Executive Summary

A Performance-based Standards (PBS) framework legislates the dynamic performance and road-width usage of heavy vehicles, allowing the length and mass of a vehicle to exceed prescriptive legislation. The PBS framework defines the safe performance envelope of vehicles but does not optimise their safety and productivity. The design process to achieve the optimal productivity of PBS vehicles is highly iterative. An initial design is evaluated using multi-body dynamics simulation. If the required PBS performance is not achieved, design iterations are made until the required PBS performance is achieved. The process is costly, time-consuming and computationally expensive. The objective of this research is to quantify the relative effect of each Vehicle Design Parameter (VDP) of a multi-body vehicle dynamics model on the vehicle safety as measured within the PBS framework to assist in the PBS assessment process. To achieve this, three representative baseline PBS vehicles were developed (a quad semi-trailer, tridem interlink and rigid drawbar combination) from PBS assessments conducted in South Africa. A set of ranges within which each VDP could be varied was developed by considering Original Equipment Manufacturer (OEM) data, legal restrictions, physical constraints and South African PBS assessments. Each VDP for each baseline combination was varied in isolation to evaluate its influence on the vehicles performance within the PBS framework. A comparative matrix was developed for each baseline vehicle comparing the relative influence of each VDP on each of the PBS performance measures. The matrices yield insight into which VDPs have the most influence on each performance measure for each of the baseline vehicles. Furthermore VDPs that have a negligible influence on the performance of all baseline vehicles can be conservatively estimated in the absence of OEM data while still predicting representative vehicle performance. These insights will guide designers to focus on VDPs with a high influence on vehicle performance, allow PBS assessors to determine which design parameters can be modelled with generic approximate data in the absence of OEM data, and speed up the process of assessing vehicles within the PBS framework.