Chapter 5: Conclusions and recommendations

5.1 Conclusions

Present compressor control methods are not efficient. Compressor priorities need to be updated regularly by the compressor control room operator. These compressors' priorities remain fixed and certain compressed air network conditions may cause the compressors to cycle. Compressor pressure set point control is done on all compressors at the same time, causing all the compressors to run at reduced efficiency. The compressed air networks in the mining industry are generally old and not very well maintained. This contributes to pressure friction losses.

The need exists for a demand-side and supply-side management tool for large compressed air systems in the mining industry. This tool is called the dynamic compressor selector (DCS) and was developed from identified user requirements. It calculates pipe pressure losses between the compressor house outlets and shafts on a compressed air network. This information, together with individual compressor performances, was used to ensure the most efficient selection of compressors is possible.

The challenges that had to be addressed with the development of the DCS were divided into manageable parts as discussed in Chapter 1's problem formulation. These included the compressed air network, compressor control, compressor control room operator, communication network and quantifying pressure loss components.

In Chapter 2, the inherent challenges of each component of the compressed air network were discussed. A user requirement was developed accordingly. The DCS had to reduce compressor and multiple compressor pressure control. It also had to minimise compressor blow-off. Furthermore, the most efficient compressor combination needed to be scheduled by the DCS for varying system conditions. Energy costs can be further lowered by operating the compressors at the smallest possible pressure set point to reduce unnecessary system losses.

In Chapter 3, the research and calculations required for the development of the DCS was presented. This was done according to the user requirements stipulated in Chapter 2. Assumptions pertaining to fluid flow, pipes of the compressed air network and compressor performance were made to simplify the development of the DCS. The assumptions were within the 10% accuracy range that can be expected from pipe flow calculations. Compressed air properties, pipeline properties, network solving approaches, compressor mapping and a compressor selection were investigated, which led to a DCS solution that was verified with theoretical and actual logged historical data in Chapter 4.

From the results obtained in Chapter 4, it is possible to simulate compressed air networks accurately using the DCS. It was also proven that the DCS compressor selection method was an improvement on the present fixed priority compressor control method. Compressor cycling was reduced, but not eliminated. Furthermore, the power consumption and flow demand for reduced shaft pressures were investigated. It was found that less power is consumed when shaft pressures and compressor set points are reduced outside peak drilling times by the DCS.

Five DCS projects have been submitted to Eskom and are shown in Table 10. These projects were submitted as peak clipping projects with the aim to reduce electricity load on the national grid during Eskom's domestic evening peak.

	Target savings (kW)	Annual savings (Rand)
Mine 1 (Three networks)	3.33 MW	1.463 mil
Mine 2	2.40 MW	1.064 mil
Mine 3	2.50 MW	1.109 mil
Mine 4	1.44 MW	0.621 mil
Mine 5	3.00 MW	1.330 mil

Table 10: Estimated annual savings

The researcher is confident that the DCS can be implemented successfully and safely at these mines to generate compressed air more efficiently and reduce compressor cycling.

5.2 Recommendations for further study

The DCS needs to be implemented at the case study and the results have to be reported. When the surface control valves have been installed, the theoretical energy savings can be verified. The effects of compressor blow-off when using the DCS has to be investigated.

For the DCS development, the compressors were mapped at fixed inlet temperatures, using one pressure range. More detailed compressor characteristic maps could be populated and their effects on compressor selection examined.