socio-cultural and spatial values, of the Pretoria State Garage.

1.2.5.3 Fit process

This process analyses and compares specific dimensions and spatial demands of both the Pretoria State Garage and the Pretoria Technology Park respectively for the purpose of mutual fitting.

1.2.6 Study layout

Part one introduces and investigates significant precedents of European and South African science parks. Selected parks are investigated according to their operational principles, location and relevance, size, land use and image (architectural and landscapes) among others.

Part two implements the technology park development methodology for the establishment of the technology park's strategic planning and consequently its size and type. This evolves through three stages dealing with:

- Description and analysis of local technology supply, demand and transfer of Pretoria.
- Description of strategic development and planning of the park.
- Determination of the type of park.

Part three reviews different aspects of building rehabilitation assessment of the Pretoria State Garage and explores its capacity to accommodate Pretoria Technology Park building scheme. This includes proposals for the demolition of unwanted structures and elements, investigating the long-term resilience of buildings to be retained, assessing negative physical features and establishing a preliminary planning and programming of the site. The process is completed with the fitting process (comparative analysis) between the proposed building scheme of the Pretoria Technology Park and the rehabilitation capacity of the existing buildings of the State Garage.

1.3 Definition of terms and concepts

1.3.1 Science park

According to the United Kingdom Science Park Association (UKSPA, 1988:i), a science park is a property initiative which:

- has formal operational links with a university or other Higher Educational Institution, or major centre of research;

- is designed to encourage the formation and growth of knowledge based businesses and other organisations normally resident on the site;

- has a management function which is actively engaged in the transfer of technology and business skills to the organisations on site.

The term '*science park*' may be used to include initiatives called by other names such as Research Park, Innovation Centre, High Technology Development and Technology Park, where they meet the essential criteria set above (UKSPA, 1988; Van Dierdonck, Debackere and Rappa, 1991:110). In this study the term '*science park*' is used to include all the above.

There is a clear distinction between science and business park. A park is a place, generally within a town or a city, reserved for sports, leisure and pleasure. Business is associated with transaction, concentrated efforts and commerce. Business park may be a single cell, dedicated to one client, or multi-cell, subsuming different clients and architecture within an overall master plan. It may be devoted to one theme, such as scientific research, as in a science park, or it may be an administrative village, as on office park, or it may be flexible, combining speculative business building with a shared amenity building for a separate workforce (Phillips, 1993:6).

The term '*technology park*' is characterised by an environment whereby tenant companies are actively involved in trade applications in the area of high technology and particularly in production and business activities (Komninos, 1993:110). The establishment of the Pretoria Technology Park focuses mainly on upgrading the local manufacturing industry.

Science parks are uniquely positioned to encourage and facilitate start-ups and growth of new technology-based firms. They have been recognised as important institutions for industrial innovation and technology transfer, provision of public research and development, start-up finance, consultation, marketing and other services to technology based firms (Komninos, Merciev and Tosi, 1996:50).

Science parks are the results of co-ordinated initiatives from government authorities, academic institutions and businesses, for new research and development activities. Those initiatives have emerged and proved science parks to be an important organ for technological restructuring and support for industrial high-tech manufacturing.

According to Van Dierdonck and Hysman (1992:1) there are three main objectives of science parks:

1. *Technology transfer*: This process focuses on the transfer of technology from basic research at universities to commercial products.
2. *Regional development*: Science parks stimulate regional development through the revitalisation process of depressed areas and increase of average income.
3. *Urbanisation*: Science parks promote clustering of similar types of companies for reasons of environmental impact (noise and pollution) and facilitate with infrastructure for companies.

Massey and Wield (1992:11) state that besides the three popular concepts described by the UKSPA (1988), there is a fourth concept based on the assumption about what the science park characteristics will lead to, based on the aims mentioned by the park managers and sponsors. They identified a set of four key elements expected from science parks to those working to set them up:

1. The creation of employment
2. The establishment of new firms
3. The facilitation of links between host academic institutions and park firms (including the start-up of firms by academics)
4. The generation of firms with a high level of technology at the leading edge.

In their investigation, Massey and Wield (1992:15) indicated that the effects postulated by the popular science park concept have not happened and indeed in some cases where the outcomes do look positive the underlying processes are not those postulated by the model. Due to the doubt cast on popular science park concept, they suggested an alternative conceptualisation with three main elements:

- First, the particular model of scientific investigation and innovation on which science parks are based is a linear model- beginning with academic research and leading eventually to commercial production.
- Second, science parks are based on particular spatial characteristics located close to academy, away from physical production, in exclusively high status locations.
- Third, science park are property development, but with very different results in different places.

Komninos (1993:117) describes science parks as a zone of co-operation between research, industry and training, engaged in the following activities:

- Physical infrastructure that accommodates research laboratories, research councils, light industrial units, companies rendering services (market research, counselling on management, technology and financing), administrative services and technology transfer.
- Increasing the relevance of applied industrial research and joint contract between research institutions and industry.
- Production of prototypes.
- Provision of specialised services to companies.
- Nurture of start-up new-technology based firms and provision of accommodation and finance.
- Provision of educational and training schemes.
- Cultural and refreshment services can be provided depending on the site.

The role of science parks in economic development has been recognised and recommended. Much of the credit should be taken by the public sector, which initiated most of the programmes. Yet the private sector has been slow to recognise the growing opportunities offered by the success of parks and tenant companies alike (Sunman, 1988:ix). In addition Gower and Harris (1994:24) assert that it is evident that science parks may seem to be achieving success against the notably very similar property sectors such as business parks.

1.3.2 Technological innovation and innovative companies

Technological innovation is a process that involves research and development leading to the first commercial introduction of new technologies (Mansfield et al. 1982: 5) and is usually stimulated by perceived production and marketing problems and needs than by technological opportunities (Bruun, 1980: 204). Innovative companies are companies that are susceptible to diffusion of technological innovations and depend on that for profit and survival. Small companies seem to be more flexible and innovative at a lower cost (Hesketh, 1996:252).

1.3.3 Start-up companies

Start-ups are companies usually created by researchers in an effort to transfer technology from institutions of higher learning to the manufacturing sector or commercialisation of academic research.

1.3.4 Incubators

Incubators provide accommodation and common administrative services to newly founded technology firms and start-up companies stemming from researchers involved in the park.

1.3.5 Innovation financing

Innovation financing (as part of the risk capital) provides funds to new start-ups companies by strengthening their equity base and increases their chances for long-term survival. This funding is provided to innovative companies that are already accepted by the incubator management. Initial funding for the establishment of a science or technology park comes mainly from the public sector (government, local authorities and universities) and often followed by corporate groups such as banks and research institutions.

1.3.6 Small and medium sized companies

There are many definitions of small and medium companies worldwide. In South Africa, measures used are usually based on elements such as the number of employees, turnover, value of assets and even the amount of electricity consumed. Employment seems to be the preferred measure with firms of less than twenty to thirty employees being regarded as small. Following success, firms grow, employ more people and raise more capital and delegate significant authority to at least one subordinate, which results in the medium category (Hesketh, 1996:251).

1.3.7 High technology manufacturing

Manufacturing is the act of making something through deliberate processing from raw material to the desired object, usually with the use of machinery. This act encompasses several functions that must be strategically planned, organised, scheduled, controlled and terminated (Badiru, 1996:1).

There is a lack of common accepted definition of the high technology sector. Burke and Dowling (1987:5), for the purpose of their research, concluded that high technology industries are identified by a high percentage of research and development funds invested in the companies and above average number of scientists, engineers, professionals, and technical personnel employed as a percentage of total employees. Badiru (1996:2) defines high technology as a concept of utilising new developments in electronics, data processing, and physical materials innovatively to generate products or services.

Burke and Dowling (1987:5) use the term '*advanced technology*' in describing policies and programmes that do not focus exclusively on particular industries, but extend to the application of new technologies to all existing industries. As a result, high technology manufacturing involves the source, product design and final product of the new technologies.

1.3.8 Rehabilitation

The term 'rehabilitation' is not yet well defined to a particular process in architecture. Lowry (1981:422) observes that the term rehabilitation has been used in general to describe the efforts related to extending useful life of existing buildings, although the methodology may be applicable equally to conservation and recycling. Various definitions on rehabilitation of old buildings exist from a number of authors, which will be discussed in order to highlight the common values from each.

Firstly, rehabilitation recognises old buildings as potential resources, which through the rehabilitation process often provide cheaper and more appropriate premises for new and growing firms. Rehabilitation involves new uses that can halt decay and rejuvenate whole neighbourhoods while at the same time maintaining a sense of time and place (Eley and Worthington, 1984:3).

Rehabilitation, as defined in different contexts, is viewed as an integral part of other processes such as conservation. Sheppard (1980:601) describes rehabilitation in the context of conservation, which goes beyond the notion of preserving functionally redundant buildings. He describes conservation as a comprehensive process that encompasses all different ways and means to preserve, use, protect and consolidate existing buildings, neighbourhoods or ensembles. As a result conservation can involve any of the three following means: *recycling, rehabilitation or reconstruction.*

- *Recycling,* which is defined as the process of converting an old building to new uses usually involving a re-organisation of the building within an existing envelope. Its purpose is to make an old structure viable, contemporary and relevant, and re-integrate it in its environment.

- *Rehabilitation,* as a social act dealing with the renovation of an existing building for the purpose of extending its life, its uses and its social role. The original function is maintained, and if modified, it is done only to a certain extent. Rehabilitation involves the improvement of both the physical condition of the building and the well being of its principal occupants.

- *Reconstruction* deals with the process of creating or repairing past artefacts in a historically, faithful manner. It has an archaeological and scientific basis and is done for symbolic, sentimental, didactic or scholarly reasons.

Nelson (1982:7) refers to rehabilitation as a process of returning a property to a state of utility through repair or alteration that makes it possible for an efficient contemporary use while preserving those portions and features of the building that are significant to its historical, architectural and cultural values. Smith (1980:134) states that rehabilitation together with restoration was noticeable during the seventies as two other treatment trends parallel to renovation development for older housing. He urges that neither renovation nor rehabilitation properly describe what it entails. He argues that rehabilitation should be defined as a repair and improvement of buildings to satisfy basic health and safety standards. This brings rehabilitation as fundamentally concerned with the life support system of a unit, such as plumbing, electrical wiring, heating and structural integrity. In conclusion he refers to restoration as concerned with the replication or reconstruction of original period architecture and usually is limited to buildings formally designated as historically significant.

Smith (1980:383) defines restoration as a design process that moves backward, to recapture the form and detailing of an earlier period in a site's history, while rehabilitation moves forward to provide an essential contemporary solution to new functional requirement. He recommends that it must be admitted that rehabilitation is simply a technical or utilitarian issue. The physical modification involved in rehabilitation and adaptive re-use can be solely on technical assessments of existing site conditions. These conditions include, in the case of buildings, such factors as floors and surface coverage, structured bearing capacities, means of egress, condition of the building envelope, and the mechanical and electrical system capacities.

Rehabilitation involves either new users or existing occupants fitted in existing buildings (Lowry, 1981:421). Existing buildings may be old or new. Lion (1982:1) suggests that the distinction between the old and the new should be defined by the period of the Second World War because of the significant changes in building material and techniques from the pre-war period. Rehabilitation includes all those situations where a building is altered physically to improve space utility or to accommodate major new functions of the existing occupants. Rehabilitation may be explained in the following categories:

- An old building receiving renovation to upgrade the building systems or visual alterations to fit the existing occupant.
- An old building receiving major functional alterations, occasionally including visual alteration, to accommodate new tenants.
- A new building receiving visual alteration, and usually of minor nature, to house existing tenants.
- A new building receiving functional alteration to accommodate new tenants.

The rehabilitation process involves the infrastructure of the existing buildings and the identity of the previous or existing occupants. Words such as property and building site are preferred rather than buildings as to take into account the full range of both physical and tangible resources- the land, the buildings and the rights and obligations associated with real property.

Rehabilitation encompasses other activities involved in other processes as highlighted above. The purpose of this study is not to redefine the term 'rehabilitation' but to identify common values from each of the above-mentioned definitions. It is therefore essential to formulate a coherent and systematic rehabilitation methodology, which incorporates the following:

- Existing buildings and new or existing occupants.
- Investigation of the old building's historical, architectural and cultural values.
- Provision of essential contemporary solution to new functional requirements.

1.3.9 Literature review

This section covers two main areas of the study: development of the Pretoria Technology Park and the rehabilitation assessment of the Pretoria State Garage.

1. Development of the Pretoria Technology Park

Sources reviewed throughout this section are in both electronic and print formats. Information pertaining to the history of science parks (especially European parks) is mainly sourced from electronically due to the unavailability of relevant prints in South African libraries. Most sources used during the development methodology are by Komninos, the initial tutor to the candidate in this particular field of study. Komninos is a professor of Urban and Regional Innovation in the Faculty of Engineering, Aristotle University of Thessaloniki and a consultant for the European Union in the same field.

2. Rehabilitation assessment

A variety of sources were reviewed during this section including those by Bidwell (1977) for the assessment of negative physical features of brickwork and Worthington (1984 and 1997) and partners (Eley and Worthington) dealing with the rehabilitation of industrial buildings. Unfortunately the owner of the site, Department of Public works, failed to produce any historic material that would have enriched this assessment process.

1.3.10 Conclusion

The two programmes of rehabilitation and science park constitute the core of this study, and moreover their mutual incorporation in the programme. Broader definitions of both rehabilitation and science park are certainly embraced and elaborated on, as this coherent approach will be implemented in this study.

The definition of science park will abide with the UKSPA (1988:i) criteria and in addition to that the alternative conceptualisation of Massey and Wield (1992:15), which prioritises location proximity and result of productivity, based on the park's district location.

High technology manufacturing is a trend defined by international role players in the field of technology, which must embrace local relevance. Small and medium enterprises are defined locally according to the nature of their contribution to local economies. This study will not define further the two terms and only refer to their role, which is integral to science park planning and programming.

PART ONE

2. SCIENCE PARKS

2.1 History of Science Parks

The global economic crisis of the second half of the 1970's led most industrial nations to reconsider, correct and adjust their industrial policies to the New World market demands. The economic future of most countries depended to a large degree on their ability to create new products and processes and to make these commercially viable. A growing interest for technological change could be noticed in most industrial countries. There was a strong emphasis in economic policies on technological change or innovation that was accompanied and supported by scientific research.

The original basis for the idea of science parks came from the United States of America- from Stanford University and Silicon Valley in the San Francisco Bay area and Boston-Cambridge and Route 128 on the east coast (Massey & Wield, 1992:10). The first Science Park was built in 1946 on the Stanford University campus. It offered production facilities to new mobile technology based firms. It was not until the 1960's that science parks developed in the United State burgeoned, with over one hundred science parks operating by the middle of the decade. Science parks in the United States, however, are quite different in form from those in the United Kingdom. The average area of United State science parks is over 500 acres while in the United Kingdom an average size is less than 50 acres (Gower & Harris, 1994:25).

Historically successful science parks in the United States, science parks related to the Universities of Stanford, MIT and North Caroline, had great influence on the initial science park programme in Britain. It was during the beginning of the seventies that the idea of science parks spread to Great Britain where two universities established parks of their own: Cambridge Science Park of Trinity College Cambridge (1972) and Heriot-Watt University Research Park of Heriot-Watt University (1972) (UKSPA, vol. 1- Property 1988:84).

Significant science park developments in the European Union and the history of science parks in South Africa are discussed as precedents to the architectural manifestation and the development methodology of the Pretoria Technology Park. However, descriptions are limited to their general contribution to the development of science parks and also architectural and operational elements that are relevant to the establishment of the Pretoria Technology Park.

2.2 Science parks in Europe

Descriptions of science parks in this section will cover areas relevant to the study and distinctive to the park described. European science parks developed in two distinctive phases. The first phase was experimental developing during the early seventies. During this era only a few science parks were established as a result of joint efforts from universities, local authorities and firms. The following four science parks are the first to be developed during the first phase, with Cambridge Science Park and Sophia Antipolis becoming prominent international role players:

- *Cambridge Science Park* of Trinity College Cambridge (1970) in Britain
- *Heriot-Watt University Research Park* of Heriot-Watt University (1972) in Britain
- *Sophia Antipolis* (1972) in France
- *Haasrode* (1972) in Belgium

The second phase dates to the beginning of the eighties during which much progress was made with at least a hundred science parks built (Komninos, 1993:71-85). This phase reflects the success and influence of the preceding phase, and it is characterised by a variety of science parks, which addresses issues of technological innovation to local and multinational/international companies.

This section focuses on parks from both the first and the second phases that played prominent role in shaping the future of science parks in Europe and relevant to the establishment of the Pretoria Technology Park. The following precedents are briefly introduced and consequently referred to analytically in the text for a comprehensive interpretation and relevance to the establishment of the Pretoria Technology Park:

- Cambridge Science Park in Britain.
- Sofia Antipolis in France.
- Berliner Innovations und Grunderzentrum (BIG) in Germany.
- Thessaloniki Technology Park in Greece.

2.2.1 Cambridge Science Park: *Cambridge Phenomena*

Britain holds a prominent position in the European Union with a larger number of science parks. The Cambridge Science Park is the first science park to be established in Britain and Europe during the early 1970's in Cambridge by Trinity College (figure 1). The park originally covered 28 acres and was later extended in five consecutive phases, eventually covering an area of about 130 acres. Its major area of activities involve scientific research related to industrial production, light industrial production, accommodation for business councillors collaborating with the academic and scientific personnel, and accompanying common services to the park. From 1973 to 1986 the park accommodated 68 companies with employment capacity of 1900 people. In December 1999 the park accommodated 64 companies employing about 4000 people (www.cambridge-science-park.com). The Cambridge success, the so-called *Cambridge Phenomena*, was accredited to the park's high quality architectural and natural environment and successful marketing strategies (Komninos, 1993:72).

Since the establishment of the Cambridge Science Park the number of science parks in operation in the United Kingdom grew from three in 1982 to forty-five in 1993 (Table 1). As a result UKSPA was established with the primary objective of during the late eighties of promoting awareness and understanding of science parks. Investment has continued in an upward direction; £564 million invested and earmarked for investment 1993 and the number of science park tenants rose from 301 in 1985 to 1188 in 1993 (Gower and Harris, 1994:24).

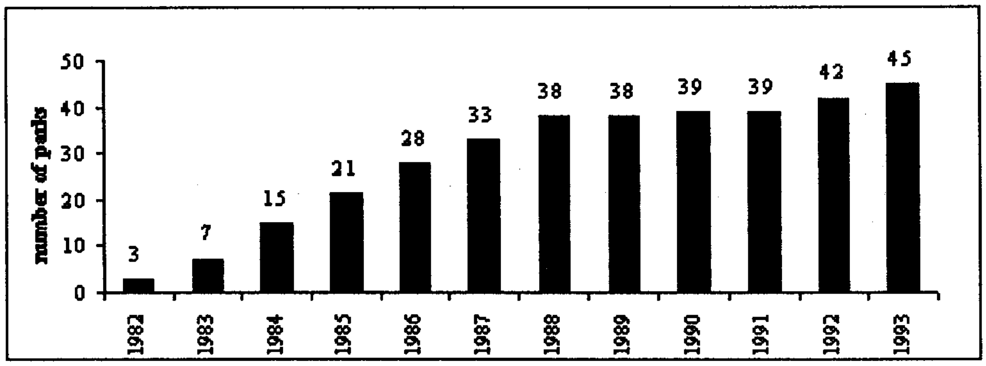


Table 1: The number of science parks in the UK from 1982 to 1993 (source: Gower and Harris, 1994:24)

The British public sector contributed to the creation of British science parks covering 62% of the total cost. At the beginning of 1988 the total investment capital on science parks development programme reached £ 296 million and with an added £ 167 million for another two-year programme for property extension and building of new science parks. The government based organisations, under the Department of Trade, Industry and Labour, spent 21% of their GDP developing eighteen science parks. Local authorities of large urban areas, under the general local development programmes sponsored by the Department of Environmental Affairs, covered 11% of investment, contributing to the creation of nine science parks. The private sector put forward the development of six parks and covered 8% of the total cost (Rowe, 1988:ix). The British science park program succeeded as a result of co-ordination between different government departments, local authorities, universities and the private sector. A similar strategic co-ordination, with the public sector playing a catalyst role, could benefit the South African science park program.

Figure 1: General view of Cambridge Science Park (source: http://www.cambridge-science-park.com)

2.2.2 Sophia Antipolis

Sophia Antipolis is located in a remote area, 12 miles from Nice, France. In 1987 Sophia Antipolis covered 5683 acres with 3700 acres preserved for natural vegetation, 370 acres offered for residential accommodation and 1600 acres for accommodating advanced technology activities such as research, development centres, engineering consultants and data processing centres (figure 2). Most buildings are two-storey high and designed to resemble the futuristic architectural style.

Sophia Antipolis is divided into four main areas of excellence:

- Computer science, electronics, robotics and telecommunication.
- Medical science, chemistry and biology.
- Research and training
- Natural sciences.

There is a significant increase in the number of firms with over a thousand companies and approximately a hundred new companies move in every year. Sophia Antipolis currently accommodates 1164 companies, 20530 engineers and technicians, and 5000 researchers and students (http://www.sophia-antipolis.net) as compared to a total of 1200 jobs in 1987 (http://www.etud.insa-tise.fr).

The Sophia Antipolis initiative became a prototype to the so-called Technopole phenomenon in France. This unique approach was developed in two forms: La Technopole and Le Technopole. La Technopole are developed at a large urban scale actively involved in high-tech development schemes such as the Sophia Antipolis. The main objective for this programme is to upgrade high-tech production standards to become competitive within the common European market. La Technopole phenomenon becomes a model for any similar initiative specifically in the Gauteng Region, which has the highest per capita income, number of scientists and institutions of higher learning in South Africa.

Le Technopole are parks developed at a smaller scale as technology parks or innovation centres. The main function of these initiatives is to act as incubators for high-tech companies and as instruments for technology transfer, which is similar to the Pretoria Technology Park.

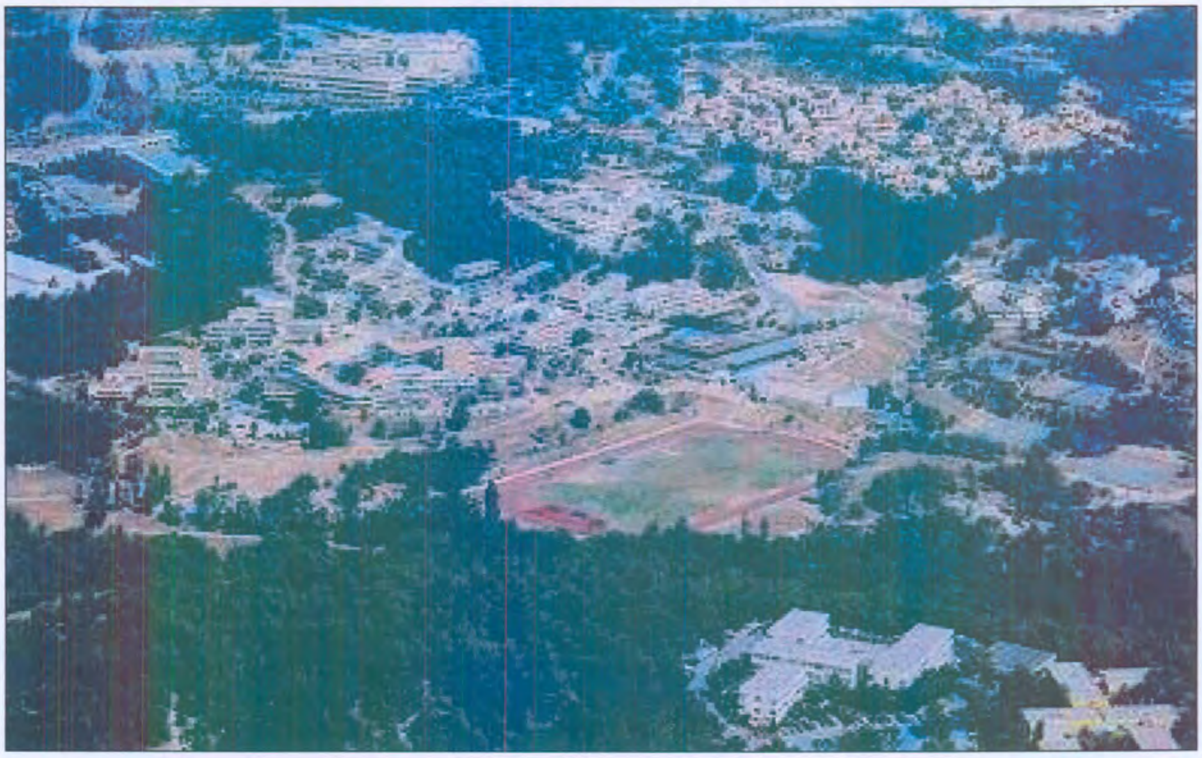


Figure 2: General view of Sophia Antipolis (Source: http://www.etud.insa-tise.fr)

2.2.3 Berliner Innovations und Grunderzentrum (BIG)

Berliner Innovations und Grunderzentrum (Berlin Innovation and Business Incubation Centre) is located in the heart of Berlin, in an area surrounded by old buildings (figure 3). BIG is accommodated together with TIG in the 1887-1905 Allgemeine Elektrizitats-Gesellschaft (AEG) machinery production plant and are both managed by the Innovation and Management Centre Berlin Ltd. (IZBM). Included on site are the 1909 Turbine Factory buildings designed by Peter Behrens. Fletcher (1975:1264) describes the site as good industrial architecture solely by meticulous organisation of the structure and materials, without recourse to ornament. The BIG was established in 1983 as the first German technology and business incubation centre. These AEG rehabilitated building structures currently accommodate over sixty companies and fifteen research institutes of the Technical University of Berlin (TUB) and the Fraunhofer Gesellschaft (FHG). The site offers a total area of 96,000 square meters of business and office space that can be rented at reasonable low prices (http://www.big.izbm.de).

Figure 3: Berliner Innovations und Grunderzentrum (Source: http://www.big.izbm.de)

BIG, in partnership with TIG, specialises in the fields of information and communication technology, multimedia, electronics, laser technology and photonics, measurement technology and analysis, automation technology, biotechnology, medical technology, laser technik, quality control, engineering services and other related fields. Required information on the architectural rehabilitation process of this significant precedent could not be available.

Following the establishment of the Berliner Innovations und Grunderzentrum (BIG) six centres for high-tech firms and new establishment had been established at the end of 1984. Up to the middle of 1985 ten other centres were erected. Most parks were initiated, financed or co-financed by local authorities. These parks are used as instruments for local economic promotion. Private agencies are employed to manage the parks. Due to limited funds and time constrains local authorities often make use of vacant industrial buildings d AEG industrial site in Berlin (Komninos, 1993:77).

2.2.4 Thessaloniki Technology Parks

In 1990 the Chemical Process Engineering Research Institute (CPERI) established the Thessaloniki Technology Park (figure 4). The park is located in Thermi, fifteen kilometres east of Thessaloniki and the main campus of the Aristotle University of Thessaloniki. This initiative followed the 1989 Greece government call to develop a science park program. The government geared up a general technopole and innovation program, which aimed at resolving the crisis in the field of research and development. The program was based on three hypotheses (Komninos, 1993:215):

- That the Greek research and development has the potentials for re-orientation and sustainability towards high-tech activities for local market as well as to reduce imports.
- That strengthening of research activities and industrial high technology can be achieved through creation of technopoles and restructuring of Greek industrial centres.
- That for such a purpose, legislation should play a leading role, than transformation being conducted by the functions of the market, which usually do not lead towards qualitative development of productivity.

As a result four technology parks including the Thessaloniki Technology Park were developed in Greece and are all members of the International Association of Science Parks.

The Thessaloniki Technology Park promotes the following activities (http://www.techpath.gr):

- *Regional development* through increased competitiveness of local industry mainly in the areas of chemical technology, material technology, food and beverage, textiles and energy and environment.
- *Technology transfer* between local industries and higher educational institutions.
- *Contract research* that links industries to local universities for joint ventures.
- *International technology transfer* between Greece, United States, Eastern Europe, and the Balkans.
- *Contract education* between local industries and international research and technology organisations.

The park is divided into three main operational centres: administration/conference centre, incubator, and laboratory units. These centres constitute basic components of the technology park.

Figure 4: Thessaloniki Technology Park (Source: http://www.mercury.techpath.gr)

Administration/Conference Centre

This centre (1425m²) provides technology transfer services in the following areas:

- *Dissemination of information* in the areas of information technology, telecommunications, system automation, environment, agro industrial, food and beverage, materials and energy.
- *Research-Industrial liaison* through analysis of technology demands of companies, regional technology demands, and assessment and exploitation of research results.
- *Analytical services* using measurements, testing and quality control.
- *Research and technology development programs through* preparation of proposals, project management, implementation of technology development projects and partner searches.
- *Consulting* in the areas of technology auditing, intellectual property rights, system automation, technology brokerage, quality assurance and energy.
- *Financial and business services* in terms of funding, investment, joint ventures and assessment of investments, technology adaptation and new products
- *Education and training in the areas of business executives' further education and graduate placement.*

Incubator

This centre was designed to accommodate twelve start-up and tenant companies in 1200m² building block, but presently accommodates fifteen.

Laboratories

This centre composes of two laboratory units: Unit I (3024m²) that accommodates bench type laboratories for CPERI research purposes; and unit II (1850m²) that accommodates specialised experimental unit including pilot plants.

2.3 Typologies of European Science Parks

The Western European experience shows that most parks, initiated by public authorities, universities and industry, are orientated towards strengthening bonds between the academic and business environment. Most science parks have common characteristics: typological and functional collaboration with a university or a higher educational or research institution.

European science parks can be classified according to size and production activities (Komninos, 1993:140):

1. Large sized parks located in areas with a traditional industrial past. Their location is aimed at innovation in traditional production and also the establishment of big high-tech companies.
2. Large sized parks located in areas without any industrial past. They are aimed at attracting well-established technology companies with high specialisation capacity in production.
3. Small sized parks situated in areas with an industrial history. They are orientated towards diverse high-tech demands of small and medium sized companies.
4. Small sized parks located in areas without any industrial history, orientated towards high-tech small and medium sized companies and specialised research activities.

Most small sized science parks such as the Thessaloniki Technology Park provide innovation to local small and medium enterprises by means of technology transfer mechanism, while large parks such as Sophia Antipolis attract small and medium enterprises and well-established high-tech businesses and research departments of multinational companies. A number of multinational companies have selected Sophia Antipolis to establish their European headquarters.

2.4 European science parks and the built environment

Both the Cambridge Science Park and the Sophia Antipolis are prominent in the development of the science park built environment. The landscape of the Cambridge Science Park is shaped in an irregular 'Y' shape surrounding three lakes linked by footpath, which is based on a spine road looping around (figure 1). The landscape plan is developing in three phases, each running concurrently with the park's development and extensions. The two roads and disused railway line to the south determine the boundaries of the park. A plantation of mixed conifer and deciduous shelter some parts of the park though obscuring some of the building views from afar. Some sites have nature reserve characters like hawthorn hedge with rabbit burrows, which happen to be the original habitats of the site before conversion into a park. Much attention was given to the landscape design, which would retain the natural morphology and wildness and minimise artificial interventions, particularly on lakes (Shinn, 1986:32-34).

The evident success of the Sophia Antipolis is highly attributable to the park's built environment, which embraces futuristic high-tech structures and well designed landscapes and contains well preserved buildings and ruins from the 16^{th} century and the Roman era (figure 5). This kind of environment has appealed, in conjunction with research and development activities, to both local and multinational companies (http://www.alpes-azur.com).

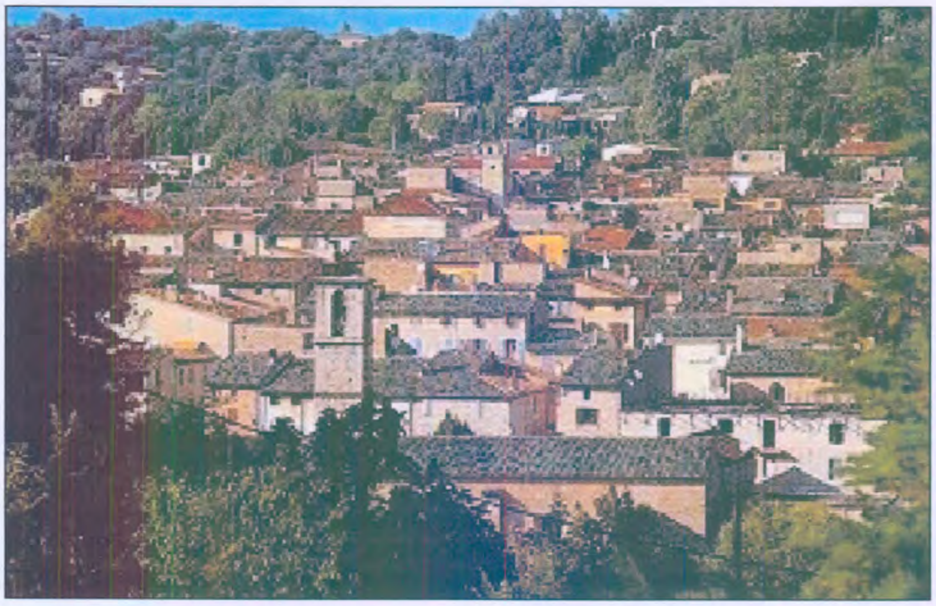


Figure 5: 16^{th} century and Roman era architecture at Sophia Antipolis (Source: http://www.etud.insa-tise.fr)

2.5 Science Parks in South Africa

Stellenbosch Technopark is the first South African science park developed by the Stellenbosch municipality in collaboration with the University of Stellenbosch. This high technology park initiative covered approximately 148 acres. The development was initially aimed at accommodating over a hundred companies, including foreign companies that are involved in high technology developments. The University of Witwatersrand and the University of Pretoria followed the Stellenbosch initiative by developing the Highveld and the Persequor Technology Parks respectively. The former is located within the boundaries of both the Midrand and the Centurion municipalities while the latter is located in Pretoria East between the CSIR and the University of Pretoria. The Highveld Technology Park was unsuccessful. This is warranted by a number of reasons, one of them being that there was lack of research personnel from the university working close to the development (Els, 1989: 22). Since Els's report in 1989 little has been mentioned of the developments in the above-mentioned programmes.

In South Africa institutions of higher education initiate science park programmes. This includes the newly initiated science park by the Technikon Free State.

2.5.1 Science Park of the Technikon Free State

The Science Park of the Technikon Free State is one of the emerging programmes that transpire success. It is the first South Africa science park to register with the International Organisation of Science Parks (IASP). It is one of the three registered IASP members in Africa together with Technopole de Dakar in Senegal and Parc Technologique in Tunis. The following services are offered by a number of expertise centres operating with academic faculties of the technikon (http://www.tofs.ac.za):

- Supplementary health services
- Environmental monitoring
- Rapid prototyping, manufacturing and testing of mechanical products
- Electronic design and manufacture
- Fibrinogen Unit
- Aspects of hospitality management and tourism
- Health and Environmental Research and Development

2.5.2 Perseqour Technology Park

The site is located west of the CSIR and covers approximately 148 acres. Twenty-seven landowners occupy 17246 m² of the site. It comprises of 25 stands their sizes ranging from 3447 m² to 11519 m² (figure 6). The park was established in 1989 with the aim of providing state owned enterprises, the principal figure being ARMSCOR, with military high-tech equipment. After a few years the

University of Pretoria decided to sell land, on site, to private companies with the aim of maintaining rental income.

Companies on the park specialise in variety of activities such as:

- Courier services
- Provision and installation of office equipment
- Engineering, design and manufacturing
- Accounting services and computer hardware and software installation
- Technologies in the field of communication electronic warfare, spectrum monitoring, mining electronic system and security
- Project management
- Multimedia
- Techno-economics
- Pharmaceutics

There are plans to re-establish the Perseqour Technology Park as a science park. The Gauteng Premier, Mbhazima Shilowa, officially announced this initiative on 15th February 2000, as part of the Innovation Corridor forming alliance between the University of Pretoria and the CSIR. This initiative was later named SERA (Southern Education and Research Alliance), which was allocated a 60-hectare site between the University of Pretoria and the CSIR. This initiative will link business, education and research to create, nurture and grow technology-led businesses in South Africa (University of Pretoria, 2000:1).

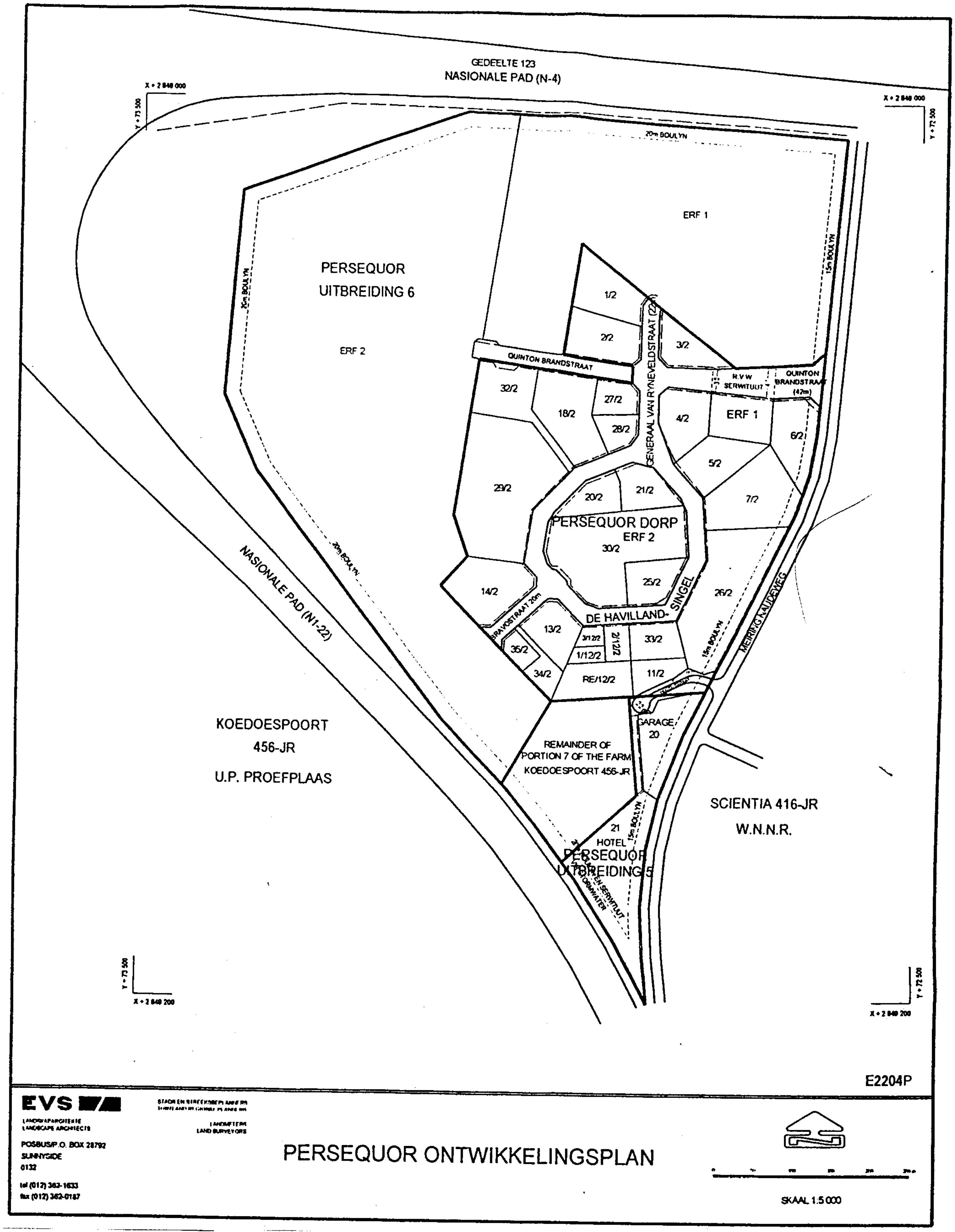


Figure 6: Persequor Technology Park Development Plan (Source: EVS Landscape Architects)

2.6 Conclusion

In Europe, governments, local authorities and universities together with local industries initiated most science parks with the main objective of strengthening bonds between academic research and business. Most parks have permanent links established with at least one higher educational institution and encourage start-up companies. Though South Africa was slow in recognising the role played by science parks, most science park programmes already developed were hampered by political instabilities and subsequent reduction of financial assistance from the government. New hope was born with the announcement of SERA, which aims at upgrading the innovation programme in the Gauteng Region and the South African industry. A lesson from the European experience is that science parks were established with the aim of uplifting local companies (especially small parks) and offering intellectual and physical infrastructure of international standards to tenant companies.

Large parks such as the Sophia Antipolis attract mainly multinational companies by offering architecturally intimate spaces and competitive high-tech environments. Occasionally, internationally competitive companies get involved in the development of science parks, which enhances the image of the parks. These parks become centres of excellence dealing with technological innovation and transfer for various industrial sectors. Unlike large parks, small parks such as the Thessaloniki Technology Park can only focus on particular industrial activities usually associated with light industrial manufacturing.

Basic land use program of developed science parks comprises of (see diagram 1):

- Administration centre that includes technology transfer unit and financing offices
- Research (innovation) laboratories
- Accommodation for start-up (incubator) and technology firms
- Zones for socio-economic activities (conference, arts and exhibition halls, banks (ATM), post, restaurants/cafeteria, etc.)
- Parking

Large parks usually include residential and recreational facilities and reserve spaces for future expansions. Most parks are landscaped to enhance their image while their building coefficient is low.

An investigation and consideration of the diverse European examples offers valuable knowledge and experience that can be utilised in South Africa's diverse nature of universities and local industries, towards a successful implementation of science and technology park initiatives.

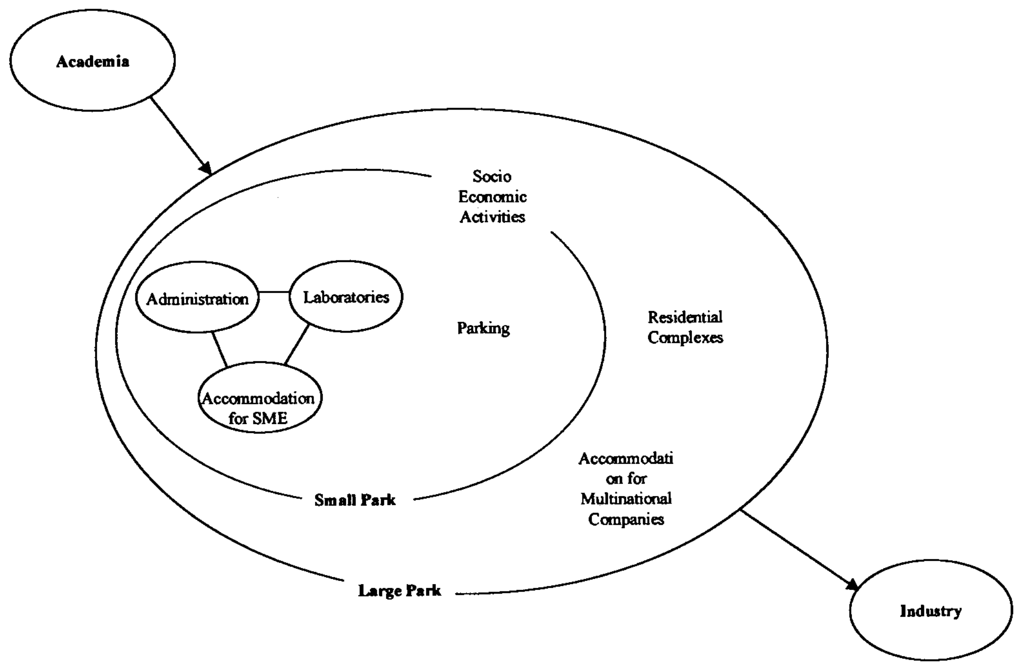


Diagram 1: Elements and structure of a Science/Technology Park

PART TWO

3. ESTABLISHMENT OF THE PRETORIA TECHNOLOGY PARK

Sustainable development of the Pretoria Technology Park relies on the relevance and efficiency of its development methodology to local business and research communities. The development methodology aims at establishing the park's strategic planning and the type of a technology park. Consequently, different centres are established to provide accommodation and services to park's major activities. Each centre is defined according to its spatial characteristics and design specifications. These demand certain architectural qualities from the existing physical forms of the Pretoria State Garage, which will ultimately determine the appropriateness of the rehabilitation fitting process.

The development methodology of the Pretoria Technology Park should involve four stages (Komninos, 1993:135):

- The first stage is concerned with the description and analysis of the area and concentrate on local supply, demand and technology transfer.
- The second stage is concerned with the description of strategic development of the park in relation to real business needs of the region and the capabilities of local scientific and research community.
- The third stage, which is the most important, describes the choices as strategy and model of the park.
- The fourth stage is concerned with the carrying-out of the program involving introduction of legislation and administrative organs of the park. This is related to the implementation programme and not covered in this study.

3.1 Description and analysis of the Gauteng Region

The analysis and description of the region is based on the objectives of the interested groups. Van Dierdonck and Hysman (1992) classify those groups interested according to their objectives into the following four categories:

- Objectives of regional development office, government and politicians
- Objectives of university, institutions of higher education and research centres
- Objectives of local industry
- Objectives of new firms

3.1.1 Objectives of regional development office, government and politicians

Objectives of the regional development office, government and politicians focus mainly on the development of the area and urbanisation. The public sector mainly provides funding.

Development of the area

This section focuses on the following objectives:

- *Creation of job opportunities in the region.* Unemployment remains a major challenge for private and public sector in South Africa. In 1994 unemployment in the Gauteng region was 28.7% as compared to the national average of 32.7% (Provincial Statistic: 1995). Attention is also given to the creation of jobs for special groups such as woman, people with a low level of education and prevention of emigration of people with a high level of education.

- *Increase the average income.* The Gauteng Gross Geographical product per Capita is the highest of all provinces with the rate of R19261 to national average of R8704 (Provincial Statistic: 1995). Though measures of the Human Development Index indicate that the Gauteng Region occupies the 52nd position scoring 0,820 on the high human development mean of 0,886 (Human Development Index for the RSA, 1981and 1991).

- *Development of the infrastructure* that will benefit the overall image of the designated region.

- *Implementation of industrial defensive strategy* through revitalisation of zones with existing old industrial by attracting high-tech industry.

- *Implementation of industrial offensive strategy*, which stimulates the development of a region with a low degree of industrialisation.

Urbanisation

Urbanisation focuses on the zoning of different groups of companies for reason of common infrastructure to deal with issues of pollution, noise, logistics and interactions. The zone in which the Pretoria State Garage is located is characterised by museums and office buildings. Buildings, such as the former SA mint, that used to house industrial functions in the area are being constantly transformed into museums, which are currently underachieving.

Supporting organisations

The public sector and local authorities in order to carry out a mandate to meet the above-mentioned objectives should create the supporting organisations. The South African Department of Trade and Industry (DTI), as part of its strategy, has formed the following partnership programmes for the promotion of technology in South Africa's manufacturing industry:

- Support Programme for Industrial Innovation (SPII). This program provides incentives for the development of innovative products and processes, administered by the Industrial Development Corporation of SA Limited (IDC). It is designed to promote technology development in manufacturing industries in South Africa through support for innovation of competitive products and/or processes (Support Programme for Industrial Innovation, 1997).

- The Technology and Human Resources for Industry Programme (THRIP) managed by Foundation for Research Development (FRD) and guided by a board comprising representatives from industry, government, higher education, labour and science councils. This program supports science, engineering and technology research collaboration focused on addressing the technology needs of the participating firms. THRIP also encourages and supports the development and the mobility of research personnel and students among participating organisations (THRIP, 1997).

3.1.2 Objectives of university, institutions of higher education and research centres

The objectives of the universities, institutes of higher education and research section focuses on the technology transfer, scientific aspects, financial aspects and marketing.

Technology transfer

Technology is transferred from institutions of higher learning to the manufacturing sector through exchange of researchers and personnel. This exposes researchers and personnel to the manufacturing sector, which will possibly result in the creation of spin-offs and commercialisation of academic research.

Scientific aspects

The link between the institutions of higher learning and the manufacturing sector will increase the industrial relevance of university research and give academic research access to leading-edge research and development of park firms.

Financial aspects

Institutions of higher education benefit through links with the manufacturing sector in terms of:

- Income that is generated through investment in the manufacturing sector.
- Expensive equipment donated by companies.
- Usage of the facilities belonging to the research park firms.
- Employment and consultation opportunities for academic staff and students in the manufacturing sector.

Marketing

Relevance of the academic research to the manufacturing sector improves the marketing image of the academic institutions.

Supporting organisations

Both the University of Pretoria and the CSIR are two prominent organisations that are capable of establishing required partnership with the Pretoria Technology Park in order to develop. Both organisations have the capacity to render engineering and management support to the park. The link between the two institutions and the park will provide the opportunity to exchange ideas on the relevance of academic intellectual capacity to local industries.

3.1.3 Objectives of local industry

The involvement of local industries in the science park projects benefit industry in terms of the following:

- Increase in the number of suppliers or potential clients.

- Increase in the number of inhabitants in the region and their average income.
- Synergy with new firms.
- Possible location of subsidiaries of existing companies.
- Improvement of the image of the area.

3.1.4 Objectives of new firms

This section indicates a number of ways in which new firms on the park benefit from the objectives of the industrial park, availability of services and the presence of the university on the park.

Objectives of an industry park

- High-tech image.
- Synergy between firms.
- Accessible and attractive location of the science park.
- Living facilities in the area such as housing, cultural activities, schools and recreation.
- Upgrading the degree of education of people in the area.
- Provision of financial support.

Presence of services

- Financial services.
- Consultation and training facilities concerning finance, accounting, marketing and personnel.
- Common services such as secretarial, reception and possibility for group meetings.

Presence of university:

- Availability of external scientific and technological resources.
- Recruitment opportunities.
- Access to post-graduate education programmes at the university.
- Academic environment.
- Academic amenities.
- Network opportunities.

3.2 Description of strategic development

Strategic development of the park should relate to real needs of local manufacturing companies and technology supply capabilities of local scientific and research communities. It involves:

- Macro-planning strategies and
- Type of a technology park

3.2.1 *Macro-planning strategies*

Macro planning strategies focus on systems of local technology supply, transfer and demands. This is most significant to the establishment of a relevant technology park to the user group. The actual survey to measure the value of this section can be conducted in a separate study and focus exhaustively in topics to be discussed below, including target groups in the region. As a result, the following topics are discussed in general according to the concerns and framework established by relevant government departments such as the Department of Trade and Industry, user groups, institutions of higher learning and research (such as the University of Pretoria and the CSIR in this regard).

1. Local technology supply

Analysis of local technology supply systems identifies applied research activities and potentials for technology applications to companies stemming from non-company research centres. Small and medium sized companies are turning more and more to external sources for technology in order to develop their technological capacity. Technology support from local research and development institutes and universities plays a prominent role in applied industrial technology development. Within this context, the investigation of technology supply focuses on regional research and development potential and the collaboration between research institutes and industrial firms.

- The University of Pretoria has the capacity for rendering technology support and innovation to the industry. The Faculty of Engineering is the largest in the country with different fields of specialisation: Agricultural, Computer, Civil, Chemical, Electrical, Electronic, Industrial, Technology Innovation, Mechanical, Metallurgical, Mining Engineering, and Engineering and Technology Management. The faculty regards its ties with industry as one of its unique characteristics and aims at keeping expertise relevant by regarding the need of industry as top priority.

- The CSIR as government and business technology partner renders scientific and technological services to industries in the fields of Bio/Chemical, Building and Construction, Defence, Water, Environment and Forestry, Food, Information and Communications, Manufacturing and Materials, Mining, Roads and Transport and Textiles.

2. *Local technology demand*

Analysis of regional and local technology demands determines the basic orientations of the region and its innovation capacity. The manufacturing and services sectors have important needs for innovation. Pretoria, like the rest of South Africa, compared to the complex global market demands with its mixed First and Third World characteristics lacks competitive technological infrastructure and resources when compared to international industrialised nations. South Africa was rated eleventh out of fifteen newly emerging industrial countries in 1993 World Competitiveness Report (Whiteside, 1996:265).

South Africa industries need technology know-how in most fields of engineering: research, manufacturing, management, marketing, design, training, production, and quality assurance. This is evident from the disappointing results of the development strategies of South Africa (Unger, 1996:172). Recent initiatives such as the Innovation Hub by SERA show a growing need for technological innovation in the country.

3. *Local technology transfer*

The University of Pretoria plays a prominent role in terms of technology transfer in the region. The Pretoria Technology Park will benefit from the link with the University of Pretoria, since the university collaborates with local and international companies such as SASOL, AEGI, ISCOR, CSIR, SAA, Eskom, Alcatel and Nokia.

The most important field for every innovation system is technology transfer. This should follow the linear model by Massy and Wield (1992:15) that product development starts with academic research, which eventually leads to the final product. According to Badiru (1996:28) the question of technology transfer has to address and overcome, at least, the following issues:

- The nature of technologies to be transferred.
- Parties subjected to technology transfer.

- Clarification of the objectives of technology transfer.
- The financial implications of acquiring required technology.
- The similarities, differences, advantages and disadvantages of the new technology as compared to the previous technologies.
- The ability of the local infrastructure to sustain technology transfer process.
- Flexible macro-planning strategies that will accommodate future technological changes.

3.2.2 Type of a technology park

The Pretoria Technology Park aims to facilitate the local small and medium enterprises in the manufacturing sector and services of Pretoria and the Gauteng Region. This is warranted by both international and local trends of industrial competitiveness. This urges manufacturing industries to appreciate the value of integrating their operations, which includes interested groups like the universities and research institutions.

Following is a list of supporting co-operative actions of subsystems, which serve to counterbalance the weakness at certain points during the integration process (Badiru, 1996:5):

- Manufacturing system.
- Management system.
- Quality information system.
- Financial information system.
- Marketing information system.
- Inventory information system.
- Personnel information system.
- Production information system.
- Design and engineering systems.
- Management information system.

These systems are consequently accommodated in different centres of the park in accordance to the nature of their operations and objectives of the park. Recent developments in innovation policy and criticism of science parks functioning show that technology transfer is the key element in science park planning and operation (Komninos *et al,* 1996:50). As a result, these systems will be integrated around the park's main objective of technology transfer.

3.3 Description of centres and services of the Pretoria Technology Park

The main objective of this section is to propose a technology transfer mechanism for the Pretoria Technology Park that will facilitate the local manufacturing sector. It is imperative that the organisation and management of a technology park, in order to address issues of technology transfer, be organised around four centres dealing with technology transfer, provision of technology services, support of new start-ups and innovation financing (Komninos *et al,* 1996:51). The similar nature of operations and spatial requirements in the centres for technology transfer and innovation financing suggest that they be accommodated in the central management building for efficiency. As a result the general layout of the park is divided into a management centre, technology building and incubator building.

The description of centres and services of Pretoria Technology Park is based on the software program of the Science Park of the Technical University of Crete by Komninos *et al* (1996) and the Fix Technology Park by Setshedi (1998). This relation is warranted by the fact that all three projects are orientated towards establishing a technology park that responds to the innovation demands for small and medium enterprises. Space and design specifications relating to the centres and services discussed below are discussed in section 3.4, which includes centre for socio-economic activities and a museum.

3.3.1 Management centre

This centre comprises of technology transfer and innovation financing units that provide technology transfer and innovation financing services to tenant companies respectively.

3.3.1.1. Technology transfer unit

This centre is a major institution and tool for technology transfer. Badiru (1996:30) describes duties of this centre as "triple technology transfer modes" focusing in: transfer of complete technological products, transfer of technology procedures and transfer of technology concepts, theories and ideas.

- *Transfer of complete technological products*, whereby a fully developed product is transferred from a technology source for utilization at a technology target. With very little product development effort carried out at the target point, information about the operations of the product is fed back to the source so that necessary product enhancement can be carried out.

- *Transfer of technology procedures and guidelines*, in this the technology transfer mode, procedures and guidelines are transferred from the technology source to the technology target. The technology blueprints are implemented locally to generate the desired products. The use of local raw materials and manpower is encouraged for the local production.

- *Transfer of technology concepts, theories and ideas*. This strategy involves the transfer of the basic concepts, theories and ideas associated with a technology. The transferred elements can then be enhanced, modified or customized within local constrains to generate new technological products. The local modifications and enhancements have the potential to generate an identical technology, a new related technology, or a new set of technology concepts, theories and ideas.

The centre for technology transfer consists of three different services (Setshedi, 1998:22 and Komninos *et al*, 1996:53):

1. *Industrial liaison office*

The industrial liaison office develops technological corporation and networks between participating organizations such as the University of Pretoria, CSIR and other research institutions, tenant companies, including local and international retailers and producers. This technological co-operation develops networks to identify a particular industrial sector such as manufacturing that can benefit a considerable geographical area and establishes technology structures that will benefit the typology of local generic technologies.

2. *Observatory and information office*

The observatory and information services provide information on technological development to those parties involved in production practices and policy making. This unit operates on double information interface. Firstly, a structure investigating information on technology issues of great importance to large companies and small and medium sized companies. Secondly, a structure diffusing information to all park parties concerning a wide range of issues related to specific small and medium sized companies, policies and programs of technological development.

3. *Career advisory office*

This office focuses mainly on the link and co-operation between the higher education institutions and the business sector. This unit is responsible for initiating programs for training scientists, graduates and students according to market needs. It supplies firms with information concerning graduate qualifications and specialization, provided by higher educational institutions and supply of information to higher education institutions for the trends of the labour market and to promote the absorption of graduates of firms.

The unit focuses on the two areas of labour market demand for graduates and relevance of qualifications. This is set-up through a creation of a consulting office for students and graduates, the publication of informative prospectuses for post-graduate studies and career possibilities, meetings, and the realization of annual studies on trends of labour market.

3.3.1.2. Innovation financing unit

This unit provides innovation funding to newly founded business and start-ups in forms of seed and venture capitals (Komninos *et al*, 1996:60). Levy (1996:11) states that:

"South Africa's banks, owned by the country's major business groups, skew their activities to large enterprises within their own business stable, and neglect small firms", and that "a common factor criticism is that the banks tend to discriminate against business borrowers other than white".

Most start-up firms require loans that banks evaluate according to their risk levels and transaction costs and also that they vary in making loans to start-ups, young firms and small firms. In most cases the banks would require collateral that will amount to 100 percent of the value of the loans. The South African Department of Trade and Industry, in partnership with THRIP and SPII, has established incentive and funding schemes to assist small and medium innovative enterprises.

1. *Seed capital service*

This unit embraces the incubator concept by providing finance support to high technology start-ups. The unit offers financial support provided that the intellectual property schemes meet the required criteria for innovation.

2. *Venture capital service*

The venture capital service complements the seed capital service by providing the following services:

- Formation of the fund on an equity basis, in co-operation with existing financial institutions and schemes.
- Formation of an upraising unit for innovative projects.
- Unit for information of small and medium sized companies on the financial capabilities of the scheme and comparative advantages.
- Design of the exit routes, always in co-operation with the financial institution or bank involved and withdrawal from the individual projects.

3.3.2 Technology building

This centre is the second principal component after the centre for technology transfer. It offers advanced technology services and applications that are required by small and medium sized companies, which are not widely accessible in the market and internally. Advanced technological services are basically related to research, manufacturing, production, design and quality assurance.

As a result, services provided by this centre to tenant companies are grouped in the following categories:

- Business services
- Multimedia services
- Telecommunication services
- Systems and automation services
- Quality analysis and certification services

1. Quality analysis and certification services

The services will co-ordinate a number of dispersed and non-organized initiatives in the field of quality analysis and control, and certification in the fields of industrial quality, engineering and production sectors. Certification issued through this unit is vital for competitive marketing of products, locally and internationally. A co-operative network is established to promote the co-use of equipment by interested organizations.

2. Business services

South African companies need various technological services and inputs such as technical, financial, training and marketing, which are necessary components of small and medium sized companies. The business service is designed to provide the most essential services for small and medium sized companies and start-ups.

The business service unit focuses in the following areas:

- Technological evaluation of new proposals for products and firms (analysis of technology based discoveries inventions, technical feasibility and marketing).
- Protection of intellectual property, model protection, registration of trademarks and licensing royalties.
- Design of development plans involving business plan preparation, build and testing of prototypes, user questionnaires and product improvement.
- Marketing, which involves choice of marketing route, design of marketing strategy, new venture plans and establishment.

3. *Multimedia services*

The purpose of the service is to develop expertise in areas that have been identified as critical to the development of software for the marketing and promotion of local activities. The service will be based on a range of multimedia platforms, applications and peripherals and will invite interested parties from the software and related industries to view and develop relevant applications. The service will also offer consultation on the suitability of multimedia for different applications and help companies to select multimedia platforms or applications.

4. *Telecommunication services*

Telecommunication networks will play a significant role in the operation and competitiveness of the park due to its increasing integration to the international market. Efficiency can be achieved by dividing the telecommunication system into different field of specialisation in developing networks and integration (transmission networks, data transfer, storage and processing network).

5. *Systems and automation services*

Industrial modernisation and company competitiveness are directly related with process automation and dynamically aided by system analysis and design. The laboratories can support active collaboration with national and international institutions in research, development and applications.

3.3.3 Incubator building

The incubator building provides accommodation to start-up companies and technology based firms in their early stage of growth. An evaluation committee is required to monitor acceptance of tenant companies into this centre. Deirdonck and Huysman (1992:22) establish a system of evaluation criteria, which take into consideration the following parameters:

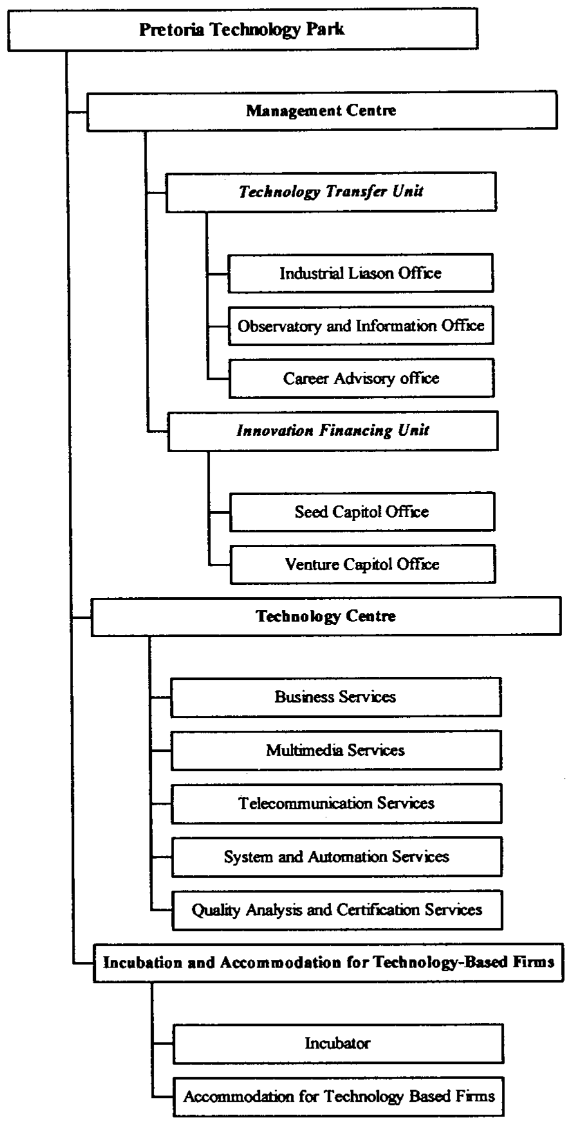
- Research and development effort of company, measured by percentage of turnover devoted to research and development, number of patents, and percentage of employees who are qualified scientist or engineers.
- Collaboration between tenants and university or whether it is to be establishment in the future.
- Active character of company in the high-tech field for which the university partner is recognised as having an outstanding position.
- Possible synergism with the existing firms.
- Multiplicatory character of functions of the company.

This centre provides common services to tenants such as:

- Secretarial support
- Marketing services
- Financial advice
- Professional continuing training programs
- Information on intellectual property rights and patents
- Internet and Integrated Service Digital Network (ISDN) services
- Access to international databases

These are similar services provided by the incubator of the Thessaloniki Technology Park that accommodates about fifteen small and medium companies since its establishment in 1990 (http://mercury.techpath.gr).

Diagram 2: Pretoria Technology Park Centres



3.4 Pretoria Technology Park space and design specifications

This section complements section 3.3 dealing with descriptions of centres and services. A complete science park usually includes technology transfer orientated administration, research institutes and laboratories, accommodation and services provided for start-up companies, accommodation for selected companies and common services such as post, banks, lecture rooms, restaurants, exhibition and seminar halls. Basic characteristic for science park design is a layout program for land use, basic buildings and installations. Land use and building program includes (Komninos, 1993:141 and Setshedi: 1998:21):

- *Central building* – which consists of office space for administrative personnel and park committees; technology transfer services, innovation financing services, services for projection-communication-advertisement, seminar and exhibition halls, cafeteria, restaurant and accompanying services such as post, banks and pavilions.
- *Incubator* – which accommodates start-up companies with common use spaces for incubator's administrative personnel and installation of selected companies.
- *Technology building* –for research institutes and laboratories.
- *Parking space* – from one space for every two persons.
- *Landscapes*- average of 50% coverage of park space.

Due to various requirements of tenants to be located on the park, Southern (1988:52) provides a summary of main factors influencing decision-making:

- The prestige, which the site offers, and its overall image.
- The type of accommodation provided.
- Car parking.
- The availability of premises and the access to the nearby higher educational institutions.

Southern (1988:53) also provides a description of the overall impression that the park should ideally make for immediate and favourable impact on the visitor:
- A visible and attractive entrance.
- Well-designed and maintained landscapes.
- Adequate parking, which should ideally be landscaped or hidden from main approach roads.
- Clear sign posting.

In *The building and its cartilage* Southern (1988:53) summarises the building envelope as according to specific requirements of occupiers as follows:

- *Density and building form.* The building form is normally a one or two storey with occupier's normal preference of single storey with own front door.
- *Expansion space* to cater for fast expanding companies.
- *Building material* can vary, but brick and tile have figured strongly, and quality cladding has been used at a number of locations.
- *The building module and fenestration.* The module is generally 1:1 or 2:1 and its average depth should allow people access to windows and natural light.
- *Entrances.* Occupiers have a preference for entrances, which are immediately noticeable to visitors.
- *Internal height.* A minimal internal floor-to-ceiling height of 3m (10 feet) meets most needs; a void of around 60 to 90cm will accommodate the majority of services required by occupiers.
- *Heating and services* that offer the flexibility to alter or add to a system.
- *Internal finishes.* Floors are normally finished to dust free concrete to enable the occupier to choose his final finish, which is often, vinyl/ceramic tiles or carpets. Walls are often plastered and suspended ceilings are normally included in most speculative schemes. Internal partitions should be capable of easy adaptation.

Miller (1988:32) states that developers prefer the English conventional developer's specifications building, which seem to be equally suitable with very few exceptions that users can be accommodated in a regular 1.5 meter grid with the conventional 13.5 meter wall to wall interior.

3.4.1 Space description

The space descriptions reflect the amount of space required for each activity. Specific space characteristics should meet the park's long-term development of requirements and a complete product definition. Science park design specifications should allow for flexibility when fitted within a rehabilitated property. Space planning should first provide required square meters for each component. Growth is also a major component of building design that should be incorporated in the planning process. This could either be approached through centralising or providing space for growth in one area, or decentralising space for growth among existing departmental parameters (Rayfield, 1994:91). The space description of supporting areas will be determined by their role in facilitating the main units and the availability of accommodation space. Salata (1983:9) quotes Ronald Ward and

Partners stating that there is no such thing as a standard office, but dimensions that have been traditionally accepted. This is relevant to space planning and dimensions for building rehabilitation. Ancillary areas usually cover approximately 30% of the building space and house activities, which attract people and bring income to the park. Following (see Table 2) are the square meters of basic technology park spaces and necessary ancillary areas. These surface areas are similar to those of the Thessaloniki Technology Park (Setshedi, 1998).

1. Management centre

Technology transfer unit

- Industrial liaison office - liaison service: 250-300 m²
- Technology observatory - information service: 250-300 m²
- Career advisory unit - counselling service: 250-300 m²

Innovation financing unit

- Seed capital service: 250-300 m²
- Venture capital service: 250-300 m²

Ancillary Areas

The surface area of ancillary spaces cannot be predetermined but depends on the availability of the remaining spaces and are usually located where space is available. Most of these activities can be located along significant pedestrian intersections.

- Exhibition hall: 80 m²
- Conference hall (50-150 seats): 200 m²
- Reception: 20 m²
- Lecture rooms (100m²x2): 200 m²
- Library: 100 m²
- Amenities: 60 m²

The total area requested for the accommodation of the management centre equals to 2160 m², which is 465 m² more than the total area of the Thessaloniki Technology Park's Administration and Conference Centre.

2. Technology building

- Business service: 300-400 m²
- Multimedia service: 300-400 m²
- Telecommunication service: 300-400 m²
- Systems and automation service: 300-400 m²
- Quality analysis and certification service: 300-400 m²

Ancillary areas

- Special library: 100 m²
- Reception: 20 m²
- Amenities: 60 m²

All areas of this centre including circulation add up to 2180 m² as compared to 1850 m² of the specialised experimental unit (excluding two CPERI laboratories that occupy 3024 m²) of the Thessaloniki Technology Park.

3. Incubator building

Special attention is required to buildings accommodating start-ups and selected companies. Komninos (1993:93) describes incubators as rectangular buildings with one to two storeys, divided into units of 30-250m². A basic criterion in designing incubators is flexibility, which caters for further subdivisions and alterations. Accommodation is also needed to house tenant companies ranging from 80m² to 300m², which do not necessarily have to be accommodated in the same building as the incubator

Administrative and ancillary areas

- Manager office space: 50-100 m²
- Cafeteria/lounge (50-150 people): 80-180 m²
- Reception: 20 m²

The total area for both the incubation space and accommodation for technology-based firms can range from 1000 m² to 2000 m² each depending on the tenancy demand.

4. Museum and centre for socio-economic activities

The museum will display historic artefacts and events relating to the site. The centre for socio-economic requires:

- amenities (60 m^2)
- pavilions (100 m^2)
- amphitheatre for 150 people (200 m^2)
- parking (to be relocated to the site south of the Pretoria State Garage),
- banks (including ATM machines covering about 50 m^2)

The total area for this section amounts to 410 m^2.

Defining approximate areas needed for different spaces offers an insight into the shapes and sizes required for accommodating the Pretoria Technology Park activities. This is a preliminary stage, which will be taken into consideration during the rehabilitation assessment and the fitting process of the State Garage buildings. As a result the Pretoria Technology Park requires approximately 10250 m^2 (see Table 2) for its functions as compared to a total of 7499 m^2 of the Thessaloniki Technology Park. These surfaces might change depending on the availability of space within the existing forms of the State Garage buildings but still confirms that the Pretoria State Garage is a small science park located in an area with an industrial past, like BIG.

Centre	Area in m²	Total area per centre
Management centre		
1. Technology transfer unit		
- Industrial liaison office	300	
- Observatory and information services	300	
- Career advisory office	300	
2. Innovation Financing Unit		
- Seed capital service	300	
- Venture capital service	300	
- Ancillary spaces	520	
Total area		2160
Technology building		
- Business service	400	
- Multimedia service	400	
- Telecommunication service	400	
- Systems and automation service	400	
- Quality analysis and certification service	400	
- Ancillary spaces	180	
Total area		2180
Incubator	2000	2000
Accommodation for tenant companies	2000	2000
Museum	1500	1500
Centre for socio-economic activities	410	410
Total area (for the technology park)		**10250**

Table 2: Required surfaces for the Pretoria Technology Park

3.5 Market research for alternative locations for the Pretoria Technology Park

Pretoria like most South African cities dating from the second half of the eighteenth century shows signs of decay. One of the major elements of market research is the selection of a positive environment that appeals to all the parties involved. It is useful to judge right at the outset whether a building site is likely to be capable of re-use, and for what. That evaluation is vital as to determine, from the outset the difference between success and failure. The main factors affecting market are *location, configuration and condition* (Department of Environment, 1987:8), though factors such as *financing, timing, ownership* and *function* play decisive roles (Theron, 1981:427).

- *Location* refers to the parts of the country or type of neighbourhood in which a building site stands, but also alternatives of area to different types of use and possible expansion. Deirdonck and Huysman (1992:23) suggest that for the evaluation of the location the following should be taken into consideration: access to transport ways, housing in the area, degree of education of people in the area, entrepreneurial attitude of people in the area and presence of venture capital.

- *Configuration* refers to the shape and the size of the building, which is very important. Natural light-distance from the windows determines how building can be re-used. The two main considerations are the depth of the building and the ceiling heights.

- *Building condition* is the most variable in building re-use. The longer a building is left empty, the greater and more expensive will be the work required.

The ideal location for the Pretoria Technology Park lies in its proximity to the main campus of the University of Pretoria. A site that meets this demand is apparently not available within the main campus of the University of Pretoria and the surrounding area. It is therefore necessary to allocate a site within the vicinity of the city of Pretoria. The Pretoria State Garage was initially chosen and because it contains a surplus of obsolete buildings that can provide suitable accommodation for the park. Both the Marabastad and the Asiatic Bazaar areas and the Pretoria West industrial sites are identified as possible alternative locations after the Pretoria State Garage (figure 7).

3.5.1 Pretoria State Garage

The Pretoria State Garage (figure 7 and 8) lies in the southwest quadrant of Pretoria Central and has the kind of distinct and boundaries that create an identifiable neighbourhood:

- Potgieter Street and the new Tshwane Mail Centre to the west, which was built on the site of the former South African Railways good yard.
- African Window museum on the rehabilitated former South African Mint property to the east.
- Minnaar Street and railway lines to the south.

The site is situated in a quadrant intensively characterised by museum buildings of monumental and architectural significance such as the African Window (former South African Mint), Transvaal Museum, Fire station, Loreto convent, Land Bank and City Hall. Instead of looking at this site for public uses like museum and galleries, it is efficient to look at the site and its new use as an effort towards re-adaptation and continuation of its original industrial functions. The site covers approximately 7.5 acres with the adjacent vacant site (across Minnaar Street to the south) covering approximately one acre.

The Pretoria State Garage is an industrial site comprising of stores, workshops and offices spaces. Le Roux (1993:22 and 57) describes the site as:

- Economically viable and requires rehabilitation.
- Physically good for restoration.
- Typologically important.

Figure 7: Aerial photo of the southwest quadrant of Pretoria (source: Tshwane Municipality)

3.5.2 Marabastad and Asiatic Bazaar

Marabastad became the first African settlement in Pretoria, which came into existence in August 1888. The settlement was named after Chief Maraba who had served as a translator for the Landlord of Pretoria. It was evacuated in 1940 as a result of the reallocation processes of the then Local Authorities (Freidman, 1994:25). The ***Asiatic Bazaar*** is situated south of Marabastad. It was also established in the late 19th century, for the settlement of the growing Indian population in Pretoria (Freidman, 1994:37).

Marabastad (figure 8) is characterised by a fine-grained urban fabric with distinct zones (not legally defined), that affords a convenient way to describe the area (Meyer *et al.* 1999:45):

- *The Asiatic Bazaar* is located within DF Malan West, Struben Street, Steenhoven Spruit Street and the railway line. The area is the main Indian trading area and part of the Central Business District of Pretoria. It has been in existence for almost a hundred years and is predominantly occupied by retailers and wholesalers. The area comprises of undeveloped pieces of land, with limited entertainment and religious activities. The western part, formally housing schools, comprises of filling station, government buildings and vacant land.

- The *Belle Ombre Station Precinct* is located east of township Asiatic Bazaar Extension 1 and north of Boom Street. The area comprises of the Belle Ombre Train Station, bus terminal, and Boom Street Taxi Rank.

- The *eastern and southern-eastern quadrant* is an area situated south of the Belle Ombre Station Precinct and east/south-east of the Asiatic Bazaar. It was traditionally designated for 'white' Central Business District or inner city of Pretoria. This area is of a mixed-use zone made up of businesses, light industries, high-rise buildings, flats and vacant properties.

- The *southern and southwestern quadrant* is an area situated south of the Asiatic Bazaar. It comprises of municipal depots and workshops to the south of Struben Street and the Heroes`Acre Cemetery and a national monument on the northern side of Church Street. There is also a tennis club located to the northeast of the cemetery.

The present picture of the area reflects an immediate need for redevelopment. Marabastad constitutes of properties that hold historic, typological, architectural and social context (Le Roux, 1991:19):

- Buildings with outstanding qualities which can easily be restored
- Buildings conserved or to be conserved within their typological context
- Properties to be redeveloped for complete image of the area.
- Present/previous shopping malls or squares which through redevelopment can assist the total image of the area.
- Small new buildings, which already contribute to a better image of the area.

3.5.3 Pretoria West

Pretoria West (figure 8) was laid out in 1892 after the 1890 establishment of the residential areas of Arcadia, Sunnyside and Les Marais and later followed by Muckleneuk, Mayville and Goedehoop in 1893, 1896 and 1897 respectively.

In 1909 the first factory was erected in Pretoria West. During the 1950s various areas, including Pretoria West, a portion of the farm Daspoort 319-JR, industrial townships Koedoespoort, portions of Hermanstad, Silverton and Booysens, as well as a number of stands in Pretoria Central were zoned for industrial purposes (Rossouw, 1984:12).

As a result of the uncoordinated nature of earlier development, industrial development in Pretoria was initially scattered in and around the city.

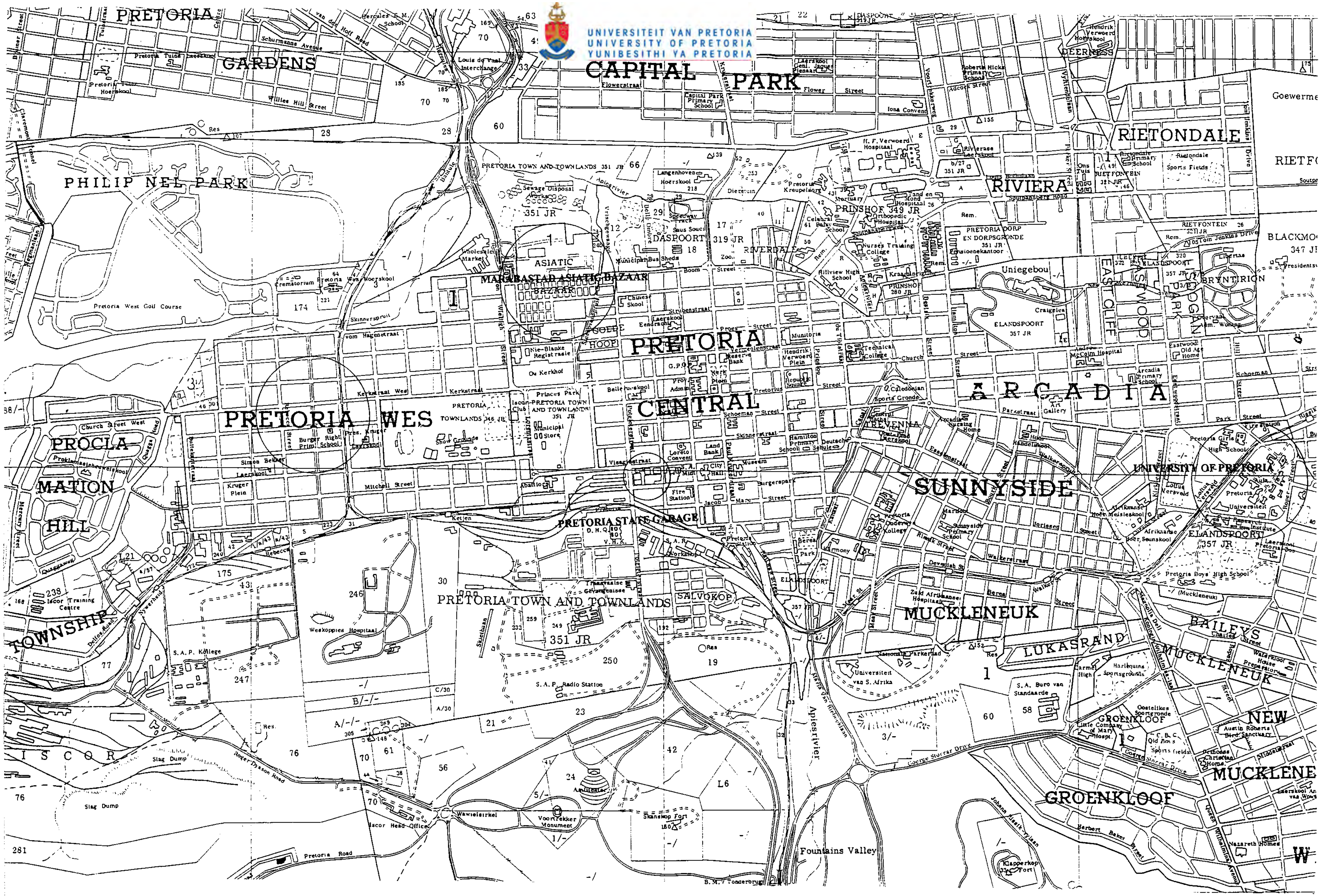
Apart from smaller industrial areas, industrial development within the municipality area of Pretoria was, at the end of 1979, predominantly concentrated in a few areas (Rossouw, 1984:30):
- The Booysen-Daspoort-Hermanstad-Zandfontein area to the north-west of the city centre
- The Pretoria North area.
- The Koedoespoort-Silverton-Waltloo-Crysler Park area to the northeast of the city.
- Certain parts of Pretoria Central.
- The Pretoria West industrial area which links up with the ISCOR works.

The three sites offer competitive spaces with common characteristics but also significant variations that will influence the ultimate selection. The selection of the Pretoria State Garage is based upon the following considerations:

- The Pretoria State Garage is an industrial type building that is consistent with the general Pretoria Technology Park building configuration requirements. The site offers minimal accommodation space for the park. Its buildings are in physically good condition and provide the rehabilitation process with the least renovation cost and high future returns. This is a major advantage as compared to the other two sites, which are relatively larger and possibly require more expenditure for renovation.
- The site is located within a singular 7.5 acres block, which requires minimal urban re-zoning intervention as compared to alternative sites. This study focuses specifically on the rehabilitation of an existing property in order to accommodate a technology park that is actively involved in trade activities rather than urban zoning.
- The site is confined to one building block, which offers the advantage of better control and accessibility.

The Pretoria State Garage site has a potential to retain and continue with the traditional manufacturing character of the southwest quadrant of the city. Its building configuration offers competitive spaces suitable specifically for the Pretoria Technology Park and for possible future extensions and alterations. This excludes zones for housing or large recreational sites for sports and cultural activities, which might need to be included in the two alternative sites.

The above-defined characteristics thus should, for possible implementation, conform to the criteria set by local urban design regulations, which will address issues such as land use, typology and forms of buildings, zoning, development phases and town planning (Komninos, 1996:237).



gure 8: Pretoria City Plan (Source:Tshwane Municipality)

3.6 Conclusion

This section consequently establishes a preliminary corporate network involving major role players in an effort to promote technology transfer. This network emerges as an establishment meant to address issues of technology transfer in the manufacturing sector in Pretoria. Most technology parks are unique in their orientation because of the role they play in addressing technological issues unique to their respective regions. The Pretoria Technology Park's unique character is based on its objective to provide technological innovation to the local manufacturing industry. This industry is divided into two distinct groups, one from the well-established high tech industry and another from the traditional manufacturing companies in the previously disadvantaged communities. The uniqueness of this initiative is based on the ability to bridge the gap between the two industries and provide with technological innovations that will make both industries competitive.

Another study can be carried out in order to investigate the full potential of the Pretoria West and the Marabastad and Asian Bazaar sites in accommodation similar initiatives. The two sites are likely to incorporate residential zones and accompanying services such as banks, posts, transportation and sporting and recreational facilities. This would have a positive and revival impact to the land-use planning in the respective areas.

PART THREE

4. REHABILITATION AND INDUSTRIAL BUILDING TYPES

The technology and organisation of work place changes, and so do its location, servicing and spatial demands. Rehabilitation involves both the new user and the old property. In rehabilitation the potential user may be new or may be the existing occupant and that the building needs not to be old, since the procedure can apply to fitting a new tenant into newly constructed facilities. In the case of the Pretoria Technology Park, the user is new while the property is old. The concept of accommodating new activities in a rehabilitated property is a matter of mutual acceptability between the form and the context. The former pertains to the physical entity and the latter refers to the intellectual entity. The intellectual entity seeks to fit within the existing physical form while the form demands certain flexibility from the intellectual context (Lowry, 1981:421).

4.1 Industrial Buildings

Before looking into rehabilitation it is rather preferable to look at buildings as architecture, culture and history. Learning process in the field of architecture uses different ways of approaching historic material. The common method used to analyse historic architecture until the 19th century, is the distinction and classification of works of architecture in chronological sequence in epochs or periods, whereby each reflects a particular morphological unification with common characteristic. Since the 19th century to present buildings are classified according to their affiliation and styles (Lavas, 1986:13). Industrial buildings represent a style reflecting manufacturing processes of mass production. The term industrial architecture, which integrates engineering and architecture, refers to the necessity of building structures to house material handling devices and provide for the proper flow of materials, vehicles and personnel (Ingraham, 1956:10).

Jones (1985:12) suggests that an analysis for industrial architecture should follow two main lines of enquiry:

- that buildings have been placed within their architectural setting in relation both to other types of structure and to the prevailing architectural theories and beliefs (fluctuating in popular tastes).
- that building of industry have to be examined not only with reference to their designers and prevailing theories, but also in relation to local architectural traditions.

Due to advancement in the field of research and development and modern technology know-how in industrial manufacturing, most building structures from the pre- and industrial era, are abandoned, demolished or re-adapted for modern uses.

Historically, industrial activities were not associated with any particular architectural type. In the early days of manufacturing entrepreneurs were mainly focused on the issues of technology, labour organisation and finance, with industrial building architecture occupying a comparatively low priority. Most industrial buildings were simple structures, often rectangular in plan for reason of economy. Initial factories owed their appearances to watermills and cottage workshops. Some were terraced houses converted to business premises (Jones, 1985:12). These buildings are hard to classify as architecturally or historically significant (London, 1981:313).

The rehabilitation of these industrial structures is more likely to be driven by key factors of obsolescence or redundancy, aggravated by poor physical condition (Highfield, 1987:19):

- *Obsolescence* in industrial buildings occurs as a result of a shift in the manufacturing processes.
- *Redundancy* especially in old industrial buildings occurs as a result of obsolescence and age. These old buildings are usually in excellent structural condition comprising of perfectly suitable simple plans and volumes but no more needed for their original use.
- *Poor physical conditions* result when redundant or obsolete buildings stand empty for a long period, neglected, vandalised and after constant effects of the elements.

Prior to any rehabilitation process it is necessary to identify, at feasible stage, the true nature of the old buildings under consideration in terms of kind of space they contain and the kind of fabric they compromise because not all buildings are capable of conversion. A general overview show that buildings of the State Garage has the following characteristics, which according to recommendations by Eley and Worthington (1984:21), could be converted to light industrial units:

- Use category: industrial
- Building type: factories and offices
- Period: 19th to 20th century
- Characteristic location: urban
- Configuration: irregular bays
- Construction: brick, timber, steel and concrete
- Site coverage: 40% to 80%

The Pretoria State Garage courtyard comprises of industrial type of buildings. Most of the buildings stand obsolete due to a shift from its original use as a supplement for the South African Mint, accommodated laboratories of the South African Bureau of Standards (SABS) and Trigonometrical

Survey Department (TSD) (Joubert *et al* 1973:1). The site presently serves as a garage for state vehicles. The building structures are in physically good condition. The building configuration and volumes are suitable to be converted to a centre for light industrial manufacturing.

4.2 Advantages of Rehabilitation

This section analyses the advantages offered by building rehabilitation, which in most cases appears to be a more viable means of providing needed accommodation rather than opting for new construction. Highfield (1987:1) provides a list of four points, which are likely to advance rehabilitation and re-use as a better option than new construction:

1. *The availability of raw material*

Modern industries demand sophisticated building interiors, which results in a large number of old industrial buildings standing outdated, redundant or obsolete. This provides a surplus of building material suitable for rehabilitation and re-use.

2. *The quality of raw material*

Surplus of old industrial buildings in urban areas are still structurally sound because most of these buildings were overbuilt due to uncertainties in building safety and regulations. Unfortunately, the value of these structures has not always been recognised because years of neglect and lack of maintenance have made them appear shabby and decayed. The frequently unsightly appearance of these buildings should not blind communities to their potential for re-use by new industry or conversion to needed housing or small industries (Bunnell, 1978:47).

3. *The shorter development period*

One of the principal advantages of opting for rehabilitation rather than demolition and new construction is that, in the majority of cases, the new accommodation will be available in a much shorter time. Building renovation can take place in stages and in a comparatively less time than new construction. In addition to time saved during the construction phase, time is also saved during the pre-contract design and planning permission phases, which normally take much longer for new development than for rehabilitation, even where a change of use is proposed for existing building Bunnell (1978:10).

4. *The economic advantages*

The cost of converting a building is generally much less than the cost of new construction, though it is the nature of the rehabilitation property that will have a considerable bearing on the conversion cost. In addition, Bunnell (1978:8) describes some of the many contributing reasons on economic advantages as follows:

- Rehabilitation cost is greatly influenced by labour-intensive process than high cost of building materials for new construction.
- The already available infrastructure on a rehabilitated property saves the high cost of purchasing undeveloped land.
- Rehabilitation minimises the cost and energy used in building demolitions.
- Renovated properties often attract tenants that are willing to pay competitive rental rates.
- Old buildings are often acquired for a comparatively low price due to the deceiving superficial decay and poor exterior appearances of many neglected old buildings. Renovation can provide tax advantages.
- Most local authorities provide financial incentives for building rehabilitation.
- Rehabilitation imposes fewer public and social costs than new construction.

4.3 Rehabilitation Process

The rehabilitation process can be executed in varying degrees ranging from least drastic option of low-key rehabilitation to the most drastic option of leaving only the facade standing, with the erection of a completely new structure behind or total demolition of the building and erecting new buildings. Following is the scale of seven redevelopment options by Highfield (1987:20):

- *Option 1*: Retention of the entire existing building structure, together with its internal subdivisions, and upgrading of the interior finishes.

- *Option 2*: Retention of the entire existing external envelope, including the roof, and most of the interior, with minor internal structural alterations, and upgrading of the interior finishes, services and sanitary accommodation.

- *Option 3*: Retention of the entire existing external envelope, including the roof, with major internal structural alteration and upgrading of finishes, services and sanitary accommodation.

- *Option 4*: Retention of all the building's envelope walls, and complete demolition of its roof and interior, with the construction of an entirely new building behind the retained facade.

- *Option 5*: Retention of two or three elevations of the existing building, and complete demolition of the remainder, with the construction of an entirely new building behind the retained facade walls.

- *Option 6*: Retention of only one elevation, a single facade wall, of the existing building, and complete demolition of the remainder with the construction of an entirely new building behind the retained facade.

- *Option 7*: The most dramatic redevelopment option would be not to opt for rehabilitation, but to totally demolish the existing building and replace it with a new building.

During the rehabilitation process most structural elements are affected and Bidwell (1977:20) cautions that in major structural alterations, such as the removal or re-sitting of load-bearing walls, may lead to the redistribution of loading on other walls. The removal of internal cross walls may also lead to the instability of the external walls to which they are tied. Also, the effects of such measures on the interior appearance of the building must always be carefully considered. External brick walls may present greater problems. It will occasionally be possible to strengthen the existing brickwork with a new independent inner leaf or piers to carry the extra load, but where this is not possible, careful reconstruction may be inevitable. In such cases, every effort should be made to salvage as many of the exiting bricks as possible for re-use.

In terms of openings, demolitions and extensions Bidwell (1977:20) cautions that:

- Increase in the width of existing openings or the formation of new openings will also call for careful consideration to be given to the effects on the adjoining structure. Since the tendency will be to concentrate loading on to smaller areas of wall, some form of strengthening may be necessary.

- Demolition should be carried out with care. The effects on the remaining structure should be assessed, to ensure that its stability will not be impaired, and the material of the parts removed should be carefully examined to see whether they would be suitable for re-use in the repair and restoration of the remaining parts. Some of the aspects to be considered are the extensions, to assess whether or how they are to be tied into the existing brickwork, what effect they will have on sub-soil conditions and foundations, and whether they will set up any direct or indirect stresses in the existing building.

The nature of role players in the building rehabilitation varies and requires standardised guidelines to allow for a comprehensive rehabilitation in cases that share similar concerns. Theron (1983:2 and 46) establishes the following ten general guidelines for rehabilitation, which are based on the 1980 standards for rehabilitation by the United States Department of the Interior and adapted for local conditions and specifically for the rehabilitation of the 19th century Port Elizabeth:

1. Every effort should be made to integrate alteration with an existing building or its surrounding property.
2. The distinguishing original character or qualities of the building and its site should not be diminished or destroyed.
3. All building types and structures including their site should be recognised, as products of their own time and alterations, which have no historical basis, should be avoided.
4. Changes, which have occurred during the course of time, should be regarded as evidence of the history and development of a building and its environment.
5. Any distinctive stylistic features, examples of skilled craftsmanship or ornamentation that characterise a building should be treated with care and sensitivity.
6. The gentlest method possible should be used for the cleaning of structures.
7. Every reasonable effort should be made to protect and preserve archaeological relics affected by or adjacent to any project.
8. Any alteration and additions designed for an existing property should be encouraged provided they do not destroy any significant historic, architectural, or cultural material.
9. Any new development carried out in the area should be adapted to the environment in an unobtrusive manner.
10. It is important to seek advice from qualified professional, such as architects, architectural historians and archaeologists skilled in the preservation, restoration and rehabilitation of old buildings.

5. ASSESSMENT FOR THE REHABILITATION OF THE PRETORIA STATE GARAGE

Rehabilitation of the Pretoria State Garage is vital for the site to retain and reflect its cultural significance. The Burra Charter (1999) defines the term "*cultural significance*" as the aesthetic, historic, scientific, social or spiritual value for past, present or future generations.

Pretoria State Garage is a courtyard site with masonry warehouses, garage and factory buildings, of repetitive character, with site coverage of approximately 80%. The site comprises of a number of building structures, which can be classified according to the building type, configuration and chronology. The nature of each existing structure determines the limits of its adaptability to new uses and additions. The building heights range from single to three stories.

Rehabilitation of this site aims at enhancing the traditional industrial image of the site, eradicate sense of abandonment and general dilapidation, motivate local authorities and produce an image that inspires the idea of a safe environment. Rehabilitation will include demolition of unwanted structures, general thoroughfare planning, which enables pedestrian interaction and improve access onto the site from the existing main entrance. Rehabilitation and retention of all of the existing buildings is not feasible because of the space needed to accommodate parking, landscaping and easy access and communication routes between significant buildings. The State Garage site currently contains a significant number of small single-storey buildings that flank most buildings that would be vital and maintained for the rehabilitation process.

5.1 History of the Pretoria State Garage

The Pretoria State Garage activities are currently housed in most buildings on site including those previously owned by SABS. Also on the site is the redundant Trigonometrical Survey Department (TSD) building that presently serves as storage for various government departments. Though the TSD building functions independently from the State Garage, it forms, and will be considered to be part of the State Garage due to its contribution and common architectural values shared with the rest of the buildings on site.

The site developed in a number of phases starting early in the 1940's. Though not much information is available relating to the history of the State Garage, it is evident from the assessment of physical elements that the site has undergone functional and physical changes. The street and site boundary patterns changed considerably when the site was cut-off from the (former) Mint. Schubart Street was extended southwards from Visagie Street towards Minnaar Street and from that point cutting diagonally through the southern site of the former SAR diagonal (southwest) to join Potgieter Street (figure 7). As a result of the area (land) lost during the extension the Pretoria City Council compensated the Pretoria State Garage by offering an empty site, south of the site across Minnaar Street (Joubert *et al*, 1973:2). This site is presently used as parking and it is therefore proposed as a possible site for the relocation of the current State Garage functions. Among other modifications on site, available drawings show a proposal for the extension of block E during 1945-6 and the renovation of the site in 1977 following a proposal by JON Architects (Joubert *et al*, 1973).

5.1.1 Site and space description

Building site

Building facades are divided into vertical and horizontal sections by standard window patterns and concrete lintels (figure 9). Most windows are rectangular standard industrial types. Rayfield (1994:99) recommends that window mullions should be consistent because irregular mullions spacing leads to difficulty in achieving consistent office sizes. Regular mullions provide perpendicular interface between the partition and the perimeter without awkward conditions. Rooms are cubical and form simple large boxes, with most floor heights common ranging from 3.9m, 4m, 4.4m, to 5.5m. Most rooms are spatially defined with doors designed not necessarily to enhance the maximum sense of depth. These doors can be detached and redesigned to help achieve the perceptual and behavioural organisation of the room interior.

Figure 9: North elevation of Administration Building (D1) (Source: Photo by author)

Space and architectural descriptions

An in-depth analysis of architectural spaces on site is necessary prior to any alterations. It is imperative to analyse the full ontological potential of spaces, which if understood, designers could begin to incorporate such considerations into their new design process (Leach, 1997:xv). An analysis of the architecture of the Pretoria State Garage is contained within the functional aspects, which tend to be detrimental to any semantic perspective. Rather relevant would be a review of the architectural theories at the time of Pretoria State Garage, since these might have had a substantial contribution to decision making of the times.

Sometimes, it is difficult to reach a comprehensive analysis of existing structures because some architectural designs show less clearly defined architectural principles, affiliation or generally under-training (Leach, 1997:xv). Thus, an evaluation of the existing architectural space should be minimised within the existing contemporary knowledge of the site and its designers. The interior of most buildings of the State Garage is characterised by static, rectangular and occasionally dark spaces (figure 10). Most internal walls are covered with painted cement plaster. White painted plaster and gypsum-ceiling boards define most ceilings except where the roof structure is exposed (blocks E, C2, C3, D2, D, K2, K3, L2 and L3).

Figure 10: Interior of Administration Building (Source: Photo by author)

Finally, the purpose of this investigation is not to question or interrogate the architecture on site but to extend the viability and improve the spatial qualities of buildings. This will include the analysis of exterior spaces because they form an integral part of activities on site. Todd (1985:5) cautions that exterior spaces should be planned together with interior spaces and not left out to the waste of the client's money. The design of buildings should also be informed by the nature of its site as to avoid unplanned space and uncomfortable visual or physical relationship between the built and surrounding spaces, such as the uncomfortable space between blocks D3 and E (figure 11).

Figure 11: Space between D3 and E (Source: Photo by author)

5.2 Philosophy of new insertions

This section presents an introduction into the vast and sophisticated nature of the philosophy of new insertions onto existing sites. In addition, this section intends to stimulate debate on whether or not such new insertions can reflect local architectural value. This argument is warranted by the prevailing universal concerns about the investigation of the nature of local architectural values. Architecture, as according to Leach (1997:xiv), is not the autonomous art that it is often held out to be but buildings are designed and constructed within a complex web of social and political concerns. Throughout time, the State garage was designed and constantly expanded for purely utilitarian purposes and not merely architectural.

There should be a distinction between the former structures and new insertions that speak contemporary language. The dividing line is distinct as manifested by different architectural and philosophical approaches. Such opposing architectural manifestations usually pose questions to people's attitudes, including leading figures such as designers, due to different architectural affiliations. In addition Leach (1997:xviii) argues that:

"*The process of rehabilitation and new insertions are didactically related and that the one anticipates the other in a mechanism of reciprocal presupposition*".

As a result, within the rehabilitation framework of the state garage no one is bound to do replicas for the sake of history but bring about consistency and comprehensive super-imposition of new insertions.

5.3 Comprehensive planning

Comprehensive planning focuses on the general locations, philosophies and guidelines for major design features (Todd, 1985:7). This will include general demolition on site, demolition of interior partitioning, office space planning, vertical transportation, exterior spaces, handicapped accessibility, site entry and exit, and parking.

5.3.1 General demolitions on site

The current image of the site undermines the architectural potential and the viability of the site. This situation is a result of sporadic erection of relatively small structures attached to main buildings. These structures obscure the architectural qualities and cause structural defects such as cracks on main buildings and should, as a result, be demolished (figure 12 and 13). The demolition of these structures inevitably reduces the historic material fabric but is deemed to be vital for a productive future of the site. Interior and partial demolitions are dealt with separately during the descriptions of individual buildings.

Figure 12: Typical examples of flanked buildings (G1, G2 and G3) (Source: Photo by author)

Figure 13: Structural crack caused by attached structure (J) on K2 (Source: Photo by author)

This study proposes the demolition of buildings A, B1, B2, D4, D5, D6, D7, E, F1, F2, G1, G2, G3, H1, H2, I1, I2, J, L, M1, M2, O1 and O2 (figure 36). The demolition of these flanked structures reduces the historic material fabric but it is inevitable because they undermine the architecture and the viability of the site. The boundary wall is also due for demolition because it obscures the architecture of the site and in the past it encouraged architecturally unworthy structures such as the erection of the barbeque stand located west of L1 (figure 34).

5.3.2 Demolition of Interior Partitioning

Most interior partitions are destined for demolition warranted by the fact that they create static spaces (figure 18), which do not conform to flexible office planning discussed below in 5.3.3. Such alterations can take place because most partitions are not structural. Demolition of the existing partitions should be such that it should not present any unusual problems or structural instability. If, however, the partitions to be removed are structural, then they carry part of the structure and cannot be removed before measures are taken to transfer the loads they carry to a substitute structure or to modify the bearing partitions accordingly. When removing any partitions, whether entirely or only partly, special attention must be paid to any piping, conduits, or wiring that may be embedded in the partition and must be cut or re-routed.

The choice of new partitions, apart from economic considerations, will depend on weight considerations, fireproofing regulations, locally applicable building codes, and aesthetic and design preferences. The use of prefabricated modular partitions provides the design with high flexibility of partition layout combined with the possibility of frequent changes (Lion, 1982:48).

5.3.3 Office space planning

There are three basic approaches to office space planning: closed plan, open plan, and modified open plan. Open and closed plans were never entirely accepted (Salata, 1984:17), but modified to fit specific needs. In designing the interior Rayfield (1994:92-99) provides a list of criteria that can be used as a foundation to evaluate the above plans:

- *Space utilisation.* This section refers to the efficiency and density of the planning concept. In terms of space utilisation, the open plan is more efficient than closed plan because of the following three reasons. First, the closed plan rectilinear rooms do not allow flexible manipulation of space. Second, in case of rooms aligning along the wall perimeter, the room partitioning should align with window mullions and column location. Third, additional space is required to cater for private door swings and stand areas.
- *Planning flexibility.* Open plan offers more flexibility than closed plan. In closed plan alterations could be costly considering that in most cases walls are relocated. Relocating walls could mean that mechanical, electrical and lighting systems and carpeting are also affected.
- *Communication among personnel.* The advantages and the disadvantages of both closed and open plans depend on the kind of communication that the working environment requires. Closed plan is less conducive to interoffice communication among personnel than is open plan.
- *Office technology flexibility.* Closed plan provides more limited flexibility in responding to changes in office technology, primarily because of the difficulty in changing wire distribution for electrical and data cabling and outlets. Open plan allows great ease in interior reconfiguration.
- *Visual expansiveness.* In closed plan visual expansiveness is limited due to partitions. Open plan provides visual expansiveness that windows are opened to the whole interior than to private office spaces in closed plan.

- *Visual privacy.* Most office design requires visual privacy to reinstate a desired organisational culture or provide for specific duties. Closed plan provides greater manipulation of such desired spaces than open plan. The commonly used method to provide visual privacy to the open plan is through usage of floor standing panels, file banks or plants. This is required for managers of the park and open plan for those in the clerical support personnel who must deal with the public.
- *Acoustical privacy.* Acoustical privacy can be achievable in both open and closed plans spaces through usage of insulating walls and floor-to-floor partitions.
- *Security.* Closed plan provides for better security to classified and confidential material than open plan.
- *Cost.* An evaluation of cost with either planning approach must be considered in the context of the life of the projects and the number and extent of modifications of the space.

Vital to office space is the support and amenity spaces. Such spaces are needed for communal activities and compromise as much as 25% of the total floor space in an office building (Salata, 1984:17-40). These communal activities are divided into *communal working areas, leisure* and *amenity areas, and reception.*

- *Communal working areas.* These are areas used to provide for working groups, conferences, meetings, office machine processing equipment, goods lifts, cleaner's cupboard, and storage.
- *Social and amenity areas.* These include toilets and washing facilities, catering, and external amenity space.
- *Reception areas.* This is a lobby functioning as a recipient for visitors and security checkpoint and convenient point to monitor the building exterior.

5.3.4 Vertical transportation

Most stairs and lifts in the Pretoria State Garage buildings need to be upgraded to fully comply with the present building regulations [contained in South African Bureau of Standards (SABS) 0400-1990]. Their size and location do not conform to modern office design and building regulations and it is therefore necessary that they be upgraded and strategically repositioned. Installing a new stair, or even enlarging an existing one that is found to be too narrow to conform to building regulations, can create many problems. Apart from widening their space, it may entail extensive structural changes to the existing framework (Lion, 1982:90).

There is a need to install new stairs in most building blocks and particularly blocks D3 and C5, to meet the proposed new activities. In case of retaining existing structural elements, alterations might entail extensive structural changes to the existing framework. If the structure is able to assume the additional loads then it becomes a matter of framing new openings at each floor level and supporting whatever portion of floor has lost its continuity. The support can either be by means of new beams and columns, if required or by means of bearing partitions extending for the full height on each floor. If, however, the floor systems cannot assume the additional loads, it may be necessary, apart, from framing openings, to have an independent stair shaft built within the building (Lion, 1982:90)

Figure 14 illustrates a lift located on the eastern side of D1 that does not comply with present building regulations and certainly unfavourable for the image of the administration building. Both blocks C1 and D1 require new installation of lifts and elevators, incorporated within a new spatial design.

Figure 14: Lift in building D1 (Source: Photo by author)

5.3.5 Handicapped accessibility

The State Garage, like many buildings in Pretoria, does not provide full accessibility and facilities for disabled persons. Part of the new insertion strategy is to incorporate requirements for the handicapped. Such design guidelines are specified in the *Code of Practice for the Application of the National Building Regulations* (SABS 0400-1990:151- 155).

5.3.6 Exterior spaces

Part of the building site is the external hard spaces, which interact with buildings, plants and landforms. In most science parks such as Sophia Antipolis and Cambridge Science Parks exterior spaces play an important role in determining the image of the park. Their design should be incorporated into the entire design process. This study will only concentrate on the comprehensive planning of the exterior and not explore the design and the technological aspects of landscaping.

Insufficient circulation spaces and the proximity of buildings in the courtyard may result in the exterior spaces dominated by hard paving. According to Pinder (1990:1) the function of the paved surfaces will generally address the following interdependent issues:

- *Practicalities*, to provide a surface that addresses the quality and properties of used materials.
- *Direction*, to reveal the identity of different areas and guide people to various destinations.
- *Repose*, to provide neutral areas between highly functional spaces for resting or social purposes.
- *Hazard*, to provide awareness of dangerous areas, including junctions and pedestrian crossings.
- *Scale*, which addresses usage of materials, especially of different sizes, qualities and properties and their interfaces to each other and to the surrounding.
- *Use*, which reflects on the ownership of the property, whether private or public.
- *Character*, which offers a particular identity to the demarcated area.

The landscape of the Pretoria State Garage will probably be dominated by new design due to lack of elements of architectural significance. A challenge to the designer is to allow free and continuous circulation on site. This is regardless of physical barriers that occur on site distinguishing different areas on site. Such barriers must be subtle to allow for smooth transitions from one area to the other (Todd, 1985:5). A further investigation should address issues of overall lines, widths, location and form of junctions, relationships with associated land-form, planting, footpaths, walls, steps and buildings (Pinder, 1990:11). Figure 15 shows an area designated for central pedestrian area following the demolition of buildings G1, G2, G3, H1, H2, I1, I2 and J (figure 36). This area is centrally located such that it visually and physically connects to all major buildings and routes.

Figure 15: Pretoria State Garage central yard (Source: Photo by author)

5.3.7 Site entry and exit

There is a need to create a common entrance for the site though the necessity for secondary entrances is inevitable due to scattered nature of buildings on site and that most buildings have street facades, though not on site boundary line. Currently the state garage can only be accessed from three entrances (figure 36):

- The main entrance is located along Visagie Street between building D1 and C1. This entrance is used for both pedestrians and vehicles (figure 16).
- A secondary entrance exists along Visagie Street between building B and C1. This entrance is currently locked and offers a narrow visual contact to the designated central pedestrian area (figure 36).
- A service entrance is located along Minnaar Street between building H1 and K2.

Figure 16: Main entrance (Source: Photo by author)

It is vital to create an entrance that will allow easy access to both pedestrians and vehicles. High traffic on Visagie Street does not allow that. The rehabilitation of Minnaar Street could be extended towards the park in order to create a suitable main entrance to both the technology park and parking to the south (figure 37). This will also emphasize the north-south axis of the park. The rest of the entrances could be maintained and enhanced for future access into the park. Blocks B, C, and D have north facing street facades, which if enhanced, could be utilised as architectural interface between the park and visitors.

5.3.8 Parking

An adjacent vacant site, across Minnaar Street to the south, may be used to accommodate a multi-storey building for parking. This initiative should provide much needed parking for the Pretoria Technology Park and adjacent sites. This site covers approximately one acre and a maximum parking plan should be reached to meet parking needs. The design of the multi-story building should take into account the existing architectural designs in the vicinity. Most current functions of the State Garage could be relocated to this site in the future.

6. ASSESSMENT OF PHYSICAL FORMS

This section assesses physical forms of the State Garage and establishes appropriate remedial measures for the rehabilitation and restoration processes. This framework focuses mainly on the old brickwork but includes other integral building components such as exterior openings, roof structures and concrete structural elements. It offers a broader assessment of problem areas and solutions and an insight into whether rehabilitation and restoration are possible to certain areas of the State Garage buildings. The rehabilitation process should be carried out without adversely affecting the architectural character or stability of the building. Remedial measures are also suggested in this section for the purpose of understanding the general principles that apply to specific cases. Any intervention on site should be preceded by a thorough inspection in order to realise the true nature of these physical features. Thus, proper remedial measures can be suggested. Aspects pertaining to the restoration of brickwork are quoted from Bidwell's (1977) "*The Conservation of Brick Buildings*" due to a wider framework that this book offers in terms of the restoration of brickwork.

The most common enemy factors contributing to the instability of the State Garage brickwork are water penetration (especially capillary moisture and roof leakage), decay and structural instability (caused by flanked buildings). Important aspects discussed of building rehabilitation and restoration include: foundation failure, leaning and bulging of walls, cracking of walls, structural frame, exterior openings, roof and sheet metals, cracks relating to arches and lintels, built-in timber, iron and steel members, bonding or brickwork, sulphate attacks, corrosion of reinforcement, mortar, interior restoration, energy aspects. These are aspects and failures are common to most old brick building and form a framework reference through which physical features of the Pretoria State Garage building structure could be investigated for further analysis. The following is a summary of the above-mentioned types of building failures and how such failures could be remedied. Different building defects analysis and remedial techniques for building elements discussed below are available from a wide range of maintenance and preservation guidelines and could be applied according to the level of craftsmanship and equipment available.

6.1 Foundation failures

Foundation failures can be the results of overloading on the foundation structure, differential settlement, or movement of the ground, and produces the characteristic symptoms of leaning, bowing and cracking. These have not been identified on site. As a matter of precaution r*emedial measures* suggest a possible redistribution of the loading move evenly and to relieve the foundation of the excess load. In terms of differential settlement, the remedial measures will usually involve tying the two elements together (in an acceptable manner). However, where there has been horizontal as well as vertical movement, rebuilding may be required. In terms of subsidence and soil movement, underpinning in some form will probably be necessary.

6.2 Damp patches

Dampness on walls is a common feature inside State Garage buildings (figure). This is mainly caused by direct penetration of rain through leaking roofs and gutters, leaking pipes, rising damp, hygroscopic salts and condensation within the building. It is important that the real cause of dampness be identified so as to select the appropriate remedial measures. Possible additional sources include lowered internal floor to the external ground level and high levels of water table. Remedial measures suggest that reconstructing the point of penetration should prevent dampness and prior to that an accurate investigation of the cause should be established (Ashurst & Ashurst, 1988:1). However, most corrugated iron roofs require replacement.

Rising damp is characterised by a descending moisture gradient within a wall from ground level sometimes to a height up to 1.5 meters. The main causes of rising damp are movement of water through capillaries and the amount of moisture absorption usually through the mortar, which also increases the damage caused by the crystallisation of salts. Removing the source of dampness can easily eliminate rising damp. Hygroscopic salts attract moisture from the atmosphere. These salts occur as a result of deposits from the wetting/drying rising damps. Remedial measures suggest that hygroscopic salts be removed by clay poultice.

Figure 17: Capillary moisture (Source: Photo by author)

6.3 Cracking

Cracking in buildings occurs in various ways that have to be investigated to determine the relevant remedial measures. Following methods investigate the different aspects of cracks in old buildings:

- The width of the cracks, which are classified in three groups of fine (width up to 1.5 mm), medium (from 1.5 mm to 10 mm) and wide (above 10 mm). Figure 13 shows a wide structural crack caused by flanked structure J on K2.
- The route of the crack, whether it passes (usually diagonal) through the brick joint, leaving the brick themselves undamaged, or passes through individual brick as well as joints (figure 18).
- Investigate whether it is the internal or external wall that has to be repaired. In figure 13 it is the external wall that require repair.
- When repairing external walls, the nature of the brick should be considered in relation to different mortar constructions of jointing (flush, raked or weathered) and pointing (flush, tuck and bastard tuck). These must be documented for the establishment of proper remedial measures during repair and restoration of brickwork.
- Fluctuation of crack in width with the season.

Remedial measures suggest that cracks can be remedied by cutting out and rebuilding, raking out filling and repair of the material. The measures are applicable to different nature of remedies required under specific circumstances.

Figure 18: Structural crack on block L (Source: Photo by author)

6.4 Built-in timber, iron and steel members

Attention should also be given to failures of related parts of old brickwork building such as *built-in timber members* and *built-in iron and steel members*. These are not visible and their existence not shown on available drawings.

Built-in timber members

The most common structural elements in such failures are timber joists, bearers, plates, lintels, stud framing and bonds timbers. Failures of such timber elements can have considerable effects on the walls, drastically reducing or eliminating lateral support, causing distortion, fracturing and occasionally outright collapse.

Remedial measures suggest the definite removal of the rotten timber treatment to eliminate any rot or insect attack present and the filling of cavities thus left, either with brick or concrete.

Built-in iron and steel members

The corrosion of iron and steel members embedded in brickwork may well cause fracturing, distortion and loosening of the bricks immediately surrounding the built-in members.

Remedial measures suggest that wherever possible corroded iron and steel should be removed from the wall and cavities bricked up. If this is not possible the ends of the iron or steel member should be cleaned until they are free from rust and protected by zinc-rich paint or bitumen before the brickwork is rebuilt. Where ties have failed through corrosion and are considered necessary to the safety of the structure, ties of stainless steel, non-ferrous metal or mild steel, should replace them and in any case care should be taken to prevent future ingress of water.

6.5 Cracks relating to arches and lintels

Cracks on arches and lintels are usually caused by the lack of properly formed abutments and the same problem can arise from the excessive deflection of a lintel over an opening.

Remedial measures suggest that when an arch abutment shows signs of failure it will normally be necessary to reconstruct both arch and abutment. Where the brickwork over a lintel has moved excessively it will be necessary to replace the lintel and rebuild the brickwork.

6.6 Failure in the bonding or tying-in of brickwork

Walls of the State Garage buildings appear to be stable. Investigating and applying some of the following remedial measures may rectify future leaning and bulging of walls.

Failure of facing leaves

This failure occurs, in most cases, to walls consists of two skins of bricks. The outer is more deceptive giving solid quality and the inner built by whatever brick possible and the bonding and coursing tended to be erratic. Symptoms are local bulging in the exterior face of the wall, often adjacent to window reveals, where a gap will open between the window frame and the brick reveal and arch soffit, or between window openings. Often the failure is accompanied by the disintegration of the mortar.

Remedial measures will be directed towards correcting the lack of bond between the brick skins. In severe cases, this may well mean that the affected parts of the wall will have to be taken down and rebuilt. Where only small areas of brickwork are involved it may well be possible to rebuild the area of loose facing brick only, obtaining a key to the inner skin by the use of metal ties, which can be secured into the load-bearing part of the wall, or by cutting out cavities to allow the headers to be secured right back into the inner skin.

Junction between structural walls

The junction between structural walls is another potential source of weakness in a brick building, being dependent for its strength on regular and sufficient bonding. The cracking is usually due to the movement of the external walls and again it must be established whether they are still moving.
Remedial measures suggest cutting out the crack and to stitch across it with new brickwork, with adequate bonding, block bonding of bonding at every course is not possible. Additional strength can be provided by its ties set into the brickwork horizontally in chase at about one-meter intervals.

Wrought iron structural ties

In many old buildings there are existing ties, usually of wrought iron, either rods or straps fixed back on the floor structure, taken through the wall and terminated on the exterior in an iron roundel or a cross made up of two length of flat iron. Cracks in the brickwork radiating out from or associated with the roundels or crosses or serious distortions of the floor structure may indicate that movement is still occurring and that further remedial measures will be required.

6.7 Sulphate attacks

Sulphate attacks are likely to occur when the sulphate can be transferred from the brick to the mortar and can cause severe damage or failure of the brickwork. The severity of the attack will determine the remedial measures, but in all cases the most important requirement is to remove sources of water where only particularly vulnerable elements such as parapets have been affected, it may be sufficient to modify the detailing to prevent moisture from building up. In some severe cases, however it may be necessary to rebuild. The rebuilding may have to include the use of sulphate-resisting cement, flue lining and, if it is possible from the point of view of appearance, bricks of low sulphate content.

6.8 Corrosion of reinforcement

Where moisture has penetrated to the reinforcement, often due to inadequate maintained pointing and failure of rainwater goods allowing the walls to get saturated in places, the reinforcement then corrodes leading to horizontal separation at the mortar joints.

Remedial measures suggest that once the reinforcement has started to corrode it will tend to continue to degenerate even if the source of moisture is removed. It is therefore necessary to cut out the corroded iron and if necessary replace it with galvanised steel, before making good the mortar joint.

6.9 Structural frame

Roofs of blocks C1, C2, D1, D2, K2, K3, L2 and L3 are supported on steel structures. Future sagging may be require jacking up and reinforcing the beams by welding or bolting on steel plates to provide greater stiffness. Lion (1982:28) cautions:

"an older building is in static equilibrium and that any alterations to the building structure may have unexpected and undesirable effects as a results of upsetting the equilibrium and releasing latent stresses inherent in the structure".

A thorough inspection on site should be carried out to determine the seriousness of the structural status, especially the weaknesses, as to determine appropriate remedial measures.

6.10 Floors

Most buildings on site contain double-volume spaces with the exception of the two administration buildings and blocks L1 and K1. Floors are usually made from reinforced concrete and covered using tiles or screed. Most floors are likely to be ground to allow for new services ducts and light-wells.

6.11 Exterior openings

It is possible that certain windows and doors in old buildings require complete replacement. The wood sash may be rotten, sash balance may be broken, or steel sash may be rusted badly. Windows in old buildings usually have small panes with consequent loss of light. Chances are that metal windows, which will have to be custom-built, will replace the old windows. The replacement windows must have a perfect fit to ensure proper weatherproofing of the openings. Some of the types of windows and doors used in the state garage include: fibreglass louvers, SS 31, ND9, SSF 53, SS 53, NSDAS, NDAS, NDDA and SS 32. Most windows do not need replacement but repair.

Exterior doors require replacement, in which new case frames are needed. Another complication will develop if the doors are not large enough to satisfy exit regulations. In such a case it may mean that, in addition to changing doors and frames, structural alterations will have to be made to accommodate the larger doors. Using pre-finished metal doors and frames will eliminate painting and other inconvenient maintenance work that would be required for wood doors. Aluminium doors require anodised finish, which will protect the door from discolouring and will present a visually acceptable appearance. Most doors should be re-designed to suit the holistic visually acceptable image of the park.

6.12 Roof and sheet metals

The roof is more likely to need replacement other than any other components of the building. It is evident in most State Garage buildings. The roof is indeed an important place to start an inspection, because water penetration at the roof is usually the most serious cause of deterioration in older buildings. Evidence of roof failure usually shows up inside before it is visible on the outside. At first, damp patches, flaking paint, and actual dripping water on walls or ceiling are the signs of roof trouble (figure 19). A thorough inspection needs to be carried out to determine whether it is the roofing material itself, the flashing or the gutter system that has failed. Sometimes, moisture penetration through the wall is simply a matter of poor drainage, blocked gutters, or backed-up leaders, all of which can be taken care of through routine maintenance (Shopsin, 1986:62 and 113).

Roof insulation may need replacement, especially if it is an older fibre type insulation that does not stand up as well in time as foam types. Sheet metal, if in good shape and if removed carefully, may at times be salvaged. However, this may be risky. If it is galvanised metal, it may be sufficient to warrant discarding. Only aluminium or copper are likely to be candidates for salvage, though this outlast galvanised metal by many years, but at some point will come also to a point of replacement. Replacing the sheet may also require investigation and possibly replacing the battens. In conclusion, a thorough inspection should be carried out to determine whether the roof structure supporting beneath is sound, as to avoid overloading.

Figure 19: Evidence of roof leaking (Source: Photo by author)

6.13 Mortar

The pattern of the mortar joints is a significant element in the architectural character of a historic or rehabilitated structure. Mortar joints in buildings weaken due to weathering, cracking and loss of adhesive properties during the life circle of a building. During building restoration it is necessary to consider pointing of mortar joints. The traditional appearances of an old building can be radically altered by subtle changes in the width, colour and texture of the mortar joints. During restoration the new mortar should match the colour of the old in a true historic restoration and it will have to be re-pointed into the joints in the same style as the original. However, the composition of the mortar need not duplicate the original. Most buildings were built with a cement-based mix that produced an inflexible mortar incapable of responding to thermal changes in the bricks. Lime mortar is recommended for joining and pointing (see section 6.4) because it compresses and flexes with thermal changes (Shopsin, 1986:113). Figure 20 shows the English bond of the state garage that certainly requires re-pointing. This restoration process will take time and requires specialised craftsmanship.

Figure 20: Raked-off mortar on English bond (Source: Photo by author)

6.14 Interior restoration

The interior of most buildings has been subjected to more changes than the exterior. Quite often there is little extant physical evidence to serve as a guide to restoration. In this case an architect has several acceptable alternatives (Shopsin, 1986:155-156):

- Create a modern interior: from a practical stand point the loss of the original interior finishes can be advantageous, permitting greater latitude in the choice of a new use. Greater flexibility in the case of colour, material, and layout is another advantage. The new interior may be developed so that the old exterior retains its original appearance.
- Create a conjectural re-creation of the original interior: many old buildings are similar to surviving prototypes, so that a new interior can be fashioned to approximate an old one, or missing portions of it can be restored, without the need for exhaustive research.
- Create a pastiche of old and new: in many cases, parts of the original decorative elements and finishes remain intact and can be incorporated into a new design.

It is apparent that most objects of the existing furniture cannot be considered for reuse, though an overall evaluation should be conducted to identify possible objects for refinishing.

6.15 Energy consideration

Energy is an important component in building construction. It is calculated from the time of producing building materials and later, during construction, in activating construction equipment and providing temporary light and heat. After construction a building requires power for its daily operations including lighting and activation of its mechanical systems. The amount of energy wasted when building demolition takes place, it is calculated that the energy lost, in British Thermal Units, per square foot of building area, ranges from 600 to 2000 MBTU, depending on the type of building (Lion, 1982:21).

Lion (1982:21) refers to a 12-storey office building with a typical floor of 930m², which may represent an energy loss equivalent to 20000 MBTU if demolished. When roughly calculated it is equivalent to an energy contained in 7500 tons of coal or a million gallons of oil or 200 millions cubic feet of gas. That is sufficient fuel to drive a car for approximately 40 million kilometres.

6.16 Special features

The fabric of the Pretoria State Garage contains information that is vital to the recording process and better understanding of its subsequent uses and original form. There are features on State Garage buildings that show evidence of multiple phases and interventions. Evidence is available in a wide variety of structural and decorative elements (Icomos, 1990:73):

- Figure 21: Breaks in masonry show latter addition and reinforcement of the original south wall of block E1.
- Figure 22: Former door opening, west wall of block C3 was blocked using stretcher bond instead of the original English bond.
- Figure 23: Brick column, attached to the concrete column of block D1, used for structural support of the extended block D2. This implies a change in the structural technique that was deemed appropriate when the building was extended.
- Figure 24: Two adjoining parts of the west wall of block K1 are structurally independent of each other. The south adjoining part shows evidence of blocked door or window opening and pavement, which appears to have been raised to the level of the windowsill.

These features are common on most State Garage buildings and require thorough investigation as to determine their contribution to history and rehabilitation of the site. The are other features such as the wall alignment, wall thickness, evidence for demolitions, alterations, inserted passages, decoration and dates that are still to be thoroughly investigated to realise the long-term resilience of these buildings. It not always necessary to restore these features to their original use but could be used towards a comprehensive interpretation of the site.

Figure 21: Breaks in masonry (Source: Photo by author)

Figure 22: Blocked door opening (Source: Photo by author)

Figure 23: Brick column of D2 attached to concrete column of D1 (Source: Photo by author)

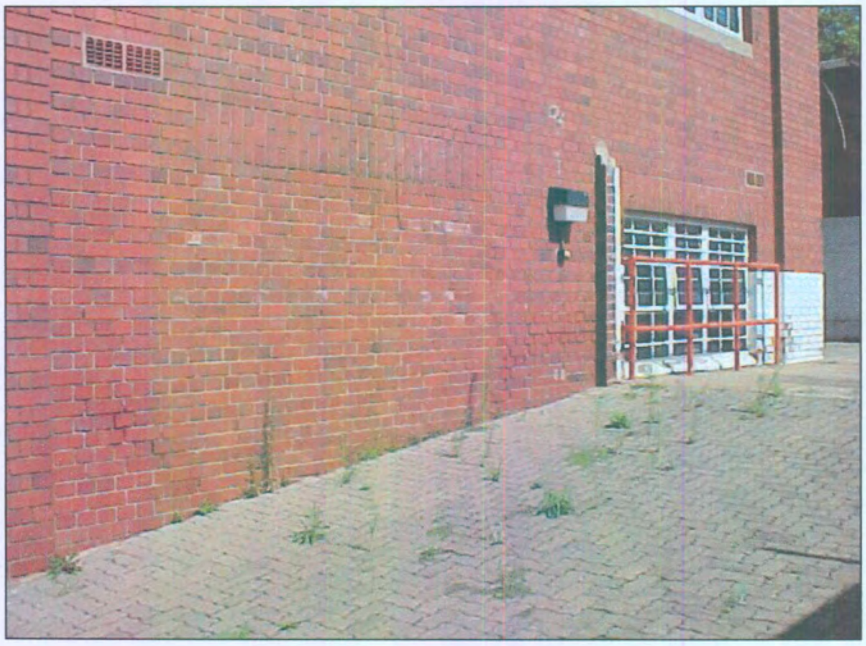


Figure 24: Blocked window opening (Source: Photo by author)

6.17 Conclusion

The above-mentioned aspects of rehabilitation and restoration methods cover a broader area of challenges that are likely to surface during a thorough inspection of the site. The Pretoria State Garage was built in different phases, from the interwar period to present. Though most building extensions were built to match the existing structures, the rehabilitation process will require variation of restoration techniques to appropriately respond to different building skills, age and materials qualities.

Common to all structures on site is the exterior brickwork, which unifies the exterior image of the courtyard and requires consistent restoration. The brickwork offers valuable knowledge on the skills and the materials used during its development phases but no specific architectural significance. This will enhance the image and the industrial past of the site in comparison with the monumental character of most buildings in the southwest quadrant of Pretoria.

In addition, a general inspection of the site indicates that there are no building elements that should be recorded as elements of architectural significance. The buildings can be classified as structurally and historically significant. Most buildings are structurally sound because they were heavily or over built to accommodate heavy equipment, especially the workshops. The historical significance is warranted by the general history of the site throughout time. Thus the site is rehabilitated on the basis of obsolesce and redundancy, offering an absolute utilitarian space with a strong industrial manufacturing background.

7. DESCRIPTION OF BUILDING BLOCKS AND THE FITTING PROCESS

This section describes building blocks that remain after the implementation of the proposed demolition list in section 5.3.1 and compares their spatial qualities to the proposed surfaces of section 3.4.1. During the fitting process it is possible that the already proposed surfaces be modified and the existing forms of the State Garage be physically altered. Following are the remaining major building blocks (figure 25 and 37):

- Building E is a single storey building that is presently used for parking.
- Buildings C and D accommodate administration offices and storerooms while their respective ground floors provide a unified parking area.
- Buildings K and L house the workshop and storeroom.
- Building B is a three-storey building currently serving as a storeroom.

An important aspect of building rehabilitation is the assessment of the long-term resilience of old buildings. This refers to a system used to define values of existing buildings (including sites) designated for rehabilitation using the following three basic elements (Jenkin and Worthington, 1997:91):

1. The building volume, particularly in sectional height and potential risers between floors, capable of providing adequate space for service installations.
2. Simple plan forms with minimum of columns that can accommodate integrated organisational demands.
3. The separation of building components into clearly definable parts.

As a result Table 3 shows descriptions of spatial qualities and surface areas of the State Garage buildings worth retaining while Table 4 compares those surface areas to the accommodation schedule of the Pretoria Technology Park, which is necessary for the fit process. Description of individual buildings is completed by the list of building elements proposed for demolition and proposed new insertions and uses.

Figure 25: Building Blocks to be retained (source: Tshwane Municipality)

7.1 Block E

Figure 26: Block E (adjacent to the south are F and F2) (Source: Photo by author)

Block E is a single story structure located southeast of the site (figure 25 and 26). The structure comprises of physically sound red face-brick walls and leaking multiple corrugated iron pitched roofs. It still retains its original function as a garage, providing parking to VIP vehicles. The floor is covered with concrete interlocking blocks. The roof structure is supported on rotten wooden trusses, iron girders and concrete beams and marked by a series of roof lights and ventilators. The height of the internal volume spanned by the trusses is approximately 3m.

The floor is covered with concrete interlocking blocks. Repeated corrugated iron pitched roofs are marked by a series of roof lights and ventilators cover the three units. The roof structure is supported on wooden trusses, iron girders and concrete beams. The height of the internal volume spanned by the trusses is approximately 3m.

It was developed in three phases increasing its surface area from 1925m² to approximately 6249m² (drawing C and D):

- Unit E1 belongs to the first phase covering an area of 1925m² (25m x 77m). It has a deep depth, long west elevation and short north and south elevations (figure 27).
- Unit E2 developed in two parts: west and north wings covering an area of 1848m² (24m x 77m) and 976m² (16m x 61m) respectively. The long north elevation of this unit is located close to the elevation of unit D3 creating closed passage.

- Unit E3 covers an area of $1500m^2$ (50m x 30m). The horizontal space of this structure is only defined by rows of steel tubular columns.

All of the later additions are attached to the original structure (E1). These units together form a large internal space divided by rows of steel tubular columns (7.6m east-west x 15.2m north-south column bays). The interior space is defined horizontally by:

- Rows of tubular steel columns to the east.
- Blind structural walls to the south, west and north sides of unit E1.
- Structural wall to the north of unit E2 comprising of windows and buttresses. On the exterior the walls are defined by row of windows trimmed by plastered lintels and quarry tile sills.

Figure 27: North and east interior elevations of block E (Source: Photo by author)

Figure 28: West elevation of block E1 (Source: Photo by author)

Demolitions

The main elements designated for demolitions are the rusty and leaking corrugated irons, rusting steel columns and physically unified spaces and roofs, which limit daylight penetration, ventilation and ease (figure 27 and 28). The south, north and west external masonry walls may be retained and repaired. These walls are physically sound with long frontage and provide enough flexibility and structural support for future use. The remaining walls have long frontage and provide enough flexibility for conversion of the remaining interior space into smaller units for events of cultural and socio-economical significance.

New uses and insertions

This building block provides adequate space to be transformed into a centre for socio-economic activities (information centre, pavilions and banks/ATM, cafeteria/restaurant, amphitheatre and amenities) (figure 37) and underground parking for approximately 250 vehicles. It provides a grid of 12m (east-west alignment) by 15m (south-north alignment). The process of new insertions and replacement should be in accordance with contemporary architectural design practices. The following activities are proposed as new insertions:

- Socio-economic activities such as cafeteria/restaurant, four to five pavilions (10-20 m^2), reception, amphitheatre for 100 to 150 people, ATM/banks and amenities that require 410 m^2. These activities are aimed at attracting ordinary people to come to the park and give the park a social character, and while at the same time bringing income into the park. The rest of the area could be landscaped to enhance the image of the park.
- The remaining area (5839 m^2) of block E will be landscaped to form part of the pedestrian area (see Table 3).

7.2 Blocks B, C and D

Blocks B, C and D are physically sound three-storey rectangular buildings located along the boundary line looking towards Visagie Street. Both blocks C and D were extended southward with single-storey industrial buildings-type structures covered with south facing saw-tooth corrugated iron roofs. The three-storey sections of blocks B, C and D have floor-to-ceiling heights of about four metres offering adequate space for pleasant office environment and required mechanical and electrical installations. These blocks contain load-bearing walls and are subdivided internally by a network of concrete, brick and steel columns (figure 31). Window planning offers a consistent pattern of window mullions for easy space office planning (figure 29). Their first and second floors are currently used for storage and administrative purposes while their extended ground floors house workshops and provide parking for state vehicles.

Blocks C and D comprise of buildings C1, C2, C3, D1, D2 and D3 respectively (figure 36). The 1st and 2nd floors of buildings C1 and D1 currently accommodate administration offices and storerooms. They are rectangular industrial administration three storey buildings. They have pitched corrugated iron roofs. Buildings C2, C3, D2 and D3 are designed as extensions of C1 and D1 respectively and form unified parking areas (figure 30). These are typical industrial rectangular, single storey buildings covered with south facing saw-tooth corrugated iron roofs containing translucent windows (figure 30 and 31).

Figure 29: North elevation of blocks C and B (showing entrances on Visagie Street) (Source: Photo by author)

Figure 30: Southeast corner of block D (Source: Photo by author)

All building blocks consist of load bearing walls and internal column network. Blocks C1, D1, D2, D3, C2 and C3 consist of concrete columns, steel columns, and masonry columns respectively.

The internal area of (drawing A and B):

- Ground floor of D1 measures 68m long by 11,5m wide with internal height of 3,9m.
- Ground floor of C1 measures 43m long by 11,5m wide with internal height of 3,9m.
- D2 measures 68m long by 20m wide with internal height of 4m.
- D3 measures 68m long by 17m wide with internal height of 5,5m.
- C2 measures 43m long by 20m wide with internal height of 4,4m.
- C3 measures 43m long by 17m wide with internal height of 4,4m.

Internal spaces of D1 and C1 are divided by column bays, which minimise the optimum planning of the interior. If the new design language proposes maintaining existing structural framework, it will then be necessary for new partitions for private spaces or support areas to be aligned with interior columns and perimeter pilasters within the walls (Rayfield, 1994:100). Floor-to-ceiling heights offer enough space for mechanical and electrical installation, and adequate height for pleasant office environment. Window planning offers a consistent pattern of window mullions for easy space office planning.

The first and second floors of unit D1 are currently used as administration offices for the State Garage, while the ground floors of C1 and D1 including units D2, D3, C2 and C3 are currently used as workshops and parking for state vehicles. The first and second floors of C1 are currently under-used and provide small-subdivided units suitable for office space.

Figure 31: Unified interiors of D1, D2 and D3 (Source: Photo by author)

Demolitions

Major alterations required in blocks B, C and D are the replacement of the leaking corrugated roof structure and re-designing of the interior, which will incorporate horizontal and vertical circulations.

Renovation, replacement and demolition of some of the interior walls and erection of new partitions should be in accordance with modern office planning and design. Maximum exploitation of light already penetrating the buildings should be encouraged during demolition so as to avoid excessive use of artificial lighting and electrical systems.

New uses and insertions

The major alterations that are required in block C1 and D2 are the re-designing of the interior: horizontal and vertical communication and partitioning. Blocks C and D require the replacement of the roof structure and partitioning for new activities to be housed inside. Maximum exploitation of light already penetrating the buildings should be encouraged. The interior spaces provide the following (see plans):

- Second floor of D1 offers an area of approximately 780m² that can accommodate the *Centre for Innovation Financing*, which requires a minimum space of 600m². This centre could be accommodated in an open plan office space and closed office space for the manager. The remaining 180m² offer adequate space for an exhibition hall (100m²), future expansions, restrooms, services and circulation.

- Second floor of C1 offers an area of 490m² that is suitable for accommodating the *Technology Park Library*. This is a functional library of the park that stores material related to the park, which park visitors can utilise.

- First floors of C1 and D1 offer a total area of 1270m² that is suitable to accommodate offices of the *Centre for Technology Transfer,* which requires approximately 900m². Two lecture rooms can occupy the remaining space, each occupying an area of 100m² installed with audio-visual equipment. The remaining space could accommodate circulation, services and restrooms.

All ground and first floors of C1 and D1 occupy a total of 2540m² for new uses.

- Both ground floors of blocks C and D offer a total internal area of approximately 5383m² (plan). This is 3383m² more than requested for maximum occupancy space for an incubator, which could be reserved for future expansions. Addition of new partition walls in accordance to the window mullions patterns provides the incubator with adequate depth for units ranging from 90m² to
- 200m². Most of the units will align along the perimeter wall, including office for the manager of the incubator, cafeteria, reception and amenities.

- *Atrium.* Open central space is required to provide daylight penetration, ventilation and ease of access to new subdivisions. Both buildings C2 and D2 are centrally located such that they are suitable for the insertion of an atrium.

- *Window pattern.* New wall openings will be introduced to provide required illumination from the building exterior.

- *Columns and roof structures.* The new structural framework should consolidate the remaining perimeter wall and carry new loads. The existing steel structure is in good condition and can be modified to support the new floor and roof structures.

There should be a clear distinction between the old and the new insertion. Such distinctions are manifest within the context of the existing structures. The free plan principle should be incorporated in the design to provide flexibility for moving partitions, fluidity from space to space and the introduction of the essence of time in space.

Access was constantly denied and drawings not available of block B. The building was previously owned by the Trigonometrical Survey Department (figure 32). It is a three-storey building in physically sound condition. It is expected to have the same architectural qualities (volumes, plan and construction material) as the three storey buildings of D and C. The building was previously used for administrative purposes and if repartitioned could accommodate the Pretoria Technology Park Museum. This museum will display information relating to the history of the Pretoria State Garage and its effects to the neighbouring sites. The total surface area of this block is not known but estimated to 1500m², which could be used entirely for the park museum.

Figure 32: North elevation of block B (Source: Photo by author)

7.3 Blocks K and L

Blocks K and L were built to resemble each other (figure 37). They each have 41m east facing frontages with depth of 43.7m. The east facing portions are single double-volume storey buildings consisting of load bearing perimeter walls and a row of columns supporting pitched corrugated iron roof. Flanked buildings J and I obscure their elevation to the central courtyard (figure 15 and 37). Blocks K and L are currently used as warehouses and workshops for heavy vehicles. The double volume portion of block K (K2 and K3) has an internal height of about 6.5 metres (figure 35) while block L (L2 and L3) has 8.6 metres allowing easement for additional mezzanine floor. These blocks were each extended westward with two-storey west-facing buildings (K1 and L1), located six meters from the west boundary wall. Each block has a west facing 40m frontages with depth of 20m. They are covered by flat concrete slab roof. Each block offers an internal space of approximately 800m² on each floor with internal height of four meters on ground floor and three meters on first floor. A bridge links the two top floors (figure 33), while K1 has an elevated tower on the northeast corner. These units fell into complete disuse.

These structures formerly housed heavy machinery reflected by their strong structural qualities (Joubert, Owens, Van Niekerk & Partners: Architects, 1973:9). Their structure consists of load bearing perimeter walls and an internal network of concrete columns. They each contain a floor-to-ceiling height of about four meters and are covered by flat concrete slab roof. A bridge links their two top floors. These units fell into complete disuse. These blocks used to house the SABS laboratories and could be easily converted (from their current function-workshops) to accommodate similar activities.

Figure 33: Blocks K and L (Source: Photo by author)

Demolition

The main elements designated for demolitions are:

- The roof sheeting of units L2, L3, K2 and K3, which require replacement.
- Present partitioning walls in all units, especially L1 and K1. These units are designated to house laboratories for advanced technologies and accommodation for tenant companies.

New uses and insertions

Blocks K and L provide adequate space to accommodate the technology building and tenant companies. The roof height in these units allows an easement for additional mezzanine floor. K2 and K3 have floor-to-ceiling height of about 6.5m while L2 and L3 have approximately 8.6m. Units K1 and L1 are capable of accommodating laboratories for advanced technologies. Each floor in every unit covers an approximate area of 800m². Each laboratory requires approximately 400m² and tenant companies occupy areas ranging from 80m² to 300m².

Unit K2, K3 and ground floor of K1 are capable of accommodating the technology building as follows:

- Systems and automation services (400m²) in the west end of K2.
- Telecommunication services (400m²) in the east end of K2.
- Multimedia services (400m²) in the west end of K3.
- Quality analysis and certification services (400m²) in the east end of K3.
- Business services (400 m²) in the south end of the ground floor of K1.
- Ancillary spaces: amenities (60 m²), library (100 m²), reception (20 m²) and approximately 400 m² reserved for common areas and circulation to occupy the remaining spaces in K2, K3 and ground floor of K1.

Business services on the ground floor of K1 will be connected to the rest of the laboratories in K2 and K3 through doors that already exist between the areas. The total surface area required for the technology building amounts to 2580 m², 400 m² (reserved for circulation and common areas) more as compared to the initial 2180m² in section 3.4.1.

Figure 34: West elevations of K1 and L1 (Source: Photo by author)

The first floor of K1 (remaining) and block L (Units L1, L2 and L3) offer a total of 4190m² for accommodation of tenant companies.

- First floor of K1 (800m²)
- Ground and first floors of L1 (800m² each)
- L2 and L3 (895m² each)

The first floor of K1 is linked to block L by an existing bridge (figure 31). The double volumes of L2 and L3 have approximately 8.6m heights that can be easily accommodate mezzanine floors during expansion of tenant companies. The total area for accommodation of tenant companies is 2190m² more than the initial 2000m² requested in section 3.4.1. If these spaces are not entirely occupied they could be reserved for future expansion of the park though unused they might affect negatively on the image of the park.

7.4 Landscape and image

The demolition process of unwanted buildings in section 5.3.1 and the conversion of a substantial surface area (5839m²) of Block E to landscape (see Table 4) provide pedestrian activities with additional spaces. The overall site density was also reduced from an estimated 80% coverage to approximately 57% leaving about 43% for landscaping. It is therefore an opportunity to implement guidelines recommended by Pinder (1990:1) for pedestrian surfaces: *practicalities*, *direction*, *repose*, *hazard*, *scale*, *use* and *character*.

Figure 35: Interior of blocks K2 and K3 (Source: Photo by author)

Building Block	Area in m²	Total Area in m²	Height in meters (m)	Construction	Building configuration
Block B				Brick and concrete	Long and narrow with shallow depth
Ground floor	500		4.4		
1st floor	500		3.9		
2nd floor	500		3.9		
Total area		1500			
Blocks C and D				Brick, wood and concrete	Long and narrow with shallow depth
1st floors of D	780		3.9		
2nd floors of D	780		3.9		
1st floors of C	490		3.9		
2nd floors of C	490		3.9		
Total area		2540			
D- ground floor (combined)	3298		4.4	Brick, concrete and steel	Unified long and narrow bays with deep depth
C- ground floor (combined)	2085		4.4		
Total area		5383			
Block K and L				Brick, concrete and steel	Double volume Unified long and wide bays with deep depth
L (west) ground & 1st floors	800x2		4		
K (west) ground & 1st floors	800x2		4		
L (double volume)	895X2		8.6		
K (double volume)	895X2		6.5		
Total area		6780			
Block E				Brick, wood and steel	Unified long, medium and narrow bays with deep and medium depth
E (1st Phase)	1925		3		
E (2nd phase: 1848 + 976)	2824		3		
E (3rd phase)	1500		3		
Total area		6249			
Total area (all buildings)		**22452**			

Table 3: Descriptions of spatial qualities of the Pretoria State Garage buildings worth retaining

Rehabilitated buildings			New use		
	Area in m²	Total Area per centre	Centre	Technology Park: Total area	Total area per rehabilitated building
Blocks C1 and D1					
1st floors of D1	780				
2nd floors of D1	780				
1st floors of C1	490				
2nd floors of C1	490				
Total area		2540	**Management centre**	2540	2540
Block K and L			**Technology building**	2590	
L1- ground & 1st floors	800x2		**Accommodation for tenant companies**	4190	
K1- ground & 1st floors	800x2				
L2 (double volume)	895				
L3 (double volume)	895				
K2 (double volume)	895				
K3 (double volume)	895				
Total area		6780			6780
Blocks C and D			**Incubator**	5383	
D- ground floor (entire)	3298				
C- ground floor (entire)	2085				
Total area		5383			5383
Block E			**Socio-economic activities**	410	
E1	1925		**Converted to landscape**	5839	5839
E2 (1848 + 976)	2824				
E3	1500				
Total area		6249			410
Block B			**Museum**		
500x3		1500		1500	1500
Total area (final)		**22452**		**22452**	**22452**

Table 4: Comparison of surface areas for fit process of the Pretoria Technology Park

7.5 Operational program of the Pretoria Technology Park

The following operational program provides a framework for the implementation of proposed action plans and identifies possible funding organisations such as the University Pretoria, the CSIR and the Department of Trade and Industry (and partnership programs) as partners in setting-up the park. The park should form a company [Management Company of the Pretoria Technology Park (MCPTP)] that will manage the park and liaison with interested organisations and stakeholders. Refer to section 3.3 for description of services offered by the following centres.

1. MANAGEMENT CENTRE

1. Technology Transfer Unit

Service	**Industrial Liaison Office**
Proposing authority:	DTI, University of Pretoria and CSIR
Financing authority:	DTI
Implementing authority:	MCPTP
Operating authority:	MCPTP

Service	**Observatory and Information Office**
Proposing authority:	DTI, University of Pretoria and CSIR
Financing authority:	DTI, University of Pretoria and CSIR
Implementing authority:	MCPTP
Operating authority:	MCPTP

Service	**Career Advisory Office**
Proposing authority:	University of Pretoria
Financing authority:	CSIR, University of Pretoria and Department of Education
Implementing authority:	MCPTP
Operating authority:	MCPTP

2. Innovation Financing Unit

Service	**Seed Capital Office**
Proposing authority:	MCPTP and DTI
Financing authority:	DTI and partnership program
Implementing authority:	MCPTP

Operating authority:	MCPTP

Service	**Venture Capital Office**
Proposing authority:	MCPTP and DTI
Financing authority:	DTI and partnership program
Implementing authority:	MCPTP
Operating authority:	MCPTP

2. TECHNOLOGY BUILDING

Service	**Business Services**
Proposing authority:	MCPTP and DTI
Financing authority:	DTI
Implementing authority:	DTI and MCPTP
Operating authority:	MCPTP

Service	**Multimedia services**
Proposing authority:	University of Pretoria, MCPTP and DTI
Financing authority:	DTI
Implementing authority:	DTI and MCPTP
Operating authority:	MCPTP

Service	**Telecommunication Services**
Proposing authority:	CSIR, University of Pretoria and MCPTP
Financing authority:	Department of Telecommunications
Implementing authority:	MCPTP and University of Pretoria
Operating authority:	MCPTP

Service	**System and Automation Services**
Proposing authority:	CSIR, University of Pretoria and MCPTP
Financing authority:	DTI
Implementing authority:	MCPTP, CSIR and University of Pretoria
Operating authority:	MCPTP

Service	**Quality Analysis and Certification Services**
Proposing authority:	CSIR, University of Pretoria and MCPTP

Financing authority:	DTI
Implementing authority:	MCPTP, CSIR and University of Pretoria
Operating authority:	MCPTP

3. INCUBATOR

Service	**Incubator**
Proposing authority:	MCPTP and DTI
Financing authority:	DTI
Implementing authority:	MCPTP
Operating authority:	MCPTP

Service	**Accommodation for Technology-Based Companies**
Proposing authority:	MCPTP and DTI
Financing authority:	DTI
Implementing authority:	MCPTP
Operating authority:	MCPTP

4. MUSEUM

Service	**Museum**
Proposing authority:	MCPTP
Financing authority:	Department of Arts, Culture, Science and Technology
Implementing authority:	MCPTP
Operating authority:	MCPTP

5. CENTRE FOR SOCIO-ECONOMIC ACTIVITIES

Service	**Centre for Socio-Economic Activities**
Proposing authority:	MCPTP
Financing authority:	MCPTP
Implementing authority:	MCPTP
Operating authority:	MCPTP

8. GENERAL CONCLUSION

The site contains about 22452m² surface area in structurally sound and historically significant obsolete and redundant buildings. The good condition of construction materials, easy to convert configurations and ample surface areas provide the rehabilitation with significant raw materials and economic advantages. A rehabilitation assessment carried out on the Pretoria State Garage confirms the fitting capacity and compatibility between the designated new user and the existing property. The discovery, theoretically, elongates the life circle of this industrial site, which possesses both the historical and structural significance and promotes the relevance of research to local manufacturing industries.

The amount and nature of material fabric that the State Garage is able to retain and rehabilitate hope to inspire those in urban conservation and promote sustainable development as opposed to total demolition. Thus, the rehabilitation of the Pretoria State Garage and the incorporation of the Pretoria Technology Park will positively contribute towards eradicating sense of abandonment and general dilapidation and produce an image that inspires the idea of a safe environment in the southwest quadrant.

The rehabilitation assessment revealed the long-term resilience of the State Garage buildings and their capability of house high technology facilities of the Pretoria Technology Park. This is consequently hoped to revive, innovate and restore the traditional manufacturing character of the site and the southwest quadrant of Pretoria Central. This intervention also retains some of the site's significant current activities such as administration in blocks D and C, and research in K and L.

This assessment provides guidelines for the documentation and systematisation of significant buildings and approach to the restoration of building components. Guidelines to conduct an in-depth analysis and maintenance of historic material are available from a wide range of sources including "*Guide to recording historic buildings*" by ICOMOS (1990). The restoration of the exterior brickwork and other integral building components will contribute towards enhancing the historic role played by building materials in these old industrial buildings. This initiative stimulates creative architectural design and the debate on the mutual existence between the old and the new. The outcome of this assessment may warrant future employment on sites of similar nature such as Marabastad and Pretoria West (already discussed in the study) and systematisation for public use and education.

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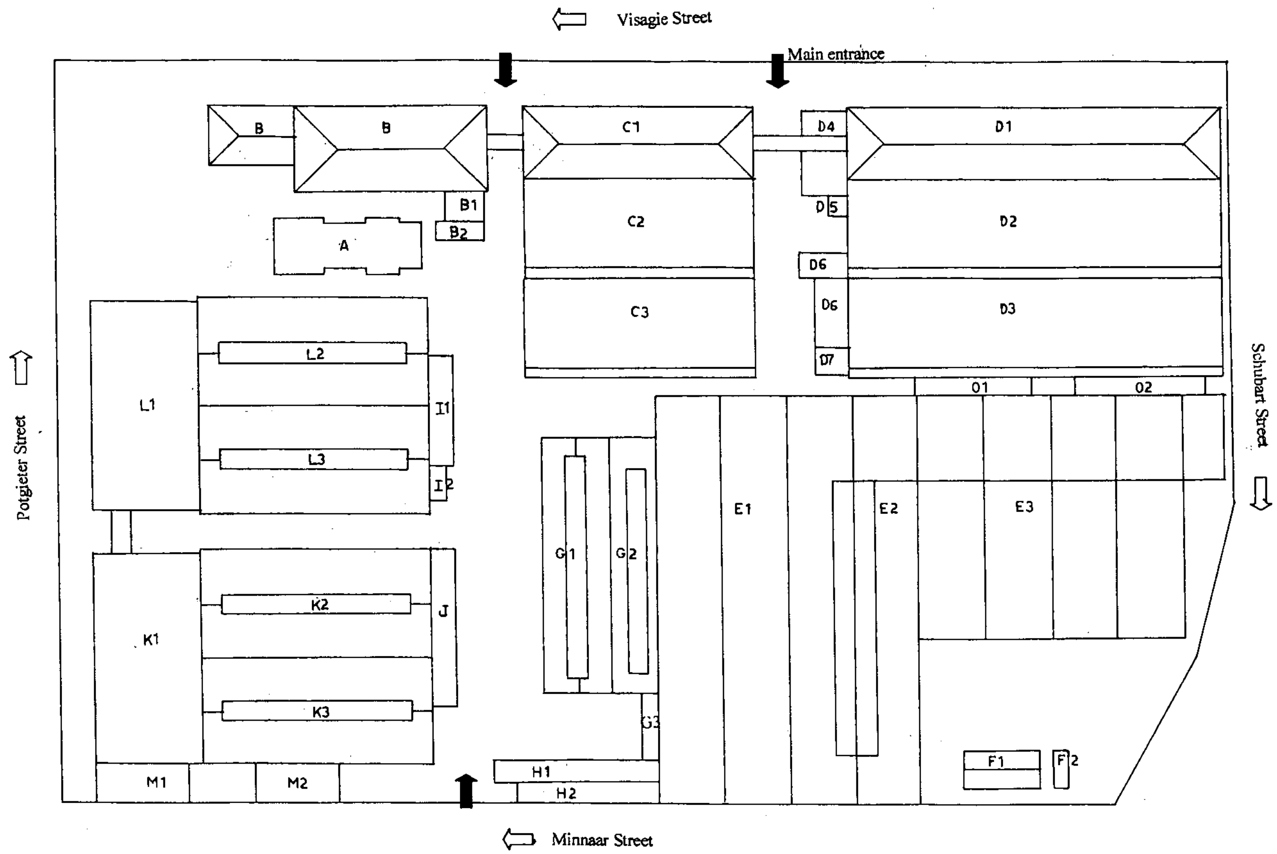


Figure 36: Existing Pretoria State Garage Buildings

1:1000

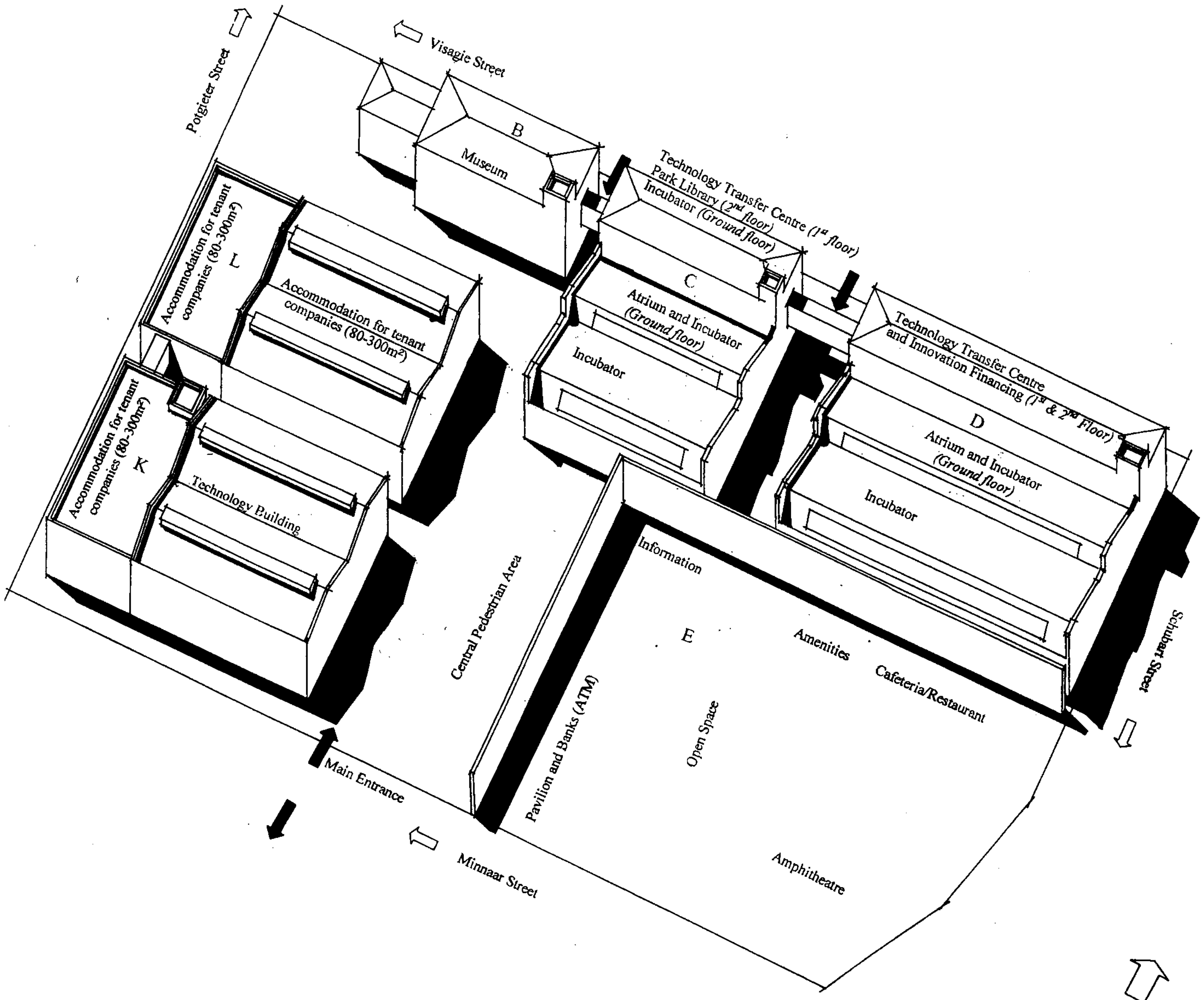


Figure 37: Proposed new activities and centres of the Pretoria Technology Park

1:1000

HISTORIC DRAWINGS

The following is a list of drawings of the State Garage buildings that are available from the archives of the Department of Architecture, University of Pretoria:

- Building A: plan and elevations
- Trigonometrical Survey Department building (B): None
- Administration Building (C): plan
- Administration Building (D): plans, elevations and sections
- Parking Shed (E): plans, sections and elevations
- Workshops and Storerooms (K and L): None
- Parking area (south of the State Garage): site plan
- Building:
- Window schedule
- Finishes schedule

Only two sets of drawings of the Administration Building (D) and the Parking Shed (E) are attached in this document for further analysis for section 7.

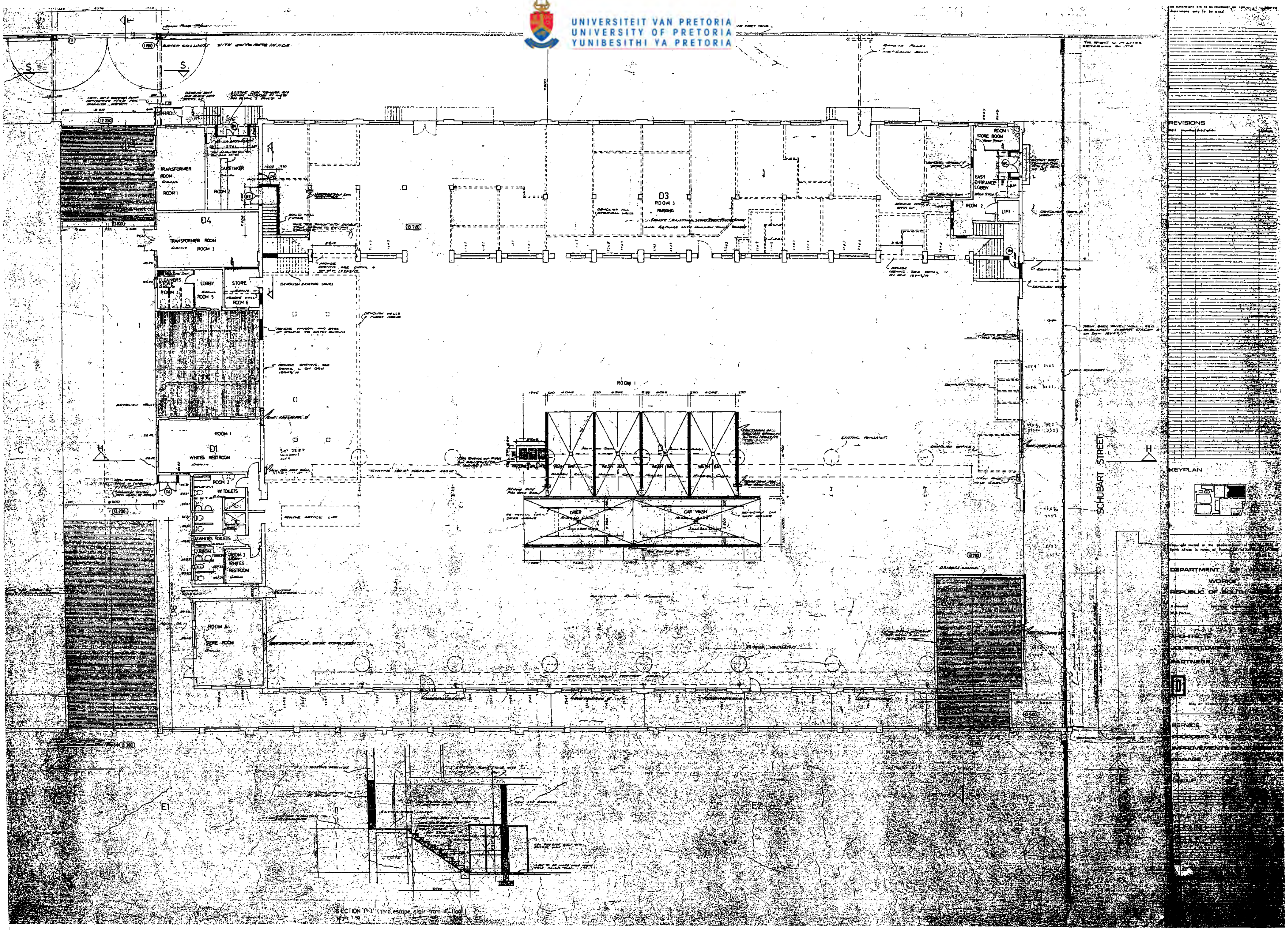
<u>List of drawings</u>

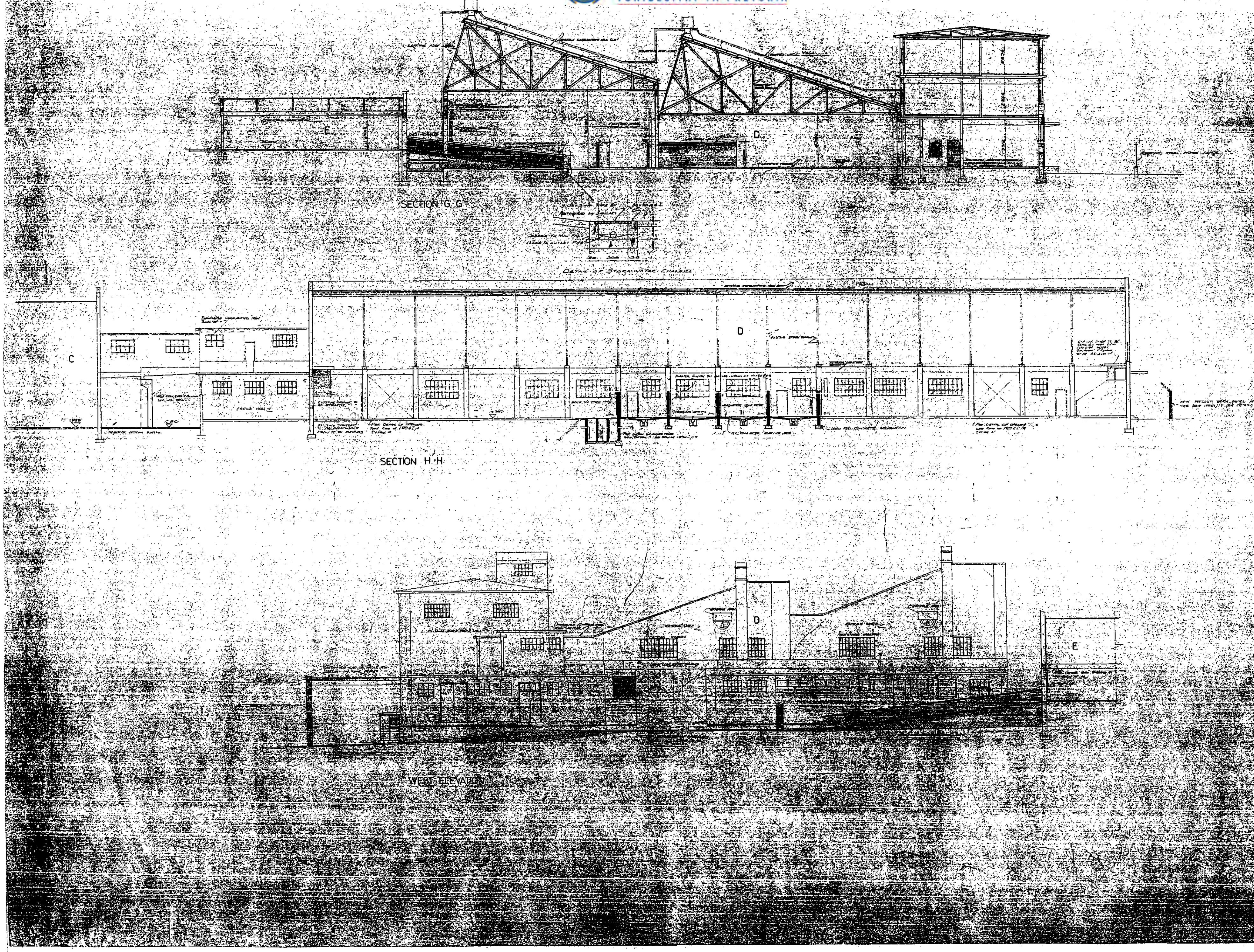
Administration Building (D):

- **Drawing A**: Ground floor plan
- **Drawing B**: North-South and East-West sections and West elevation

Parking shed (E):

- **Drawing C**: Ground floor plan
- **Drawing D**: South, east and north elevations


TRANSFORMER ROOM
ROOM 1
CARETAKER
ROOM 2
D4
TRANSFORMER ROOM
ROOM 3
CLEANERS STORE
LOBBY
ROOM 5
STORE
ROOM 6
D3
ROOM 3
PARKING
STORE ROOM
ROOM 1
EAST ENTRANCE LOBBY
ROOM 2
LIFT
ROOM 1
D1
WHITES RESTROOM
ROOM 2
W TOILETS
WHITES TOILETS
ROOM 3
WHITES RESTROOM
ROOM 4
STORE ROOM
WASH BAY
DRIER
CAR WASH
SCHUBART STREET
REVISIONS
KEYPLAN
DEPARTMENT
WORKS
REPUBLIC OF SOUTH
ARCHITECTS
PARTNERS
SERVICE
PROPOSED
IMPROVEMENTS
GARAGE
E1
E2
SECTION 1-1



REVISIONS

KEYPLAN

DEPARTMENT OF PUB[LIC] WORKS
REPUBLIC OF SOUTH AFRI[CA]

ARCHITECTS
JOUBERT, OWENS, VAN NIEKE[RK]
& PARTNERS

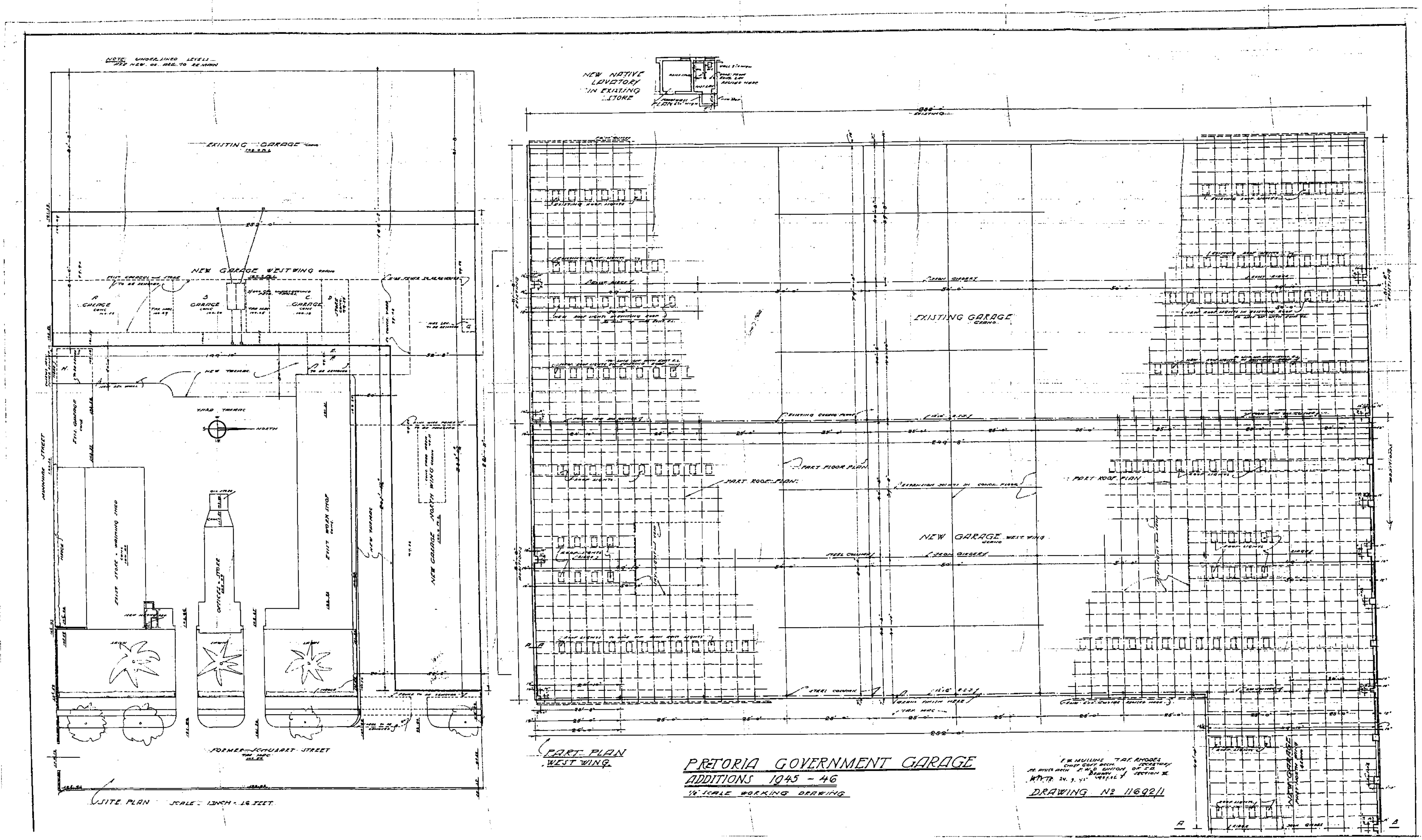
SERVICE
PROPOSED ALTERATIONS A[ND]
IMPROVEMENTS GOVERNME[NT]
GARAGE PRETO[RIA]

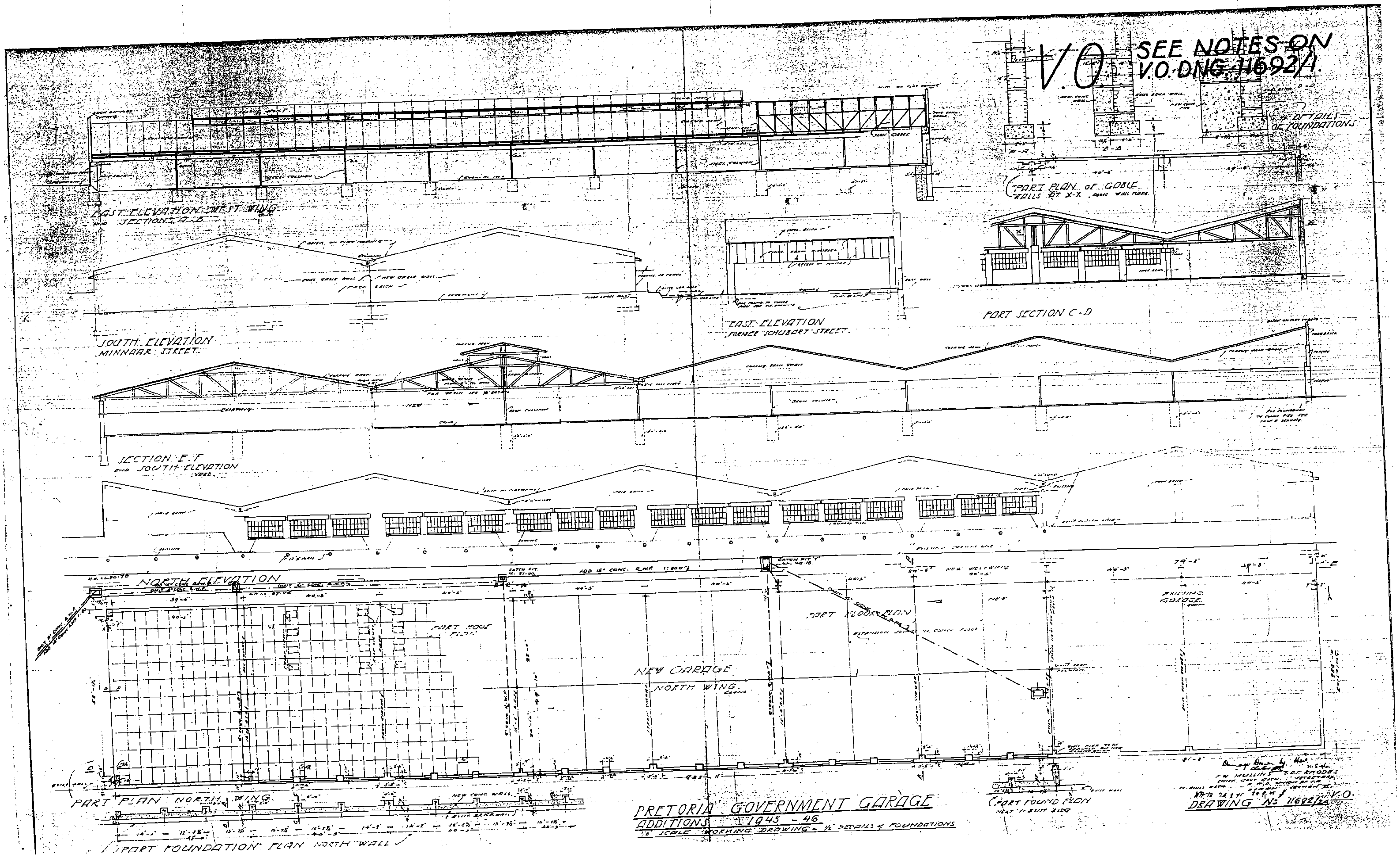
GROUP

TITLE
SECTIONS & ELEVATION[S]
BLOCK D

1:100 MRT 1977

18942/317/10/55


NEW NATIVE LAVATORY IN EXISTING STORE
EXISTING GARAGE
NEW GARAGE WEST WING
NEW GARAGE NORTH WING
EXISTING GARAGE
NEW GARAGE WEST WING
PART ROOF PLAN
PART FLOOR PLAN
FORMER SCHUBART STREET
MINNAAR STREET
NORTH
SITE PLAN SCALE: 1 INCH = 16 FEET
PART PLAN WEST WING
PRETORIA GOVERNMENT GARAGE
ADDITIONS 1945 - 46
1/8" SCALE WORKING DRAWING
DRAWING No 11692/1


V.O.
SEE NOTES ON V.O. DNG. 11692/1.
DETAILS OF FOUNDATIONS
PART PLAN OF GABLE
EAST ELEVATION WEST WING
AND SECTION A-B
SOUTH ELEVATION
MINNAAR STREET
EAST ELEVATION
FORMER SCHUBART STREET
PART SECTION C-D
SECTION E-F
AND SOUTH ELEVATION
NORTH ELEVATION
PART FLOOR PLAN
PART ROOF PLAN
NEW GARAGE
NORTH WING
EXISTING GARAGE
PART PLAN NORTH WING
PART FOUNDATION PLAN NORTH WALL
PART FOUND PLAN
PRETORIA GOVERNMENT GARAGE
ADDITIONS 1945 - 46
DRAWING No 11692/2A V.O.