

The design of a bicycle for rural transport

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Discussed in this paper are various transport issues facing the rural population of South Africa and possible solutions arrived at through design thinking. It includes a list of design requirements used when a system/ product (in this case a bicycle) is proposed for rural use. Examples of bicycle designs using this list of requirements are included and briefly discussed. Problems relating to existing bicycles within rural South Africa are outlined. The main aim of this paper is to show how design methodology can be used as a tool for change by establishing new ideas and ways of looking at a situation.

There is a dire need for a sustainable form of rural transport in South Africa. The lack of transportation in rural areas prevents people from accessing employment and educational opportunities as well as basic social services. This directly affects the economic development of the country. Many projects aimed at addressing rural transport problems have turned to non-motorised transport devices – primarily bicycles - because of their affordability and sustainability. The existing bicycles in rural areas however have a fairly short lifespan as they are often of a poor quality or not suited to the needs of the people. There have been attempts at developing a bicycle for rural South Africa, however most of these attempts do not fully meet the needs of the people and are often fairly expensive. In this paper I will discuss methods to design a mode of rural transport, specifically the bicycle, suited to the problems of people in rural parts of the country.

To begin with I would like to focus on general transport issues faced by South Africans. National statistics show that:

- 80% of South Africans depend on public transport
- 50% of South Africa's population live in rural areas of which 72% are poor
- Over 60% of rural households in South Africa say that public transport is not available to them or too far away to access.
- Of the almost 16 million learners who travel to school everyday, 76% (12 million) walk
- 550 000 children spend more than two hours a day walking to and from school (Fourie 2005;10).

These figures show the need for sustainable forms of transport. By providing transport one provides a catalyst for economic development and empowers the individual. Intermediate forms of transport (IMT's) form the bulk of rural transport. These include wheelbarrows, handcarts, bicycles etc.

Bicycles offer a cost effective and energy efficient means of transport. Many designs exist for various purposes. These range from the standard roadster design to hand-propelled tricycles used by paraplegics. Most bicycles in use in rural areas however do not fully meet the needs of people in these areas. The rural bicycle market is divided into two main areas: the new, cheap lower end bicycles, and second-hand bicycles, which are generally donated from overseas. Both these sources often fail to meet the needs of the buyers. The lower end, new bicycles are equipped with low quality parts that tend to break fairly easily. The second hand bicycles, although generally better quality, are often not suited to the rural conditions in which users travel. Bicycles in the *new* category sell for approximately ZAR700 for an adult model and ZAR300 for a children's model. These are termed *department store bicycles*. These bicycles are made as cheaply as possible and thus break fairly easily under harsh rural conditions. The average lifespan of these bicycles is 75 miles (120kms) www.afribike.org. Donated bicycles are often distributed by NGOs. They often subsidise the bicycles selling price to keep the cost to the user at a minimum. Often when importing these donated bicycles one does not know what kinds of bicycles one will receive. The most common bicycles donated are typically male roadsters. Although these bicycles are strong and stable, they cater predominantly for men. This is due to the fact that the crossbar inhibits women riders in their access, while often being too large for children. They are also perceived as "old men's" bicycles by the youth. As these bicycles are imported from many countries, they are often difficult to maintain as countries prescribe to different standards, i.e. different tube dimensions, wheel sizes etc. This increases the difficulty in finding the correct parts for ones bicycle.

With this problem and other needs of the users in mind Alewyn Botha and myself attempted to design a bicycle that would solve these requirements. The result was a modular bicycle that allowed the user to build up a bicycle suited to their specific needs (**Figure 1**). The different combinations incorporate the same frame and are assembled around it accordingly. The various seating and steering angles are determined by which way the frame is assembled. To establish the needs of a community one can carry out a *functional analysis* (**Table 1**).

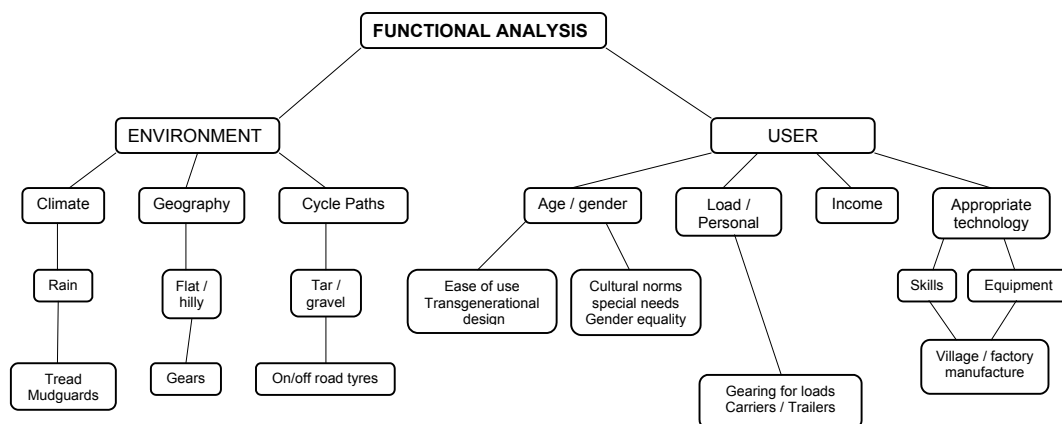


Figure 1: Modular Bicycle for Rural Transport

The following is a list of requirements I have compiled which acts as a checklist for cycle projects in rural areas. This list is not cast in stone, but a guide conceived through prior experience:

- Suitability
- Empowerment opportunities
- Sustainability
- Safety
- Information

Table 1: Functional Analysis



Suitability refers to the study of how the design fits within a given context; the functional analysis focuses on the needs of the user and the environment. Users will differ from place to place thus it is important to investigate exactly who the users will be and their subsequent needs. The two main areas of focus include age and gender. For example in some areas women do not ride bicycles because of cultural beliefs. The predominance of certain age groupings may differ vastly from village to village.

For example, some villages are largely populated by children and the elderly as older people have left to find work in more urbanised areas. When designing a bicycle for this scenario one deals with transgenerational design. Different age groups relate to different aspects of the product: the older generations focus primarily on pragmatic qualities such as strength, while an aspect of the youth's focus is often the "cool factor" and aesthetics.

When analysing the environment one needs to look at the local climate, geography and cycle paths. These environmental aspects will determine the physical attributes of the bicycle. For example if the area is prone to high rainfall and cyclists travel on dirt roads the bicycles will need mud-flaps and off road tyres. When introducing a cycle project into an area it is important to analyse the *empowerment opportunities* it will provide. The primary opportunity would be mobility of the individual and/or goods. This is often easily achieved with the introduction of an already assembled bicycle or tricycle. However, empowerment opportunities can be improved if one looks at the bigger picture. Here we need to focus on appropriate technologies and devise business models to suit the area in focus. For example one can have the bicycles assembled within the community. This would involve spoking of wheels, frame assembly etcetera. By doing this the community could probably procure the bicycles more cheaply (as parts) and begin to generate income by means of assembly shops. I worked with communities in the North West province on a similar sort of project. The two villages, Pitsedisulejang and Mathopestat, both have basic manufacturing knowledge and unemployed people wanting to work. For this specific area I designed a modular bicycle that can be built and assembled within the village using basic machinery (**Figure 2**). This results in greater job opportunities at different levels.



Figure 2: Redesigned Bicycle using Gender Neutral Frame

These levels include:

- Manufacture – Parts fabrication
 - Welding
 - Painting
 - Wheel fabrication

- Assembly –
 - Spoking of wheels
 - Assembly of frame

- Spin off possibilities - Custom paint work
 - Fabrication of seat covers
 - Transport related jobs, e.g. food delivery to the elderly

The *sustainability* of the project or product is important. A project should be able to sustain itself and grow without the intervention of outsiders. The product should last,

as people within rural communities do not often have disposable income. The product should therefore be sturdy and suited to the work it will be used for. The aesthetics of the product should not prescribe to any current fashion trends so that it has enduring appeal.

Due to the rudimentary road infrastructure often found in rural areas cyclists often have to use the same roads as motor vehicles. For this reason as well as the fact that there often aren't road lights, visibility is a very important aspect of *safety*. This can be achieved by either painting the bicycles with reflective paint or with the use of reflectors. The strength of the bicycle and its components is an important safety aspect. The bicycle must be able to carry the weight of the rider and their load often over uneven terrain. This necessitates the use of appropriate wheels. On adult bicycles a good set up is balloon-bike rims, which are wider and stronger than standard single wall 26" rims. The wheel should be spoked in a 4-over assembly. *Information* relates to knowledge transfer such as maintenance and proper use. This is important in extending the life of the bicycle and its components.

Once the context has been analysed one can go about deciding what kind of bicycle or system would be suitable. An implementation solution seen developing in South Africa is the introduction of container shops that bring bicycles and parts closer to the people in rural areas. By doing this availability of parts and bicycles is improved.

The increase of bicycle use within rural communities could be improved with the introduction of a bicycle specifically suited to the communities needs. Implementation plans can have little long term effect unless the means of transport being promoted is appropriate to the environment and the peoples real and perceived needs. This paper has attempted to address the design challenges involved in creating a mode of transport specifically aimed at the South African rural context. I have discussed the impact the lack of transport has on the social and economic aspects of rural life in South Africa and how design methodology can assist in solving this problem. The bicycles pictured are specifically suited to the needs of rural communities and are representative of a user centred design approach.

Bibliography

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