The DNA of Transportation

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OVERVIEW

Over the last 30 years the South African transport community has to some extent been overwhelmed by transport acts, policy white papers, strategies, various studies and the development of integrated transport plans at provincial and municipal levels of government. The latter recommended numerous projects of which only a few materialised in practice. The implementation of these policies, strategies and plans, or the lack thereof, did not really contribute materially to the vision that transport is the heartbeat of South Africa's economic growth and social development. In addition, it did not lead to the development of integrated and efficient transport systems either. Proof of the previous statement in statistical numbers are at least visible in the following:

- South Africa's freight logistics costs at 12.8% of GDP are approximately 50% higher than in the USA, and 20% higher than in Brazil.[1]
- The condition of 30% of the national and provincial road network is in a poor and very poor condition.[2]
- South Africans are spending an average of ten working days a year stuck in traffic.
- Road traffic deaths in South Africa of 24.64/100 000 population are among the 37 highest in the world.

BACKGROUND

Until the late seventies South Africa's transport policy and legislative framework were predominately determined by commissions of inquiry into specific transport matters, such as road motor transport (JC Le Roux Commission1929) and urban transport (the Driessen Committee 1974). The National Transport Policy Study (NTPS) that was undertaken in the early eighties was probably the first 'modern-day' transport planning study in South Africa. The purpose of the NTPS was to investigate and formulate recommendations towards a revised transport policy, which would be in line with the country's national policy. It also formed the basis of the White Paper on National Transport Policy in 1986. Since then various policies and strategies have been formulated to promote and integrate transport in South Africa. Pockets of excellence, such as the Gautrain, certain airports, national roads and a few bus rapid transit services have been developed, but a coherent, integrated master plan for a sustainable transport system is still lacking. This is probably due to policies and strategies that have been implemented partially or not at all, but also because transportation in South Africa suffers from a damaged DNA.

THE TRANSPORTATION DNA METAPHOR

All human beings contain the molecular instructions for life called deoxyribonucleic acid or DNA. The DNA is a molecule that carries most of the genetic instructions used in the development, functioning and reproduction of all known living organisms. Encoded within this DNA are the directions for traits as diverse as the colour of a person's eyes or hair.

Watson and Crick discovered the double helix DNA.[3] The DNA molecule consists of two strands coiled around each other to form a double helix with the backbone spiralling around the outside and the base pairs pointing inwards (see Figure 1).

The double helix of the complete DNA molecule resembles a spiral staircase, with two backbones and the paired bases in the centre of the helix, which resemble the steps of a ladder.

The DNA is located in the cell nucleus. Most cells are incredibly small and to fit the DNA (the strands are almost 2 m long when straightened) within one of these cells a process known as DNA Packaging is used to compact the DNA into a form dense enough to fit into the cell nucleus. The compacted DNA is kept tightly wrapped in chromosomes, which are located inside the nucleus of the cells. Chromosomes are thread-like structures which consist of long strands of DNA containing thousands of genes.

The DNAs, genes and the chromosomes all work together with the 200 cell types to enable a human being to live a full life. There is thus more happening underneath the skin of the body

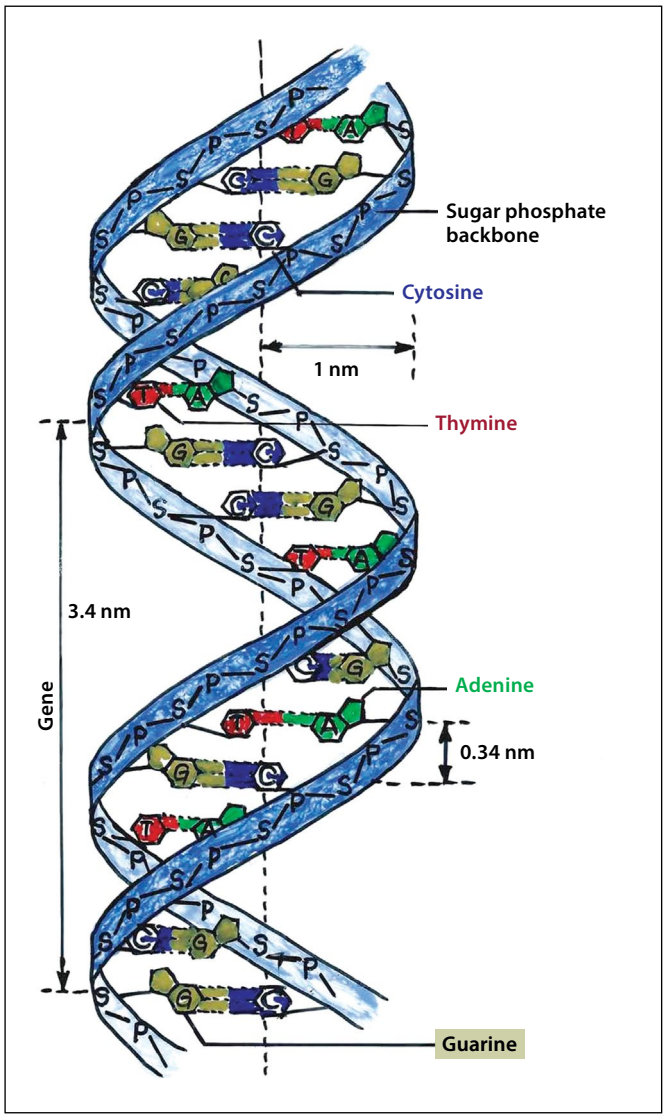

Figure 1 The DNA double helix (after Campbell 1996)

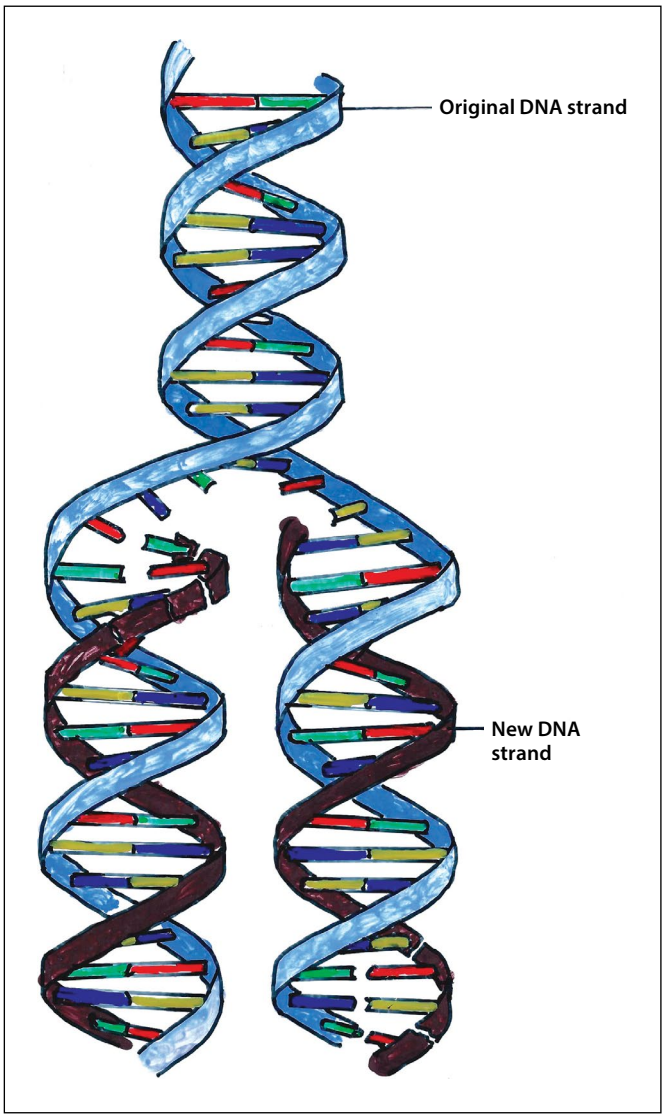

Figure 2 DNA Replication (after Campbell 1996)

than meets the eye. This is also true of transportation. Transportation is more than just vehicles and infrastructure. It also consists of 'invisible' or intangible aspects, such as policy, safety, security, social inclusion, marketing and communication.

In this article, the metaphor of the DNA is used to explain the shortcomings currently experienced in the transport sector in South Africa. The terms, such as cells, are not exact as per the scientific meaning, but are used as illustration.

As an embryo progresses through development, its cells must reproduce. Before a cell divides into two identical daughter cells it must copy its DNA. The twisted double DNA helix unwinds and separates its two strands. Each strand becomes a **template**, for making a new strand, so the two new DNA molecules have one new strand and one old strand. This process is known as **DNA Replication** (see Figure 2).

The Transportation DNA metaphor is based on the biological DNA molecule and encodes the culture, vision, strategy, values and purpose of transportation. Analogous to the human DNA it is proposed that the Transportation DNA should consist of:

- **Cells:** In the transport milieu, the cells resemble the transport authorities or transport bodies. The national and provincial Departments of Transport or the Transport Divisions of the seven Metropolitan Municipalities can be regarded as the cells of South Africa's Transportation DNA.
- **Strands:**
  - The legislation and institutional structures, together with the human and financial resources are the 'strands' which form the two double helixes of the DNA molecule in the Transportation X-Chromosome (see Figure 3).
  - The transport infrastructure and services are the 'strands' of the DNA molecule which form the double helix of the Transportation Y-Chromosome (see Figure 3).
- **Step pairs:** The step pairs are ancillary to the Transportation X- and Y-Chromosomes. Without them the transportation system can operate, but not sustainably. Transportation issues related to step pairs must be accommodated in all transportation planning

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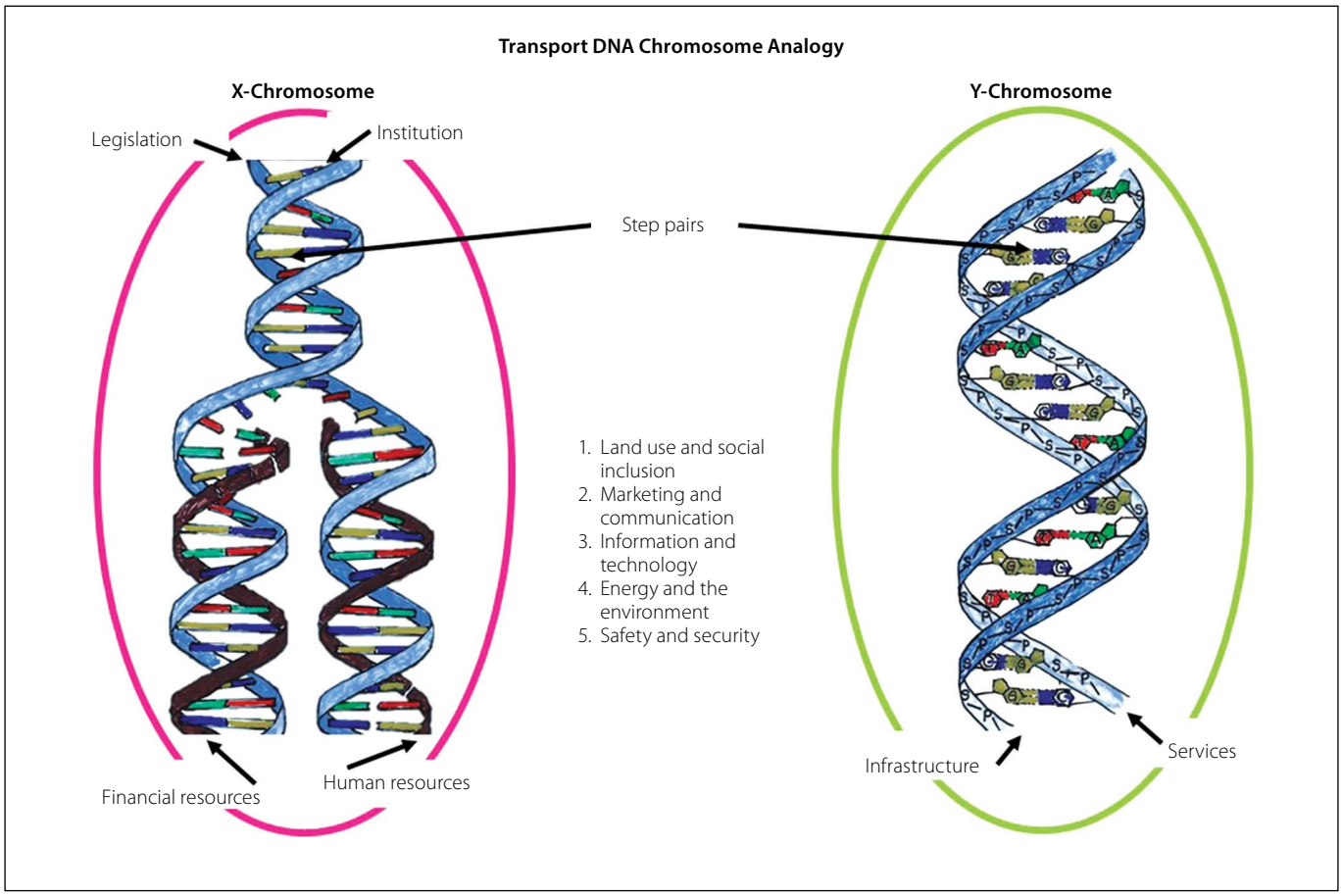

Figure 3 The authors' suggestion of the Transport DNA: the Chromosome Analogy

projects and the implementation and operations of such projects. The step pairs are:

- Land use and social inclusion matters
- Marketing and communication aspects
- Information and technology issues
- Energy and environmental issues
- Safety and security aspects.

- **Genes:** The DNA contains a record of instructions to 'tell' the cell what its job is. These instructions come from the genes that form a segment of the DNA. Genes are like recipes or instruction manuals. Essential transportation genes are such as:
  - Transportation vision, values and sense of purpose
  - Transportation policy and strategy
  - Transportation regulations
  - Political statements of intent (e.g. the National Development Plan)
  - Knowledge management and a well-structured skills transfer programme
  - Transmission of corporate culture to employees at all levels
  - Entrance of new employees with new ideas
  - Effective planning, design, construction, maintenance and operational teams (for infrastructure and services)
  - Clear procedures and structures which are enforced rigorously
  - Regular research initiatives to stay abreast with best practices and trends
  - Continuous performance measurement of the transportation system.

Building on the above figures, the authors suggest that one may visualise the Transport X-Chromosome as resembling the head of the transport body and the Transport Y-Chromosome as resembling the heart and lungs of the transport body, while the step pairs resemble the limbs of the transport body. All need to operate appropriately to have a sustainable transport system. Combining all of the above (see Figure 3) results in a perfect Transport DNA, ensuring sustainable transport.

THE APPLICATION OF THIS METAPHOR IN THE TRANSPORT ENVIRONMENT

Transport should be dealt with in a holistic manner. In the human body, defects or poor health affect the whole body negatively. Transport problems should be assessed in a way that finds sustainable and integrated solutions rather than, for example, only dealing with infrastructure provision and not considering other transport needs such as integrated public transport services. Similarly, as blood tests may reveal a particular problem in the body, interview algorithms and heuristic techniques are being used to develop a DNA scorecard to report on the problems of the transportation system and to provide a reporting system to recommend appropriate action or actions.

A damaged transportation DNA can be fixed through a scan of the Transport Department or Transport Agency to determine whether the damage occurred in the chromosomes or in the step pairs, or whether certain essential genes are missing. Thereafter recommendations can be made to rectify the damage. □

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