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Transportek Foresight Study :

Final report March, 2004

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<p>Abstract:</p> <p>CSIR Transportek decided to undertake a business and technology foresight study in order to enhance its decision making process for the investment of its Parliamentary Grant funding. The study was divided into four phases comprising the following:</p> <ul style="list-style-type: none"> • A desk study of international trends reported by Venter (Aug 2002); • An internal workshop to develop scenarios, identify future trends and challenges and provide a vision of the industry in 10 years time in terms of structure, funding mechanisms, capacity and technology needs; • An external stakeholder workshop to test the validity of the outcomes of the internal workshop; and • Analysis, offering portfolio definition and testing of the robustness of the portfolio. <p>Five scenarios were developed using the inputs from the desktop study as well as the internal and external workshop. Transportek's current offering portfolio was reviewed and shortcomings identified. The portfolio was evaluated for robustness against the set of scenarios and recommendations made.</p>				
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1 INTRODUCTION

During its strategy session of October 2001, CSIR Transportek decided to embark on a technology and business foresight process for the transport sector, over a five to ten year time horizon, in order to enhance its decision-making process for the investment of parliamentary grant funding. The recent foresight study conducted by the Department of Arts, Culture, Science and Technology¹ did not cover the Transport sector, mainly due to the fact that at the time the Department of Transport was conducting the “Moving South Africa” (MSA)² strategic planning project. Although the MSA project was taken into consideration in this foresight study, the purposes of this study were to determine broad technology trends over the next 5 to 10 years and to provide an important input into the Transportek investment decision process.

Transportek has, over a number of years, developed a systemic approach to the management of Parliamentary Grant investment as well as technology management in general. The approach has been quite successful, but has been lacking the input of a structured foresight study. This process is depicted in Figures 1 and 2.

As can be seen from these diagrams, the process comprises the following:

- The usual business development processes such as networking, participation in committees (local and international), participation in conferences, Transportek advisory committees, forums (eg: Road Pavements Forum), activities of SU fellows, anticipating current market trends and identification of customer needs.
- The combination of the information gathered from the above process with inputs from other processes such as an international peer review, inputs from strategic partners and allies and processes such as a foresight study.
- The market intelligence, along with other inputs such as the general CSIR strategy, and overall Government Policies (eg new R&D policy) are then used as inputs into Transportek’s strategic planning process that forms the kernel of the general business planning process.

¹ **Dawn of the African Century**. 1999. Pretoria: Department of Arts Culture Science and technology. (National Research and Technology Foresight Project).

² **Towards a Transport Strategy for 2020**. 1998. Pretoria: Department of Transport. (Draft Report and Strategic Recommendations).



Figure 1: CSIR, Transportek Strategic Planning Process

- One of the major activities in the strategic planning process is to produce a technology development plan based on the strategic positioning of Transportek. This plan consists of

the definition of technology thrusts, associated offerings and markets, as well as planned investment in each area.

- The thrust investment decision is made, based on a set of investment criteria and an evaluation of the potential of each technology thrust through an interactive planning process involving programme managers and thrust managers.

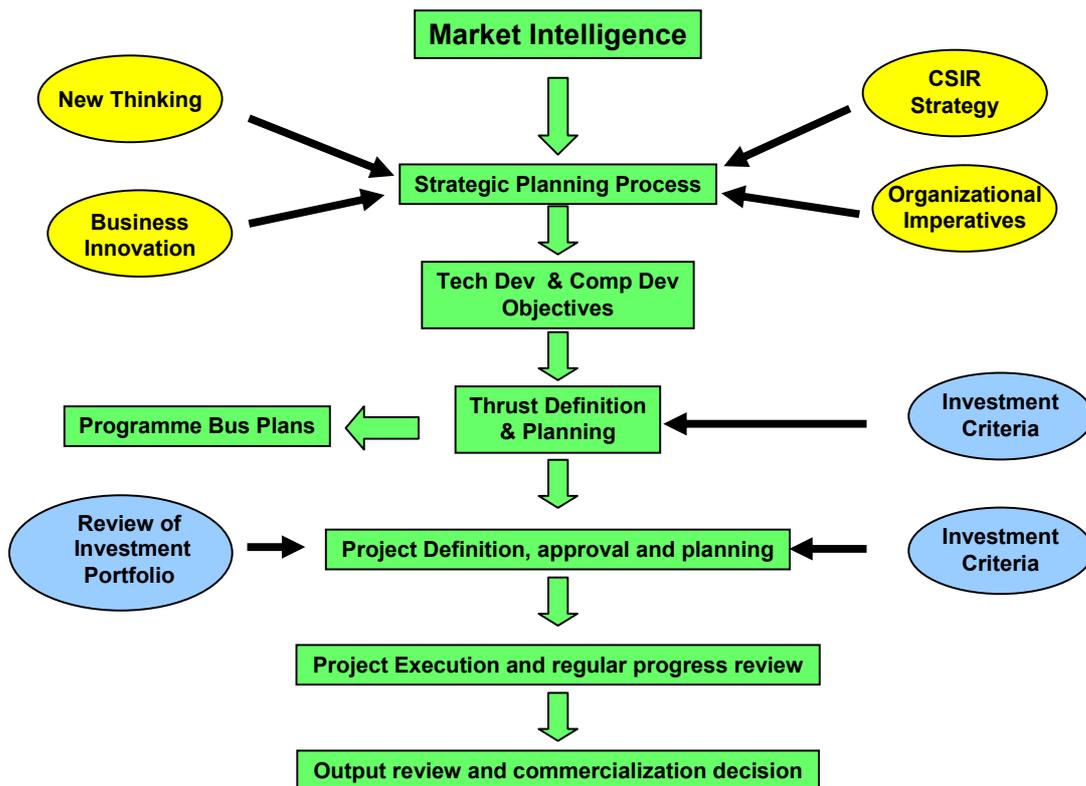


Figure 2: CSIR Transportek Investment Management Process

- Programme and thrust business plans are developed describing individual projects in each thrust, their costs, outputs, contribution to the development of technology and competence platforms as well as the business potential.
- Projects are evaluated through the investment criteria process, approved, initiated and progress monitored to achieve the agreed outcome.

- Finally, the outputs of the various projects are evaluated by the Technology Management Team in terms of match with the original project proposals, quality, value to the Division and strategic importance.

As can be seen from the process, a technology foresight study is essential to ensure that the thinking does not become incestuous and that a longer term view of technology and business trends are obtained from external stakeholder interaction, rather than only depending on an internal perception of current market trends and problems.

The purpose of this document is to record the outcome of the Transportek foresight process and will be used as an input into Transportek's strategic planning and investment planning processes as well as in interactions with Transportek's Advisory Committees. The document is a compilation of the opinions of more than thirty transport experts and industry stakeholders and does not aim to identify specific technology development projects, but rather broad technological trends in key strategic focus areas.

This is a draft document for discussion within Transportek and the broader CSIR and with selected external stakeholders. These inputs will be used to modify the document over the next two years so that it will remain relevant to the strategic planning process of Transportek.

2 APPROACH AND PROCESS

The Department of Science and Technology (DST) defines technology foresight as a systematic attempt to look into the longer-term future of science, economy and society with a view to identifying emerging generic technologies likely to yield the greatest economic and/or social benefits.

In reality, the foresight process involves the definition of a set of future scenarios, the definition of a set of current and potential future technologies and finally the assessment of the relevance and potential success of this technology portfolio in each of the scenarios. The end objective is to identify a set of technologies and competences (current and future) that will be robust in their likelihood of success and will optimally position Transportek, irrespective of the future scenario that eventually occurs. The process therefore needs to examine the major drivers of change in the transport sector as well as the likely future technological trends.

A foresight study is not an attempt to accurately predict the future, but rather a strategic planning exercise that will assist in the positioning of the organisation to meet future trends and challenges within a framework of future scenarios and uncertainties.

It should also be noted that transport foresight exercises have already been conducted in other countries. While outputs may be similar in some broad aspects there are significant differences in priorities and time horizons, not only in the development or attainment of new technologies but also in the individual countries' capacity to play a role in the development of the technologies. Hence the foresight study undertaken here must in the first instance be relevant to the local (South African) situation with secondary consideration for the regional (Southern African Development Community (SADC)) and continental (Africa) implications.

In view of the past apartheid policies, South Africa is in a uniquely poor position in terms of spatial planning of cities, which in turn, has a significant impact on its transportation systems. The past ten years of democracy has seen some major changes in South Africa with specific impacts on, inter alia, the transport sector. Due to increasing political and economic pressures, the next ten to fifteen years will probably see an acceleration in change. These political influences were also

taken into consideration in the scenario planning and development of the competence and technology portfolio.

In essence therefore, the study initially examined the international transport scene, in terms of trends and drivers and then focussed back on the local transport industry.

In order to achieve the above objectives, a phased approach to the Transportek technology foresight process was followed.

Phase 1: Desk Top Study

This study focussed on literature reviews and international macro trend analysis in order to evaluate the outcome of other foresight studies in the transport sector as well as to assess macro international trends that may influence the transport sector. The trends assessed varied from social and environmental, through economical to technological trends as reported by Venter³. This work provided inputs for the internal and external stakeholder workshops conducted as part of Phase 2 of the project.

Phase 2: Internal Workshops

Four internal workshops involving only CSIR Transportek staff were held in order to develop scenarios for change in the transport sector, to determine the major drivers in these scenarios and also to identify the major trends and challenges facing the transport sector. The results of these workshops were reported in an internal report⁴.

Phase 3: External Stakeholder Workshop

An external stakeholder workshop was conducted in January 2003, including approximately 20 stakeholders from across the industry as well as a few selected CSIR Transportek staff members. The main purpose of this workshop was to obtain independent inputs from stakeholders relating to the major drivers for change in the industry as well as the major challenges facing the industry.

³ VENTER, C. 2002. International Trends and Future Challenges for the Transport Sector. Technical Report No TR-2002/25 CSIR, Transportek, Pretoria, August, 2002.

⁴ South African Transport Foresight Study : Workshop Proceedings and initial analysis. Technical report No TR-2003/24, CSIR Transportek, Pretoria, March 2003.

Phase 4: Information analysis and final reporting

The above results and outputs were analysed in order to develop a set of five typical scenarios that are shaped by the following three macro influences :

- The degree of success in progress towards social reform, including the implementation of the New Partnership for Africa's Development (NEPAD) strategy;
- The degree of success in economic growth in South Africa and technological progress in the local and international transport industry; and
- The impact of environmental reform in the local and international transport industries.

Analysis of the desk-top study, the workshop outputs as well as team discussions within Transportek resulted in the definition of a portfolio of current and likely future key competences and technologies. The portfolio of competences and technologies was then rated by a team in terms of their relevance and likelihood to succeed in each of the scenarios. These ratings were analysed in order to assess the robustness of the portfolio in each of the five scenarios.

Recommendations regarding strategic actions to be considered in Transportek's future planning processes were subsequently made.

3 KEY INFLUENCERS AND DRIVERS OF THE TRANSPORT INDUSTRY

Twelve major drivers emerged that will shape the future environment within which transport will operate. These are grouped as follows:

Political drivers: mainly the impact of government decisions on the transport industry as a whole as pertaining to the role of transport in upliftment of rural communities as well as in stimulation of the economy with emphasis on public spending on transport (particular emphasis must be placed on initiatives such as the NEPAD strategy)

Societal drivers: trends that affect the demand for transport (mostly passenger transport), as well as the perceptions and acceptability of transport's role;

Economic drivers: trends in the macro-economy (e.g. trade, growth) or the micro-economy (e.g. industrial change) that affect the demand for transport (passengers and freight), transport investment, innovation, etc.

Sustainability drivers: trends in the impacts of transport on the environment, economy, and society, and its contribution towards sustainability; and

Technological drivers: trends in the ability of the transport sector to respond to various opportunities and constraints through innovation.

The twelve specific drivers of change are as follows:

Political drivers:

1. New government policy and government funding and initiatives such as NEPAD;

Societal drivers:

2. Continued population growth and urbanisation
3. Rising conflict and security issues
4. Changes in the nature of the demand for mobility

Economic drivers:

5. Continued globalization of markets and production
6. Growing regional cooperation in Africa and SADC

7. Continuing growth of private sector involvement in governance

Sustainability drivers:

8. Growing pressures of environmental, economic, and social sustainability

Technological drivers:

9. Advances in energy

10. Advances in vehicle technology

11. Advances in transport infrastructure technology

12. Adoption of information and communications technologies

These were described in more detail by Venter⁵. Some of the important aspects are discussed below.

3.1 Government policy, funding and initiatives

It is obvious that future policy of the South African government as well as the governments of neighbouring countries will have a major impact on the future of the transportation industry in the region. In particular, policies regarding:

- The upliftment of previously disadvantaged communities;
- Rural communities;
- Job creation in transport;
- Subsidization of public transport;
- Taxes and levies, funding of infrastructure; and
- Recapitalization of the combi-taxi industry

In this regard, the uppermost initiative is the NEPAD strategy that focuses on the following major strategic issues :

- Enhanced political governance;
- Enhanced economic governance;
- Improvement of market access and hence agriculture;
- Human development;

⁵ VENTER, C. 2002. International Trends and Future Challenges for the Transport Sector. Technical Report No TR-2002/25 CSIR, Transportek, Pretoria, August, 2002.

- Infrastructure development and maintenance;
- Enhanced role of science and technology; and
- Improved environmental protection and increased tourism

The NEPAD strategy is aimed at the social and economic development of the African continent and in both aspects transport plays a significant role.

3.2 Continued population growth, especially in large urban concentrations

Continued population growth is expected to increase the pressure on resources, infrastructure, and services worldwide, especially in cities. In South Africa, the impact of HIV/AIDS on mortality rates is generally considered to be substantial. However, the effects of increased mortality on urban population levels are expected to be offset by migration from rural areas, and immigration from neighbouring states to cities, which are perceived as wealth generators. Projections indicate that, in 20 years, 75% of the South African population will be urban. The impacts of rising incomes and car ownership will result in continued growth in the demand for mobility, straining the capacity of transport systems worldwide. Associated with increases in population is of course increased traffic congestion and resultant pollution, which has particularly severe impacts in developing communities. This may have an adverse effect on mobility in many developing countries and more demands are being put on local government to effectively manage metropolitan areas that are ever-increasing in size, complexity, and diversity.

3.3 Rising conflict and security issues

In view of the current rising conflict and polarization in many locations and the recent events relating to terrorism, transport systems are seen as vulnerable to attack and sabotage. In the United States, demands are that security must become “a central goal of transportation”. One can thus expect the trade-off between free access to transport and increased security control to remain a topic of debate and government intervention in the coming years. Security, crime and violence are receiving more attention as government priorities. Crime and violence on public transport is a major issue in developing countries, and its importance in shaping policy is expected to grow.

3.4 Changes in the nature of the demand for mobility

Cities are experiencing an accelerating change in the nature of travel demand. This is being driven by two trends that are likely to continue in the next decades: changing population demographics, and the development of a post-industrial economy.

Demographic changes affecting transport demand (especially car travel) include:

- The growing proportion of elderly people in the population;
- The growing proportion of young people in the population;
- Greater access of women to cars as new drivers; and
- The growth in one-person households.

Changes in the spatial and sectoral organization of the economy include :

- Changing balance of employment and leisure;
- Changing location of employment;
- Changing mix of land uses;
- Rise in freight volumes;
- Rise in intercity passenger travel.

Although the impact of these trends on the nature of the demand for mobility is difficult to quantify, they will certainly increase the extent of demand for both passenger and freight transport and also widen the variation in travel needs and travel patterns. Demand is likely to become more diverse and more dispersed, reflecting a more diverse set of preferences and values.

3.5 Continued globalization of markets and production

Globalization is likely to continue impacting the world economy. Increasing economic interdependence is reducing the ability of national governments to regulate or govern their own economies with a consequent greater vulnerability to global slowdowns and increased unpredictability of markets. The transportation and construction industry will remain vulnerable to cycles in the economy. In the age of globalization strategic infrastructure is critical in supporting the ability to capitalize on global trade and investment. The importance of ports and airports as

nodes of international trade, and their supporting distribution networks by road and rail, is likely to grow. Innovative concepts linking freight nodes to economic development, such as dry ports, specialized nodes, and IDZs are emerging.

In addition, globalization is likely to enhance existing trends of concentration and consolidation in the transport industry, with increases in the size of operating companies through acquisition and the forming of strategic alliances. This trend, in turn leads to the appearance of larger vehicles - mainly airplanes, ships and freight trucks. This puts particular pressure on the ability of infrastructure to accommodate these vehicles.

3.6 Growing regional cooperation

Initiatives such as the New Partnership for Africa's Development (NEPAD), and the Southern African Development Community (SADC) are a result of growing regional cooperation and integration. Common markets are being sought, and harmonized standards and procedures are making it easier to integrate operations across borders. The implications for the transport sector are two-fold: firstly, opportunities arise for more efficient, economical operations moving larger volumes of people and goods; secondly, this has to be balanced with the protection of strategic national assets and infrastructure as well as with safety and security issues.

3.7 Continuing growth of private sector involvement in governance

Governments are increasingly involving the private sector in activities that were formerly exclusively conducted by government authorities through mechanisms such as concessioning, public-private partnerships, and privatization of state assets. In some government-controlled organizations such as parastatals, service delivery is often conducted on business principles, even in countries with a traditionally very strong role for government, such as China. In South Africa, the last decade saw the creation of new provinces and many new agencies involved in transport. This trend could lead to fragmentation of and lack of communication between functions related to the funding, planning, and managing of transport

The issues facing government are so critical, in fact, that the proliferation of groups and individuals involved in governance (coupled with a reduction in the public's perception of the legitimacy of

many traditional players) is seen by the Canadian foresight study as a major challenge facing OECD countries.

3.8 Growing pressures of sustainability

Sustainability is usually defined in terms of social, environmental, and economic dimensions. Although global concerns about sustainability tend to focus on environmental issues, there is a growing debate about the role of transport in relation to social and economic sustainability, particularly relating to the understanding that the world's continuing and growing demand for mobility cannot be met simply by expanding today's means of transportation.

Environmental sustainability

All modes of transport contribute 28 percent of total worldwide carbon dioxide production by humans and this is increasing. Over several decades there has been growing global pressure to mitigate the environmental costs of transport. This has led to significant improvements in technology, including cleaner-burning fuels and vehicles that are more fuel efficient. Although some projections predict an overall decrease in vehicle-related emissions in the medium term, others indicate that increases in traffic volumes will more than offset reductions in exhaust emissions.

The situation in many Third World countries continues to deteriorate in the absence of the strict measures adopted in high-income localities. Transport-related carbon dioxide emissions will surpass developed-world emissions in little more than a decade if present trends continue. It seems likely that global pressures will lead to a gradual diffusion of "clean" technologies to less developed countries, although the pace may be slow due to political and economic barriers.

Economic sustainability

Currently, many countries have to rebuild their ageing infrastructure, primarily built in the post-World War II era, but find that available funding is insufficient. The backlog in maintenance and construction is often bordering on the disastrous (as was the case with rail infrastructure in the UK) before sufficient allocations are made. This is certainly also true in South Africa. Many African countries are faced with obsolete infrastructure that needs large ongoing investment to maintain. However the ability to fund such investment is severely limited.

The limitation of funding drives a continuing need for more cost-effective practices in the design, construction, and management of infrastructure. Innovation in the use of alternative materials is also expected to accelerate.

There is a growing awareness of the need for a more holistic approach to the provision and management of infrastructure including the costing of aspects such as environmental and social impacts. This puts more emphasis on the strategic management of infrastructure for example the inclusion of alternatives to infrastructure expansion, such as demand management. In developing countries the need for job creation through labour-intensive construction continues to be an important social and political driver. More emphasis is also placed on innovative funding mechanisms such as Private Finance Initiatives (PFIs) involving partnerships between the private and public sectors.

Social sustainability

Sustainability is linked to the enhancement of healthy, vibrant communities with the ability to create sustainable livelihoods from their available resources. Disruption of communities by transport infrastructure is a significant issue in some places. In most of the developed world, fatality rates from accidents have declined steadily and most of the obvious, politically feasible safety improvements to vehicles and infrastructure have been made. In developing countries, however, deaths and injuries from transport accidents occur at substantially higher rates, and the number of deaths and injuries are likely to continue to rise as car usage increases. This is certainly true in South Africa.

Evaluation of all three aspects of sustainability, leads to the surmise that more balanced modal approaches to transport for the future would be required, specifically between non-motorized modes, public transport, rail transport and road-based private transport (for both passengers and freight).

3.9 Advances in energy

More than 96% of all the energy used in transport comes from fuels derived from petroleum, and the transport sector accounts for at least one-quarter of primary energy use. Current trends

indicate that the consumption of energy in transport may double in the next twenty to thirty years with the result that the transport sector needs to assess the availability and cost of energy, as petroleum reserves become depleted. Advances in the development of alternative energy sources are promising but costly and their adoption will, therefore, depend largely on the willingness of governments to intervene in the market.

3.10 Advances in vehicle technology and systems

It is estimated that existing vehicle design and engine technologies can secure further improvements of about 20 per cent in fuel efficiency. Combinations of advanced emission control technologies that could allow light vehicles to meet tailpipe emission standards 50 to 80 per cent tighter than current standards in any OECD country already exist. Realizing these improvements will depend on political and financial, rather than technological, considerations.

Currently the main focus of technological development in vehicle technology is on :

- efficiency, cleanness, and safety;
- alternative fuels;
- enhancement of internal combustion engines;
- electric/hybrid vehicles;
- use of new materials;
- incorporation of advanced electronics in motor vehicles; and
- improved rail, airplane, and freight system technologies.

These were discussed in more detail by Venter⁶. Some of the most important trends include :

- use of alternative fuels aimed at mitigating emissions in internal combustion engines;
- the use of other alternative, non-petroleum-based fuels such as methanol made from natural gas, ethanol, hydrogen, and biogas;
- advanced two-stroke engines accompanied by new electronically controlled fuel-injection techniques designed to both raise the efficiency of the combustion process and reduce emissions of unburnt fuel;
- use of electric and hybrid vehicles;
- the use of light composite materials in vehicle construction;

⁶ VENTER, C. 2002. International Trends and Future Challenges for the Transport Sector. Technical Report No TR-2002/25 CSIR, Transportek, Pretoria, August, 2002.

- the use of advanced electronics to optimize steering, braking and throttle control and a number of other functions;
- high-speed passenger rail transport;
- tilt technology that allows trains to run up to a third faster on old track (with modest upgrades) by using suspension systems that lean into bends;
- magnetically levitated trains;
- applications of advanced control systems to increase capacity and safety of rail transport;
- guideway-based (driverless) systems that utilise various combinations of computer, communications and control systems technology to provide automated transport;
- the application of metro system principles to bus systems, including Bus Rapid Transit;
- incremental improvements in fuel efficiency in aviation in conjunction with reduced emissions, and reduced noise pollution; and
- improved truck design for freight transport with emphasis on:
 - improved transmissions;
 - increased aerodynamic efficiency associated with lighter structures;
 - improved tyre technology;
 - maintenance through advanced electronics; and
 - better power/load ratios through the increased use of double and triple combinations.

3.11 Advances in transport infrastructure technology

The ever increasing need to respond to funding limitations as well as the depletion of natural material sources are driving current innovation in infrastructure technology. This focuses mainly on optimization of structural and materials design, construction and operations as well as management practices. Increases in traffic volumes, vehicle sizes and weights, and the complexity of the demand for transportation places increased pressure on current infrastructure. There is also a continuing increase in social, environmental, health and safety (construction workers) and economic demands.

With respect to future innovative road infrastructure options, the following three examples illustrates some directions in current thinking (from the Netherlands' Roadways of the Future programme):

- “The Energetic Road”, combining infrastructure with energy generation. A pilot project will install elements in the asphalt road surface for direct generation of electricity, coupled with highway lighting generating its own energy from wind power.
- “The Modular Road”, constructed from prefabricated sections. The designs have to be capable of rapid construction and replacement, and meet durability, safety, and particularly noise reduction standards. Four designs are being tested, including prefabricated slabs on prefabricated support, rollable layers on top of high bearing capacity concrete slabs, and a prefab flexible asphalt mat that can be rolled up and rolled out.
- “The Intelligent Road”, exploring the possibilities of influencing, via the road surface, the driving behaviour of drivers in order to improve safety, capacity, and comfort. Two technologies are being pilot tested, both using small lights to guide drivers as to the appropriate following distance to allow for smooth merging from adjacent lanes.

3.12 Adoption of information and communications technologies (ICTs)

Although a number of foresight studies (including the 1999 DACST Foresight Study) concluded that ICTs will play a key role in the economies and societies of the next century, the exact nature and magnitude of ICT's impacts on travel demand and transport are unclear. The likely impacts of, for instance, the Internet on how people work, shop, learn and entertain, have often been overstated. The UK foresight study found that on-line services are unlikely to radically alter trip rates and modal splits, unless public transport is also dramatically improved. Research in the US suggests that telecommunications substitute for some amount of trip making. Yet, it has not proved to be the panacea some people had hoped for, in large part because most occupational roles are not suited for home working on a regular basis. The impacts of home (Internet-based) shopping, with its associated delivery needs, will affect the logistics and freight markets, but maybe less so than sometimes supposed.

The most important trends in the use of ICTs in transport include :

- electronic technologies such as tolling and electronic road pricing;
- Intelligent Transportation Systems (ITS) e.g:
- advanced traffic management (ATM); and
- advanced traveller information (ATI);
- automated vehicle control (AVC)
- the use of smart cards; and

- data and systems for supply chain management and logistics.

3.13 Key uncertainties

While general consensus exists in the literature that the factors listed below will drive and influence transport over the next two decades, they are nevertheless subject to uncertainty. The key uncertainties in respect of each factor are briefly discussed under the relevant sub-heading :

Economic trends

Uncertainty in the economic trends include :

- Unexpected acceleration in the contribution of technology to world economic growth leading to increases in personal incomes that could thus intensify transport demand pressures;
- Unexpected economic growth that could cause environmental problems to be more speedily resolved;
- Unexpected increased global financial instability, with increasing fluctuations in world economic growth and resultant reduction in travel demand; and
- Slower adoption of new technologies and thus lesser economic sustainability of urban transport.

Technological Discontinuities

An optimistic economic scenario may coincide with unexpected breakthroughs in transport technologies or in energy economics. The counter argument is that there could be a slow down in technological advance or in the ability to apply the advance. Some of the uncertainties include:

- Potential development of hydrogen-fuelled, almost completely emission-free and energy efficient personal cars;
- Potential development of new modes of personalized transit that are highly energy-efficient;
- Possible international barriers to technology flows; and
- The impact of slower technology advance on the achievement of sustainability in transportation

Oil Crises

The impact of a potential oil crisis on the transportation industry is significant as was experienced in the early 1970's. Continued instability and military activity in the Middle East could impact the transportation industry severely, particularly in the form of significant price rises and oil shortages.

This could have some of the following effects:

- Increased cost of conventional transportation;
- More rapid development of fuel saving technologies;
- The development of enhanced oil recovery technologies to address short-term demands; and
- Changes in fuel taxes that could counter the move towards alternative fuels.

Greenhouse Concerns and Policy

The increasing emphasis on the impact of greenhouse gases and the associated sustainable development argument could accelerate legislation and countering strategies significantly. This could have the following impacts :

- Increased demands for enforcement of the existing Kyoto protocols and the development of even stricter protocols;
- Consequent significant emphasis on policy changes and technological research into alternative solutions;
- Scepticism about the true impacts of global warming and other environmental issues which could slow this trend down; and
- Possible political conflict between developed (industrialized) and developing countries.

Social Factors

Social factors could have a significant impact on the future of transport. The uncertainty lies in how private vehicle owners and business would react to the changes in transport. For example, it is possible that the motor vehicle could become an even greater status symbol than it already is, particularly in developing economies. This would lead to increased resistance to sustainable transportation initiatives where these relate to other modes of transport, such as buses.

An alternative scenario could be a radical shift in society values that impact negatively on the status of the car and the social acceptability of driving. If sustainability and awareness of green

issues become strong drivers in society, conventional motorcar transport may take on the outcast social status of smoking, for example. This would clear the way for major changes in sustainable transport policies.

HIV/AIDS

The potentially devastating effect of HIV/AIDS on the African and South African economy cannot be underestimated and will have a significant impact also in the transport sector. The possibility of a cure for AIDS is a high uncertainty in this area. Currently, retro-viral drugs are creating hope for a more comprehensive treatment that will halt or mitigate the effects of HIV/AIDS.

4 CHALLENGES FACING THE TRANSPORT INDUSTRY

Based on the outcome of the desk-top study as well as the workshops, the major challenges facing the transport sector over the next 10 to 15 years can be summarized as shown below.

4.1 Provision of basic mobility needs

The transport sector is required to meet the basic mobility needs of all people, including low-income people that are increasingly marginalized by car-oriented urban development. The notion of sustainable development suggests that the demand for car-based mobility, triggered by rising incomes, should be balanced with more affordable solutions such as non-motorised transport, public transport, and full cost recovery on travel). This is an increasing need in southern Africa and fits well into the NEPAD strategy.

4.2 Improved strategic planning

The strategic planning for the provision and maintenance of transport infrastructure and operations needs to be improved. The paradigm within which transport infrastructure is provided now needs to satisfy an increasingly complex set of demands, rather than the simple mobility/economic growth objectives of earlier days. In particular, cognisance needs to be taken of the imperatives of sustainable development. Methodological challenges should include the appraisal of the full costs of alternatives, integrating land use with transport planning, inter-modal assessment and making the infrastructure planning process more open, fair, and efficient.

4.3 Economic sustainability of infrastructure investments

The challenge is to secure adequate short-term funding to make new investments as well as long-term funding for reinvestment and maintenance, effectively recapturing the benefits of investment through user-pay approaches where appropriate, and employing demand management and system operations techniques. In southern Africa in particular, emphasis must also be placed on the supporting technological capability to ensure effective maintenance and enhancement of assets.

4.4 Environmental sustainability of transport

In view of the increasing pressure and lobby from environmentalists, the transport sector faces a major challenge in becoming environmentally sustainable. This requires a combination of technological, regulatory and methodological advances. Specific research needs include the acquisition of improved data leading to the development of improved methods to predict the environmental impacts of alternative transport projects.

4.5 Optimisation of technologies for infrastructure provision

In view of the ever-increasing limitation on funding available for transport infrastructure, a major challenge is to enhance technologies of design, materials and construction in order to ensure optimal life cycle costs of transport assets. Emphasis also needs to be placed on improved management systems and methodologies to optimise decision-making.

4.6 Institutional innovation

Re-organisation of institutions in order to ensure integration among the many role players is imperative. This will allow them to address complex, long-term mobility issues, and to effectively involve the private sector in the provision and operation of transport infrastructure without sacrificing government accountability or the democratic rights of affected people. Creating institutional capacity is identified by the World Business Council for Sustainable Development as an overarching challenge to the achievement of sustainable mobility. This is of particular importance within the drive towards transformation of South Africa, where a lack of skills in certain parts of the public sector causes the capacity to deliver a quality service sometimes to be lacking.

4.7 Manpower

The current lack of skilled manpower in transportation – particularly engineers, planners, technicians and construction staff, is a major challenge for the southern African transportation industry. This is exacerbated by the brain drain and the effect of HIV/AIDS in reducing the size of the available population of transportation professionals. In addition, new directions will require

technically diverse people. The current shortage of manpower is critically important in South Africa, especially in the transportation authorities.

4.8 Safety and security in transportation

Safety issues include occupational safety for construction workers and operators. Due to the high accident rates in South Africa, the safety of the users of transport systems is a major concern.

In view of the expected increases in traffic volume of passenger traffic and freight traffic (also cross border traffic) combined with the increasing crime statistics in South Africa, crime and violence in transport are major challenges. The security of transport users requires that crime be counteracted on all modes of transport.

Changes in behaviour, innovation and political will are requirements to address this challenge.

4.9 Globalisation and regionalisation

The growing trends of globalisation and regional co-operation provide a continuing challenge to the Transportation industry and impacts also in South Africa. This includes the growth in global movement of goods and people, increased cross border traffic of people and goods, increased axle loads from trucks originating in neighbouring countries, increasing tourism and issues such as the harmonization of regional standards.

4.10 Freight transport and logistics

Freight transport by road and rail is increasing and currently government places major emphasis on logistics and related issues. Challenges include the improvement of quality, timeliness, cleanness, and efficiency of freight transport as the pressures of economic competitiveness increase. This includes adequate provision of alternatives to road freight, as the road system is expected to be unable to carry the large increase in freight demand expected. Security and freight tracking technologies are also becoming increasingly important.

4.11 Exploiting advances in alternative energy sources

The transport sector will need some flexibility in order to adjust to new technological development in the field of alternative fuels and alternative propulsion methods.

4.12 Harnessing information and communication technologies

The transport sector needs to be able to harness advances in Information and Communication Technologies (ICTs) in order improve efficiency, safety and quality of transport. Particular focus needs to be placed on Intelligent Transportation Systems (ITS).

4.13 Restoration of the transport infrastructure and the public transport fleet

A major short- to medium-term challenge in South Africa is to restore the transportation infrastructure and to make up the backlog of required maintenance and provision of new infrastructure, particularly in rural areas. In addition, special emphasis needs to be placed on the recapitalisation of the public transport fleet.

4.14 Job creation

A significant challenge in the South African transport sector remains to fulfil its promise as a major job creation opportunity.

5 SCENARIO DEVELOPMENT

5.1 Introduction

The Johari Window is a simple 2 x 2 matrix and is often used in scenario building. In this application, two independent variables define the key uncertainties that differentiate between four possible scenarios. An example is the CSIR 2007 scenario, which is based on the uncertainties of: Society's ability to assimilate knowledge intensive innovation (socio-economic factors).

The rate of availability of innovation resulting from development in knowledge services (market factors).

These uncertainties form the vertical and horizontal axes of the matrix and the combinations of the high and low values of each lead to the four scenarios described as:

- New Dark Ages
- Paradise Lost;
- Country Club; and
- Renaissance Revisited

During the internal workshops, a significant amount of time was spent discussing the future trends and look of the South African transport sector. This work was based on aspects identified during the desktop study and was reviewed during the external workshop. In addition, the important drivers of change in the transport sector were identified and discussed.

The drivers to change identified in the desktop study, workshops and analysis can be summarized into three main groups (as also used in sustainable development studies) :

- Economic drivers (including advances in technology that are associated with a sound economy)
- Social drivers including initiatives such as NEPAD
- Environmental drivers including sustainability issues

These three factors were used in a 2 x 2 x 2 matrix (each factor can be high or low) to define eight possible scenarios for the Transport sector. However, analysis of the data and information compiled during the workshops indicated that only five of these would be relevant for scenario building. The other three possibilities are either very similar to the selected five or are trivial.

The relevant scenarios are:

- Doldrums (a very low road scenario with little progress, economic stagnation and minimal social development);
- Utopia (the high road scenario with a strong economy in a politically stable environment with significant social development and minimal environmental side effects);
- Social progress (a scenario where social reforms are successfully implemented and initiatives such NEPAD is very successful, but economic success lags behind);
- Commercial drive (a scenario where economic growth and prosperity becomes paramount at the cost of social reform and environmental issues);
- Balancing act (a scenario where social reforms are slow, but significant economic growth takes place although strongly balanced with environmental concerns and focus)

These scenarios are described in terms of detailed factors and trends obtained from the workshops and desktop study. The factors and trends are categorized into :

- Political trends;
- Societal trends;
- Economic trends;
- NEPAD; and
- Environmental issues.
- Technology trends.

Each scenario is discussed in more detail below and tabulated in Appendix A.

5.2 Doldrums

This is a scenario where all three factors (social, economical and environmental) are slow or stagnant in terms of progress and success. This indicates no “winds of change” hence the Doldrums. The main characteristics of this scenario are :

Political :

- Political instability with a low priority to transport, weak traffic law enforcement and a lack of regulation

Societal trends :

- Unbalanced population growth (very high or very low);
- Uncontrolled HIV/AIDS; and
- No job increases and lack of effective public transport, subsequent low mobility of people

Economic :

- Low to negative economic growth and increased inflation;
- Dependence on imports and inability to compete internationally;
- Little investment in transport and infrastructure; and
- General inefficiency with associated high costs

NEPAD :

- NEPAD fails

Environmental :

- Increased pollution and exploitation of renewable resources
- Lack of orientation to international pressures on environmental issues
- Technology advances :
- Little adoption of new technologies, low research and development expenditure

5.3 Utopia

In his scenario all three the main factors are very important and successfully implemented. Main characteristics are :

Political :

- Stable politics with a commitment to transport as an enabler of development;
- Appropriate regulation and effective law enforcement;
- Balance between economic growth and poverty alleviation; and
- Efficient government.

Societal :

- Controlled population growth;
- Control of HIV/AIDS;
- Employment balance;

- Appropriate balance between public and private transport;
- Low crime in transport; and
- Increased mobility and flexibility in transport.

Economic :

- Stimulated economic growth with good control of inflationary forces;
- Increased access to export markets;
- Appropriate distribution of income and consumption;
- Improved balance of trade and ability to compete internationally; and
- Increased funding for transport.

NEPAD :

- NEPAD is very successful.

Environmental :

- Adoption of cleaner lifestyles through improved policy, culture and technological changes;
- Holistic approach to sustainable development

Technology advances :

- Rapid adoption of new technologies, but balance between commercial and environmental technologies
- Move towards alternative energy sources and materials
- Development of a bio-diesel industry
- Improved energy efficiency of vehicles
- Alternative cargo haulage and shipping
- Increased use of GPS, GSM, electronic routing and ITS

5.4 Social Progress

In this scenario, the NEPAD initiative and the environmental driver become important and are successfully implemented. The South African economy is lagging behind and environmental issues are of little importance. Typical characteristics are :

Political:

- Stable politics and commitment to transport as enabler to development;
- Effective law enforcement and good governance;
- Major focus on poverty alleviation; and
- Greater emphasis on public transport;

Societal:

- Controlled population growth and HIV/AIDS;
- Balance between urbanization and focus on rural development;
- Improved security; and
- Mobility demands on public and rural transport;

Economic:

- Limited economic growth with some increases in inflation;
- Export status quo remains;
- Some re-distribution of income, government intervention;
- Investment focus is on social infrastructure;
- Increased focus on SMMEs and labour-intensive construction; and
- Some research funding focused on social issues;

NEPAD:

- NEPAD is very successful in terms of the social objectives but less so with regard to economic issues;

Environmental:

- Slower, enforced focus on environmental issues;

Technology advances ;

- Gradual adoption of selected new technologies.

5.5 Commercial drive

In this scenario, the South African economy is very strong, but NEPAD and environmental issues are not successfully implemented and social development lags behind. Some typical characteristics are :

Political :

- Some instability with elements of commercialism;
- Transport becomes an economic not social driver;
- Some deregulation;
- Major focus on economic growth;
- Focus on transport efficiency and logistics;

Societal :

- Low population growth and some control of HIV/AIDS;

- Job creation in technical and commercial sectors;
- Less focus on public transport;
- Major congestion with some security risks;
- Medium crime in transport and privatisation of security;
- Mobility demand focuses on urban environment and modern systems;

Economic :

- Stimulated economic growth, inflation controlled;
- Increased access to export markets;
- Increased demand for travel, cross border traffic and freight transport increase;
- Greater inequality in income distribution and consumption;
- Improved ability to compete globally;
- Investment focus on commercial infrastructure;
- Increased funding for transport;
- Increased research funds for technological advances and commercial issues;

NEPAD :

- Limited success to NEPAD, due to lack of co-operation between nations

Environmental :

- Slow, enforced attention to environmental issues

Technology advances :

- Rapid adoption of new technologies including Intelligent Transportation Systems, artificial intelligence, new age fuels, modern transportation systems, but only where they can have a commercial impact and show financial returns
- Increased use of GPS, GSM, electronic routing and ITS

5.6 Balancing act

In this scenario, the NEPAD initiative is unsuccessful (for example due to lack of co-operation through Africa) but both the economic driver and the environmental driver is strong thus creating a balancing act between economic growth and prosperity and environmental reforms. Some of the main characteristics are :

Political :

- Stable politics

- Focus on trade off between clean transport and economic growth
- Law enforcement and good governance important

Societal :

- Controlled population growth and HIV AIDS
- Balance between urbanization and rural development
- Some reversal of the “brain drain”
- Demand for greater public transport usage

Economic :

- Some economic growth and inflation at medium level
- Some increases in export
- Some natural re-distribution of income and consumption
- Balance between investment in social and commercial infrastructure
- Increased funds for transport and research

NEPAD :

- Limited success in NEPAD mainly due to factors such as lack of co-operation between nations

Environmental :

- Adoption of cleaner lifestyles through improved policy, culture and technology changes
- South Africa is a leader in Africa in environmental issues
- Changes in taxation of pollution, noise and related to recycling
- Holistic approach to sustainable development

Technology advances :

- Rapid adoption of new technologies, but balance between commercial and environmental technologies
- Move towards alternative energy sources and materials
- Development of a bio-diesel industry
- Improved energy efficiency of vehicles
- Alternative cargo haulage eh shipping
- Increased use of GPS, GSM, electronic routing and ITS

Figure 3 shows a schematic diagram indicating a downward, level or upward trend for each of the above groups in each scenario to give a birds view of the overall trend in each scenario.

The purpose is not to determine which scenario is most likely to occur, but rather to have distinctly different scenarios against which the robustness of the technology portfolio can be evaluated.

	Polit.	Soc.	Econ.	NEPAD	Envir.	Techn
Doldrums						
Utopia						
Social						
Commercial						
Balance Act						

FIGURE 3 : General trends in each scenario

6 TRANSPORTEK TECHNOLOGY AND OFFERING PORTFOLIO

6.1 Background

Over the past 10 years, Transportek has built and modified its product and technology portfolio in order to suit internal and market trends and needs. In the past two to five years significant structural changes were also made in order to place emphasis on specific areas including :

- Transport systems technology and software products;
- Intelligent Transportation Systems;
- Contractor development and labour intensive construction;
- Transport decision support systems; and
- Rural transport development.

This was done through our standard strategic management and technology management processes but, to date, has lacked a thorough technology foresight exercise. The purpose of this analysis is to evaluate the relevance, importance and likelihood of success of each of the offerings within each of the scenarios with a view to assessing the balance in the offering portfolio.

6.2 Offering portfolio analysis

The Transportek offering portfolio is defined at the following levels :

- Competence level, a grouping of similar and connected subcompetences, based on the same set of base technologies with offerings in similar markets and to similar customers;
- Subcompetences that form the elements of the competences; and
- Offerings, a set of hard products, solutions and services in each subcompetence.

The Transportek portfolio is given in Table 1. A rating out of ten in terms of relevance, importance and likelihood of success for each of the offerings in each of the scenarios is also given. These ratings were determined in several interactions with staff in Transportek.

TABLE 1: Transportek offering portfolio and relevance and likelihood to success ratings in each scenario

TRANSPORTEK OFFERING PORTFOLIO						
THRUST	SUB THRUST / OFFERING	Doldrums	Utopia	Social	Comm.	Balance
Transportation	Transport operations :					
	Public transport planning	8	6	9	5	7
	Public transport operations planning	6	7	8	9	7
	Institutional reform planning	6	8	7	7	7
	Environmental policy development	5	8	6	6	9
	Transport software products	2	8	7	6	7
	Logistics strategy development	3	9	6	9	8
	Supply chain modelling	4	8	6	9	7
	Freight transport operations planning	5	7	5	9	7
	Average :	4.9	7.6	6.8	7.5	7.4
	Transport policy, economics and DSS :					
	Overload control	8	8	7	4	8
	Bridge management	5	8	5	8	8
	Transport economics	5	8	6	8	8
	Transport policy and feasibility	5	9	8	7	9
	Economic modelling and DSS	5	9	8	8	8
	Average :	5.6	8.4	6.8	7	8.2
Traffic Management						
	Road Safety :					
	Safety management systems	6	8	8	7	7
	Safety education and communication	6	8	8	6	7
	Traffic engineering	3	9	7	9	8
	Average :	5.0	8.3	7.7	7.3	7.3
	ITS	1	9	1	9	9
Transport Infrastruct.	Road engineering					
	Pavement analysis and design	5	9	6	9	9
	Pavement surveillance	3	9	4	7	7
	Pavement materials characterisation	5	9	7	8	9
	APT	1	9	4	9	8
	Technical audits	5	9	7	8	9
	Laboratory testing	3	9	6	8	9
	LTPP	1	9	3	8	7
	Average :	3.3	9.0	5.3	8.1	8.3
	Contractor development					
	LIC methodologies	7	5	9	4	5
	Contractor development	7	5	9	4	5
	Institutional support	9	6	7	7	7
	Conventional construction and maintenance	4	8	5	9	8

	Average :	6.8	6.0	7.5	6.0	6.3
Transport systems	Data base technologies	4	9	8	8	9
	Software development	3	9	6	9	8
	Tourism products	4	9	6	9	8
	Internet technologies	4	9	7	9	8
	Average :	3.8	9.0	6.8	8.8	8.3
Rural transport	Rural transport planning	8	7	9	5	6
	Community-based tourism	8	7	9	6	7
	Local economic development planning	8	7	9	5	5
	Accessibility planning	8	7	9	5	6
	Average :	8.0	7.0	9.0	5.3	6.0

In order to view the result of the analysis graphically, a spider web diagram as shown in Figure 4 was used. In this diagram, the five scenarios are represented by the five axes on the diagram with “low” being at the outside of the diagram and “high” being at the centre (the core of centrality). A “safe zone” of 50 per cent likelihood that a scenario will take place is shown by the dotted line. This implies that, if an offering plots inside the safe zone, that offering is reasonably well positioned if a particular scenario takes place.

In order to simplify the information, the average score for each subcompetence was calculated and then plotted on the various axes as can be seen in Figure 5. The size of the bubble for each subcompetence indicates the size of the current activity in Transportek.

A close inspection of this diagram yields the following observations and potential corrective strategies (see Figure 6) :

Doldrums scenario

It is obvious that in this scenario many of Transportek’s bigger competences plot outside the safe zone. This implies that in this scenario they will not be very relevant or applicable. Particular strategies to position for this case should be:

- Re-emphasize the importance of the international market for the road engineering and systems subcompetences (this is already there but efforts would have to be increased);

- Seek dedicated funding from the National Department of Transport for the subcompetences of Transport Operations, Traffic Safety and Transport policy, economics and Decision Support (some work has already been done here); and
- Reorganise Transportek to survive in lean times

Utopia scenario

In this scenario, the current portfolio of Transportek is well positioned. However, some gaps exist in the portfolio as discussed below.

Social Progress scenario

In this scenario, Transportek still has a problem with some of the bigger subcompetences, and therefore the strategic issues should be to :

- Re-emphasize the importance of the international market to the road engineering and systems subcompetences (this is already there but efforts would have to be increased); and
- Grow the currently small focus areas including Rural Transport and Contractor Development much more rapidly.

Commercial scenario

In this scenario, many of Transportek's large subcompetences will be well positioned, however, two of the smaller strategically important areas will be less well positioned. The strategy should be to:

- Keep the Rural Transport and Contractor Development areas small but well focused in case the scenario changes in the future.

The Balancing Act scenario

In this scenario the current portfolio of Transportek is well positioned but, once again, gaps exist as discussed below.

Likely progress through scenarios

In the past 10 to 15 years, the transport sector has been operating in a scenario that borders on the Doldrums scenario with some aspects of the Social Progress scenario. It is envisaged that the

sector will proceed through the Social Progress scenario to the Balancing Act scenario and will probably in ten to 15 years from now be in the Balancing Act scenario with some aspects of the Social Progress scenario.

6.3 Gaps in the portfolio

Analysis of the information obtained from the desk-top study, the internal and external work shops and subsequent discussion within Transportek, has identified three potential areas that Transportek may need to add to its current portfolio. These are :

Environmental Engineering in Transport

Transportek has done some work in this area on an ad-hoc basis. It is proposed that, in co-operation with Environmentek, Transportek initiates a small focused drive towards environmental engineering with specific emphasis on the transport sector. In view of the worldwide trend towards sustainable development and environmentally friendly transport systems, Transportek should position itself in this area and remain flexible enough to grow this area significantly should the Balancing Act scenario materialize.

Vehicle technologies

Transportek has recently initiated an Intelligent Transportation Systems subcompetence. However, in view of the likely changes in the nature of transport and vehicles in the next 15 to 20 years, Transportek should position itself in this area. Once again the strategy should be to initiate this in conjunction with M&Mtek in a small focused way initially. Particular emphasis should be placed on:

- Sensor technologies;
- Vehicle security systems;
- Smart card technologies;
- ITS policy and impact assessment; and
- Impact assessment of changes in the nature of transport including vehicle types and sizes, travel demand modelling etc.
- Alternative energy and fuel developments

In view of the significant changes that are likely in this area, and in conjunction with the CSIR drive in energy, Transportek needs to position itself in this area with the following emphasis :

- Assessment of the impact of alternative strategies on the transport sector;
- Policy decision support in energy for transport; and
- Economic analysis relating to alternative strategies

In all three cases, being environmental engineering, vehicle technology and alternative energy, the strategy should be to start as soon as possible in a small, focused way in order to learn more about the potential future and possible strategies for Transportek to position itself. The areas should be flexible enough to grow or shrink as the scenarios of the future materialize.

These three new focus areas are also plotted on the diagrams in Figures 5 and 6. This shows that these technologies are well positioned in the Utopia, Commercial, Social Progress and Balancing Act scenarios.

7 CONCLUDING REMARKS

This study was undertaken as part of CSIR Transportek's holistic approach to management of its technology development programme and, particularly, the investment decision. The outputs of this study will be used in the annual strategic planning process for CSIR Transportek. The foresight process will also be revisited regularly to ensure that Transportek's thinking remains strategically relevant.

Strategies were suggested for cases where large subcompetences are not well positioned in specific scenarios. These included :

- Enhancement of current efforts to open up international markets for the road engineering competence;
- Seeking dedicated funding from transport authorities for the subcompetences that will have a significant impact on social progress; and
- Accelerated growth of small areas when scenarios take place in which they are very relevant

It seems that, in general, Transportek's offering portfolio is reasonably well positioned. However, the following new areas should be investigated for investment and development:

- Environmental engineering in transport;
- Vehicle technologies; and
- Alternative energy sources.

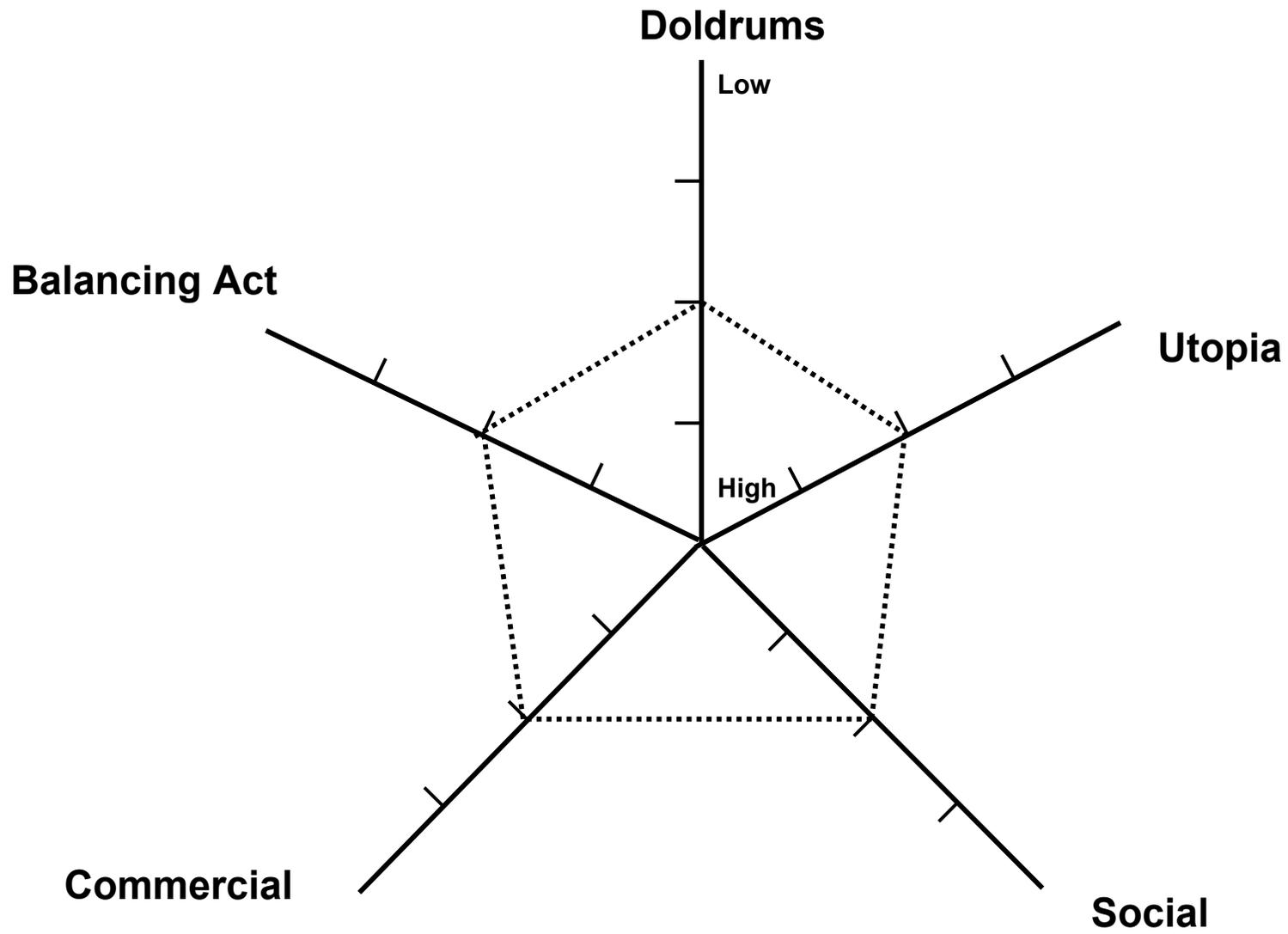


FIGURE 4 : Basic diagram for presenting evaluations graphically

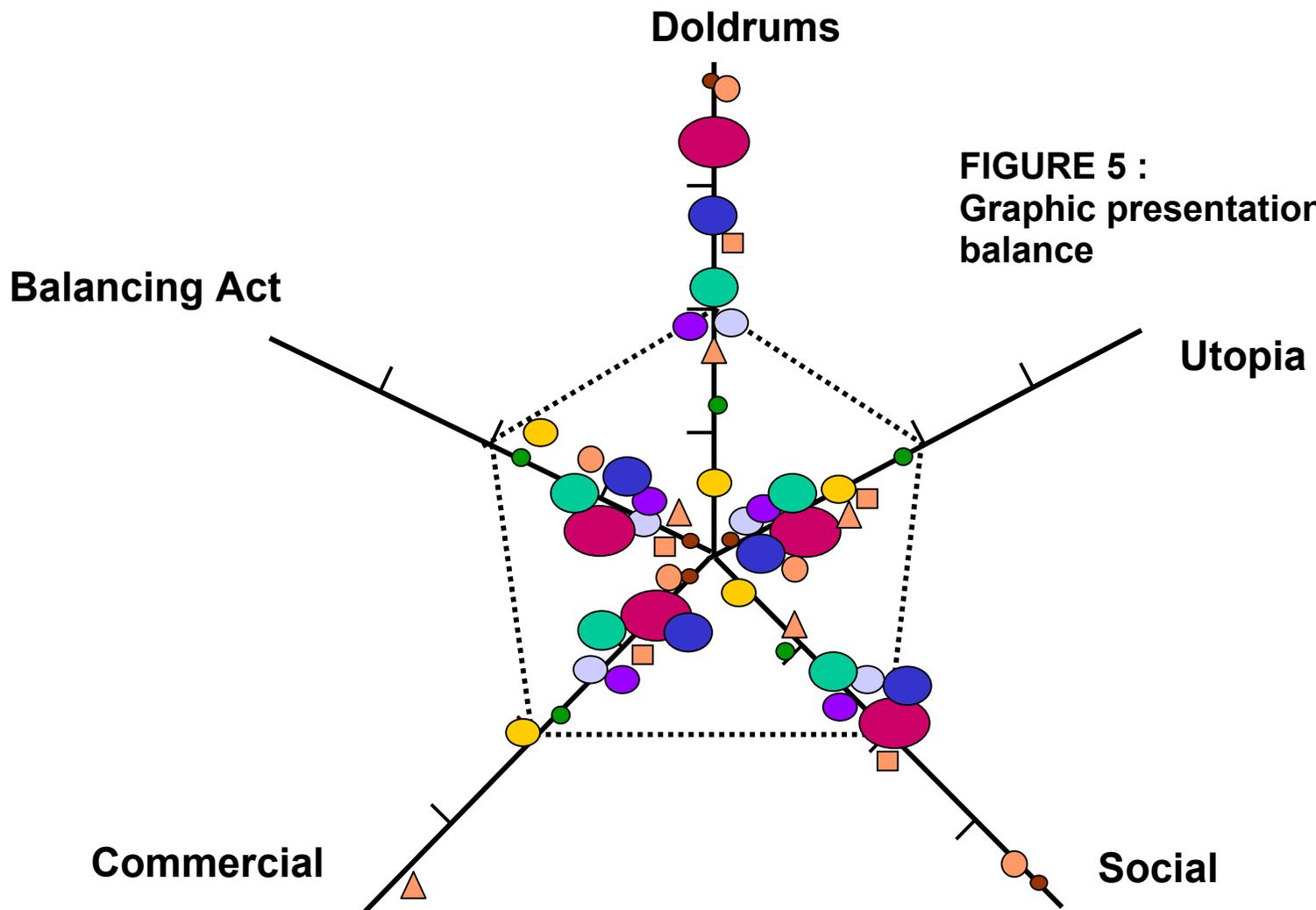
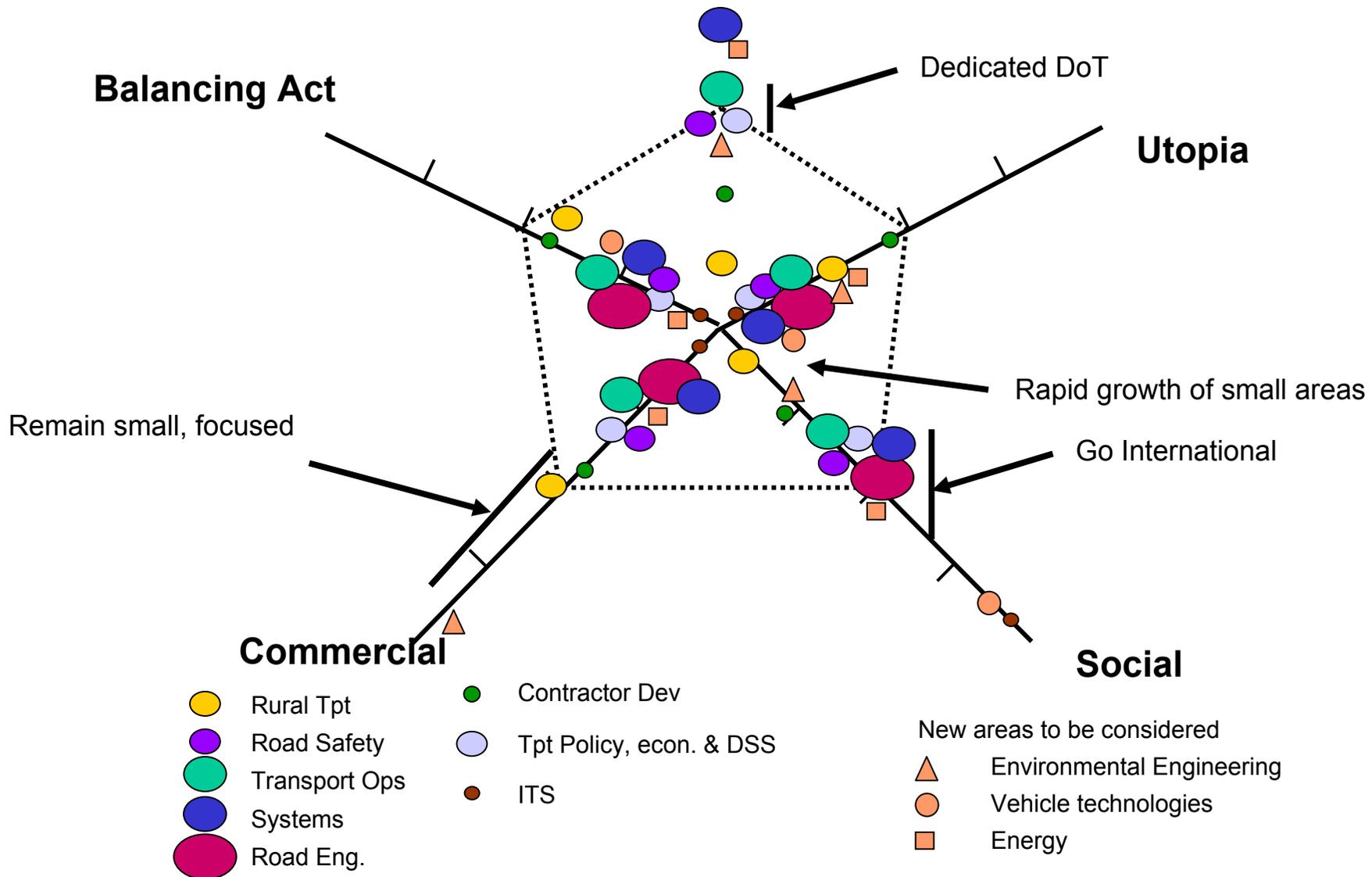


FIGURE 5 :
Graphic presentation of portfolio balance

- | | | |
|---------------|-------------------------|----------------------------|
| Rural Tpt | Contractor Dev | New areas to be considered |
| Road Safety | Tpt Policy, econ. & DSS | Environmental Engineering |
| Transport Ops | ITS | Vehicle technologies |
| Systems | | Energy |
| Road Eng. | | |



APPENDIX A : SCENARIOS

Category	Doldrums	Utopia	Social progress	Commercial Drive	Environmental balancing act
Political	<p>Instability Low priority to transport Lack of regulation No enforcement Low efficiency in transport</p>	<p>Stable politics Commitment to transport as enabler to development Appropriate regulation Effective law enforcement Good governance Balance between economic growth and poverty alleviation Balance between job creation and service delivery Efficiency and co-ordination in public sector Focussed implementation and service delivery</p>	<p>Stable politics Commitment to transport as enabler to development Some regulation Effective law enforcement Good governance Major focus on poverty alleviation Major focus on job creation Greater emphasis on public transport</p>	<p>Some instability with elements of commercialism Transport becomes an economic not social driver Less regulation, some deregulation Major focus on economic growth Emphasis on private car ownership Focus on transport efficiency and Logistics</p>	<p>Stable politics Focus on trade off between clean transport and economic growth Appropriate regulation Major focus on law enforcement Good governance</p>
Societal	<p>Very high or very negative population growth Uncontrolled HIV AIDS Increased urbanisation, degeneration of cities with no job increases Huge demands on public transport Uncontrolled informal public transport Major congestion High security risks and crime rate in transport Global conflict (Middle East) Major "brain drain" Low mobility of people</p>	<p>Population growth less than 2 per cent HIV AIDS controlled Increased urbanisation with employment balance Appropriate balance between public and private transport Informal public transport sector well managed Well managed congestion Security well enforced Low crime in transport Low conflict globally "Brain drain" reversed Increased mobility and flexibility in transport</p>	<p>Population growth less than 2 per cent HIV AIDS controlled Increased urbanisation with partial employment balance and balancing drive for rural development Major focus on efficient and cheap public transport Improved security Some congestion Low crime in transport "Brain drain" status quo remains Mobility demands in public and rural transport</p>	<p>Population growth 0 to 1 per cent Some control of HIV AIDS Increased urbanisation, job creation in technical and commercial sectors Less focus on public transport Major focus on improvement of informal public transport Major congestion Some security risks Privatisation of security Medium crime in transport Some reversal of "brain drain" Mobility demand focuses on urban environment and modern systems</p>	<p>Population growth less than 2 per cent HIV AIDS controlled Balance between urbanisation and rural development Focus on diversification of job opportunities Major focus on increased use of public transport Some security risks Some congestion Medium crime in transport Some reversal of "Brain drain" Flexibility in mobility, demand for greater public transport usage</p>
Economic	<p>Low to negative economic growth, increased in inflation Increased trade barriers Income distribution inequalities remain Dependence on imports Inability to compete globally, internal foreign competition Increased globalisation and dependence on world economy Little investment in transport</p>	<p>Stimulated economic growth, inflation controlled Increased access to export markets Increased demand for travel, cross border traffic, increased freight Appropriate distribution of income and consumption Improved balance of trade Improved ability to compete globally</p>	<p>Limited economic growth, some increases in inflation Export status quo remains Increased demand for travel, cross border traffic Some re-distribution of income, government intervention Some improvement in balance of trade Competitive position status quo remains</p>	<p>Stimulated economic growth, inflation controlled Increased access to export markets Increased demand for travel, cross border traffic, increased freight Greater inequality in income distribution and consumption Improved balance of trade Improved ability to compete globally</p>	<p>Some economic growth, inflation medium Some increase in export Some increased demand for travel, cross border traffic, some increase in freight Some natural re-distribution of income and consumption Some improvement of balance of trade Competitive position status quo remains</p>

	<p>and infrastructure Little growth in freight volumes Little regional co-operation Very limited funding for transport Very little funds for research No private sector involvement in government Government and state enterprises inefficient</p>	<p>Balance between increased globalisation and support for local economies Significant investment with balance between social and commercial infrastructure Well managed congestion and overloading Balance between road and rail freight Demand for ITS Harmonized regional co-operation Increased funding for transport Dedicated research funds Increased outsourcing and privatisation of some government functions Increased efficiency in government through restructuring of selected state enterprises and corporate governance</p>	<p>Investment focus is on social infrastructure No significant growth in overloading Balance between road and rail freight Increased focus on SMMEs Increased focus on labour intensive construction Harmonized regional co-operation Some increase in funding for transport, mainly for subsidisation and social issues Some research funds (focus on social issues) Some outsourcing and privatisation of some government functions Some improvement in government efficiency</p>	<p>Investment focus is on commercial infrastructure Demand for higher axle load limits Increased road freight Promotion of user pay principle Demand for ITS Increased focus on privatisation Limited regional co-operation Increased funding for transport Increased research funds (focus on commercial issues) Increased outsourcing and privatisation of some government functions Some improvement in government efficiency</p>	<p>Balance between investment in social and commercial infrastructure Congestion and overloading well managed Balance between road and rail freight Increased focus on SMMEs Increased focus on labour intensive construction Harmonized regional co-operation Increased funding for transport Increased funds for research, with some emphasis shift to sustainable transport Some outsourcing and privatisation of some government functions Some improvement in government efficiency</p>
NEPAD	NEPAD fails	NEPAD is very successful	NEPAD is very successful in terms of social objectives	Limited success in NEPAD, mainly due to lack of co-operation between nations	Limited success in NEPAD, mainly due to lack of co-operation between nations
Environmental	<p>Increased pollution and exploitation of non-renewable resources Lack of appropriately skilled manpower pool Lack of attention to international pressures on environmental issues</p>	<p>Adoption of cleaner lifestyles through improved policy, culture and technology changes Sufficient and well skilled manpower pool South Africa is a leader in Africa in environmental issues Changes in taxation of pollution, noise and related to recycling Holistic approach to sustainable development, integration of functions and elements</p>	<p>Slower, enforced focus on environmental issues Some improvement in manpower pool mainly through the drive towards transformation Some attention to environmental issues Changes in taxation of pollution, noise and related to recycling</p>	<p>Slower, enforced focus on environmental issues Some improvement in manpower pool mainly through the required need in industry Environmental issues enforced by international community</p>	<p>Adoption of cleaner lifestyles through improved policy, culture and technology changes Sufficient and well skilled manpower pool South Africa is a leader in Africa in environmental issues Changes in taxation of pollution, noise and related to recycling Holistic approach to sustainable development, integration of functions and elements</p>
Technology : Advances in energy	No or little adoption of technological advances	<p>Move to environmentally friendly fuels from renewable resources Move towards alternative</p>	<p>Gradual move to environmentally friendly fuels from renewable resources Gradual move towards</p>	<p>Enforced move to environmentally friendly fuels from renewable resources Move towards alternative</p>	<p>Balanced approach to the use of environmentally friendly fuels and fuel consumption reduction technologies</p>

		energy sources Move towards alternative materials (away from bitumen) Development of a bio-diesel industry	alternative energy sources Move towards alternative materials (away from bitumen) Development of a bio-diesel industry	materials (away from bitumen) Development of a bio-diesel industry	Move towards alternative energy sources Move towards alternative materials (away from bitumen) Development of a bio-diesel industry
Technology : Advances in vehicle technology	Deterioration of the vehicle fleet Lack of implementation of new technologies	Move towards intelligent vehicles and transportation systems Improved energy efficiency of vehicles Alternative cargo haulage eg air ships Anti-collision and driver assistance systems	Marginal improvements	Move towards intelligent vehicles and transportation systems New generation of vehicles to improve speed, haulage, safety and comfort Increased vehicle tracking systems Anti-collision and driver assistance systems	Move towards intelligent vehicles and transportation systems Improved energy efficiency of vehicles Alternative cargo haulage eg air ships Anti-collision and driver assistance systems
Technology : ICT in transport	Low adoption of ICT technologies	Ease of access to relevant information and more information High degree of integration of information Use of artificial intelligence Improved delivery mechanisms for information Efficient use of information generating systems (eg traffic sensors) Increased use of GPS, GSM, electronic mapping, route planning and ITS technologies Real time monitoring, optimisation and management of transport infrastructure Enhanced tourism information systems Information for decision support systems	Some, slower adoption of selected technologies Enhanced tourism information systems Information for decision support systems	Ease of access to relevant information and more information High degree of integration of information Use of artificial intelligence Improved delivery mechanisms for information Efficient use of information generating systems (eg traffic sensors) Increased use of GPS, GSM, electronic mapping, route planning and ITS technologies Real time monitoring, optimisation and management of transport infrastructure Enhanced tourism information systems	Ease of access to relevant information and more information High degree of integration of information Use of artificial intelligence Improved delivery mechanisms for information Efficient use of information generating systems (eg traffic sensors) Increased use of GPS, GSM, electronic mapping, route planning and ITS technologies Real time monitoring, optimisation and management of transport infrastructure Enhanced tourism information systems Information for decision support systems
Technology : Advances in Transport Infrastructure technologies	Some marginal improvements to attempt job creation	Enhanced conventional construction methods Labour intensive construction Substitution of non-renewable material resources Recycling of materials	Labour intensive construction Efficient and safe facilities for non-motorised transport (including pedestrians) Integrated asset management systems	Enhanced conventional construction methods Substitution of non-renewable material resources Recycling of materials Optimisation of design	Enhanced conventional construction methods Labour intensive construction Substitution of non-renewable material resources Recycling of materials

		<p>Optimisation of design techniques</p> <p>Infrastructure modification to improve operational efficiency</p> <p>Improved design including multi-modal functionality</p> <p>Efficient and safe facilities for non-motorised transport (including pedestrians)</p> <p>Rapid maintenance and alternative construction techniques</p> <p>Integrated asset management systems</p> <p>Upgrading of and specialisation of port infrastructure</p> <p>Upgrading of rail infrastructure</p>		<p>techniques</p> <p>Infrastructure modification to improve operational efficiency</p> <p>Improved design including multi-modal functionality</p> <p>Rapid maintenance and alternative construction techniques</p> <p>Integrated asset management systems</p> <p>Upgrading of and specialisation of port infrastructure</p> <p>Upgrading of rail infrastructure</p>	<p>Infrastructure modification to improve operational efficiency</p> <p>Efficient and safe facilities for non-motorised transport (including pedestrians)</p> <p>Integrated asset management systems</p> <p>Upgrading of and specialisation of port infrastructure</p> <p>Upgrading of rail infrastructure</p>
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