HISTORIC OVERVIEW OF MECHANISED TRACK MAINTENANCE IN SOUTH AFRICA

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1. INTRODUCTION

Since the delivery of the first machine to South Africa from Plasser & Theurer of Austria in 1957, mechanised maintenance machinery ownership, operating and contracting has gone through a number of evolutionary steps to become one of the most successful and productive systems currently in the world.

![Figure 1: Plasser & Theurer VKR01; the First Tamping Machine in South Africa 1957](image)

Since 1995, the railways have completely outsourced their mechanised maintenance activities and rather focused on their core business. They generally no longer lease, hire or own any heavy on-track maintenance machines as they did in the beginning but contract the full service to contractors specialising in this area. This led to efficiency that made mechanised maintenance cost in South Africa, a benchmark around the world.

The historical process was dictated by various factors including very low availability figures achieved in the beginning and the rapid technological advances in mechanised maintenance making the machines very sophisticated which required specialised knowledge from highly qualified, trained and skilled artisans and technicians. Unlike its partner firms in the rest of the world, Plasser South Africa had to adapt to these market demands and became a contractor that owns, operates and maintains an extensive fleet of mechanised track maintenance machines today.

This document will provide a detailed explanation of the lessons learned from the past and discuss the pros and cons of the various models.
2. THE HISTORICAL PROCESS OF MECHANISED MAINTENANCE CONTRACTING

2.1. Machinery Owned, Operated and Maintained by the Railway

Mechanised maintenance in South Africa started in 1957 with the landing of the first tamping machine from Plasser & Theurer of Austria, the VKR01 (Figure 1). There is no doubt that it was successful if one considers the large number of machines working on the South African railway network today and that most of these machines are Plasser & Theurer machines.

However, the railways experienced difficulty maintaining the machines without local technical support and machine components had to be ordered from Austria which would have had machines standing for extended periods on breakdown while waiting for delivery.

As a result, with the second order of the more advanced VKR 04 tamping machines in 1959, Plasser South Africa was established as the South African partner and also the first of the international partners of Plasser & Theurer.

The local establishment of the original equipment manufacturer (OEM) still benefits the railways in many ways today. Plasser South Africa’s relationship with Plasser & Theurer provides South Africa with access to the vast experience, technical know-how and continuous technological progress made by the 18 international partner firms of Plasser & Theurer. Plasser South Africa uses this benefit to their advantage by continuously upgrading and updating their machines to improve reliability and availability, something that is of paramount importance on today’s high traffic density commuter and heavy haul lines.

2.2. Machines Owned and Operated by the Railways and Maintained by the Original Equipment Manufacturer

Since delivery of the first machines to South Africa, the advances in track maintenance and construction mechanisation technology was phenomenal.
Machines were designed to produce higher production in leaps and bounds to satisfy the demand by the high traffic density and heavy haul lines. However, with high production and technology goes sophistication of all the systems used on these machines. From early days Plasser South Africa also produced the machines locally which increased their skill levels and technical knowledge of the machines.

To address the problem of maintaining specialised knowledge of the machines, the railways contracted Plasser South Africa in the 1960’s to maintain the machines by providing a fitter to work full time at the machines. Indications are that there was no synergy and conflict arose between the railway’s operator and the OEM’s fitter about the low availability of the machines of as low as 65%; with the one blaming the other.

Such low availability figures necessitated additional machines to maintain the required tamping cycle of the lines. This in turn increased the unit costs of track maintenance and was clearly not the most efficient system to use.

2.3. Machines Owned by the Railways and Operated and Maintained by the Original Equipment Manufacturer

The next logical step was to contract the OEM to operate and maintain the machines with high demands on performance and availability. Plasser South Africa was obliged to expand its operations to provide the high level of technical support that would be required to avoid the high penalties that became applicable for poor performance at the time. This model improved the availability and efficiency of the machines enough to have progressed to the point where contracting is today.

2.4. Machines Owned Operated and Maintained by the Original Equipment Manufacturer or Contractor, Railways Provide Support Resources and Manage the Execution of the Work

The railways realised that their ownership of the machines meant that machines could be run to destruction over the contract period and would never be upgraded or refurbished by the contractors.

In the mid 1970’s complete mechanised maintenance contracting was introduced where the contractors owned, operated and maintained the machines. The OEM became completely accountable for the availability of the machine and was not paid for periods of breakdown. It was in the OEM’s interest to maintain the machine to a high level and to introduce modifications and improvements to the machine to increase efficiency, productivity and ease of maintenance. The OEM would therefore insure that it maintains a stock level of spare parts with long lead items, even high value ones, to ensure that a machine could be repaired in a very short time.

Workshops with sophisticated machinery were established to re-build or re-manufacture major components at a fraction of the price of new
components. Specialised tools and equipment were continuously developed to efficiently change components on site, especially major components, as opposed to having the machine shipped to a workshop and thereby removing it from production for an extended period.

![Figure 3: Major Components being Replaced Safely in the Field](image)

None of these would have happened was it not for the contracting model where ownership, maintenance and operation of the machines were not fragmented and contractors had sufficient confidence in the industry to make the huge investments that was required.

2.5. Railways Move Away from “Plant Hire” Type Contracts and Outsource All the Work, Including Support Resources and Site Supervision

Since 1995, all work associated with the mechanised maintenance project was outsourced and payment was made for work executed and not for plant hire as before. The OEM supplied all the support staff around the machines, supplied their own diesel, flagmen, track masters, general workers etc. and became a fully-fledged contractor.

The contracts incentivise availability and production which goes hand in hand. Higher production and availability means a better income to the contractor and at the same time reduces the unit cost of maintenance to the railway. It is a win-win situation which explains why this system is still in use in 2013 and why other railways around the world have moved towards the same concept.

Machine availability is now characterised by figures averaging at about 95% across Plasser South Africa’s fleet. This is a feat that is not known to be achieved anywhere else in the world where railways are the owners, operators and maintainers even today resulting in South African production and machine availability figures to be used around the world as a benchmark. It is not a bad reflection on the railways but rather the result of specialisation.
High machine availability has many advantages including:

- ensured maximum productivity from the machines; therefore
- a reduction of the number of machines to achieve the required production; and
- a reduction of the overall maintenance costs to the railway.

This is especially important on the high capacity lines such as commuter lines belonging to PRASA, the coal line and the iron ore line where the number of maintenance windows are very limited and the time interval between trains very short.

3. WHY IS MECHANISED MAINTENANCE CONTRACTING SO SUCCESSFUL?

The successes in mechanised maintenance contracting are due to a large number of factors which evolved over decades to reach the current optimal equilibrium level. Changes to the status quo will disturb the equilibrium level and certainly lead to higher costs, predominantly for the following reasons:

3.1. Economy of Scale

The South African mechanised maintenance market is very small compared to the rest of the world. The total number of mechanised maintenance machines in South Africa is less than 100 whereas in the relatively small Europe there are machines running into the thousands.

The number of suppliers of components in Europe is vast and obtaining components and contractors are relatively easy. In Europe various industrialised countries are neighbours using a single currency and free movement of goods and services. South African machines are built for Cape Gauge, making their spares fairly unique and requiring huge local stockholding.

Geographically South Africa is also a relatively large country with major cities and very large uninhabited rural areas in-between with poor industrial development and support. South Africa is isolated and components are only available if the OEM is established in South Africa. Alternatively components have to be imported at great cost and long lead times from overseas.

Mechanised maintenance contractors in South Africa therefore have the burden of having to carry a large support structure to make up for the shortcomings mentioned above. Plasser South Africa’s approximately 50 machines on contract have the advantage of economy of scale. Whether the company has 50 or 10 machines on contract, it will make only a small difference to the size of the infrastructure required which means that the costs of the machines will increase exponentially as the number of machines on contract reduces. This is also the partly the reason why despite many foreign contracting companies trying for several decades to enter the South African market, they have not been able to do so competitively.
3.2. Training

Operating and maintaining track maintenance machinery is highly specialised and not comparable to any other industry. Experienced machine operators, artisans and technicians are therefore not available on the labour market and have to undergo intensive training before they can work independently on a machine. The training is equally specialised which require Plasser South Africa to provide the training in-house in its own TETA accredited training facility in accordance with a formal curriculum for each category. Classroom training is presented by skilled technical staff and practical training is provided on site by machine supervisors. Assessments are carried out by in-house accredited assessors. Once again, developing the curricula, training material, training facilitators and assessors has taken many years.

If the economy of scale is lost or Plasser South Africa becomes exclusively a machine and component supplier and no longer a contractor, this facility and experience will be lost. Foreign companies and/or the railways will not be able to fill this gap for several years. It will diminish the pool of qualified operators and fitters to the point where there will not be enough operators and fitters to continue with the business of mechanised maintenance. This will negatively affect the availability and productivity of mechanised maintenance machinery and increase the overall cost of track maintenance.

3.3. Optimisation of Staff

Specialisation is the key to efficiency and creativity. Under a contracting arrangement, machine staff is optimised due to the fact that operating and maintenance staff work as one team and often have a dual function. Splitting of these functions between different contractors will require additional machine staff. There will also once again be split accountabilities with one party blaming the other for breakdowns. There is also the issue of availability where one party does not arrive for work the other party must still be paid regardless whether the machine is working or not.

3.4. Local Content

Due to all staff being South African, machines being manufactured and refurbished in South Africa and most components and major components either sourced in South Africa or manufactured by Plasser South Africa, the contractual local content from Plasser South Africa is around 90%. That means that 90% of the railway’s expenditure on mechanised maintenance will be redistributed in South Africa. With foreign contractors, the majority of the expenditure will leave the country to the detriment of the local economy, enterprise development, employment and skills development.

3.5. Spare Parts Holding

To ensure optimal availability and reliability of machines, Plasser South Africa holds a very large spares stock in excess of R80 million to ensure that
breakdowns can be attended to immediately. Should a machine break down, a replacement spare part can be dispatched on the same day, due to it being in stock, to ensure that the minimum working time is lost.

It must be emphasised that a different incentive exists between a supplier of machines and spares and a contractor maintaining and operating their own fleet of machines. Under a contracting arrangement, the contractor will ensure that spares are available and shipped speedily to continue with income-generating work, whereas if the contractor is requested to supply spares to customers only as an original equipment manufacturer, the cost of stockholding must be considered and expensive components may only be imported or manufactured once requested by the customer. In other words, the potential loss of income of not having the spare available is greater under a contracting scenario than the cost of keeping it in stock. The lead time for some major components is up to four months. There is no incentive for the supplier to carry large stock levels since the costs would be difficult to recover.

The mechanised track maintenance market in South Africa is too small for a company to be sustained only on the supply of spares and machines. If Plasser South Africa ceases to exist, a number of additional complications must be considered. Obtaining spares from an OEM in South Africa is simple but if it must be ordered from the OEM in another country, there is also the issue of payment, shipment and customs. A quotation or tender must first be obtained, the order placed, letters of credit arranged and documentation and clearing organised before the spares can be dispatched. During this lengthy process, the machine will be standing, reducing availability and production. The other alternative is for the machine owner or the railway to invest in its own spares stock but without the economy of scale, the stock levels may be excessively high, increasing maintenance costs of the machine and ultimately the cost of track maintenance.

3.6. Technical Support

Mechanised track maintenance machines consist of sophisticated hydraulic and electronic circuits working under severely harsh conditions. It is therefore an international challenge to achieve reasonable availability of the machines to ensure that production targets can be achieved and maintained so as to limit the number of maintenance windows and machines required.

Because the economy of scale allows it, Plasser South Africa supports its machines through various activities, systems and programmes. These include:

- A technical call centre which is on call for emergency assistance 7 days a week despite the level of training and experience on the machines.
- Annual and bi-annual inspections and random audits to detect machine problems and avoid unexpected machine breakdowns.
- Structured pro-active maintenance plans are prepared.
- A replacement program of major machine components is prepared annually to improve predictability and avoid machine breakdowns.
When major components require replacement, Plasser South Africa have specialised equipment to do so safely together with specially trained teams to carry out this work in the field.

Even if a contractor has one machine only, this support will still be required but would be excessively expensive. This service can only be provided by the OEM if its business is sustainable but due to the small size of the South African market this is unlikely unless the service can be offered at a very high cost, much higher than the current overhead costs carried by a company like Plasser South Africa who can rely on the economy of scale.

3.7. Major Component Overhaul

Plasser South Africa have a dedicated workshop for the refurbishing of major components such as tamping units, stabilising units, bogies, final drives, gearboxes, etc. Completed units are thoroughly tested, preserved and stored; ready for shipment to machines. These major components are planned for fitment based on inspections and audits and vast experience gained regarding the component’s reliable life expectancy.

![Figure 4: Major Component Refurbishing](image)

As mentioned before, the South African market is too small for an OEM to trade only as a machine and component supplier (including major components). If Plasser South Africa ceases to do business in South Africa, the machine owner will have to import these bulky components from overseas. With no local content in these components, they will be very expensive with the added costs of shipping and currency fluctuation risks.

3.8. Machine Refurbishment

Machines in South Africa are generally extensively utilised and not much time is available for major servicing. In order to ensure optimum performance of the machine throughout its life, it is necessary to refurbish it after each working cycle of 5 years. Plasser South Africa has a well-equipped workshop and skilled staff to carry out the required work. During this process, a machine is
completely disassembled, thoroughly inspected and rebuilt to efficiently operate for another 5 year cycle. During the refurbishing process machines are also upgraded to the latest technology and specifications.

If the OEM is not in South Africa, the expertise to carry out such major work will not be available and machines will become increasingly unreliable until they will rather be completely replaced with a new machine at great cost compared to that of refurbishment.

4. CONCLUSION

For over 50 years Plasser South Africa has been much more than just a supplier and contractor to the railways of South Africa. If one considers the level of commitment, sacrifice and cooperation over these years, Plasser South Africa cannot be seen as anything other than a partner.

Over the years the partners have grown together and learned many valuable lessons regarding mechanised maintenance ownership, operating and maintenance. Due to mutual commitment and trust, these lessons have culminated into the most successful and internationally recognised mechanised maintenance system in the world by which the railways are still great beneficiaries.

Disturbing the status quo is likely to be very disadvantageous to the railways and South Africa as a whole. South Africa will become dependent on foreign countries again for OEM support causing a net outflow of currency as opposed to retaining it in South Africa. Mechanised maintenance is guaranteed to become much more expensive over a short period. The worst may be that the reliability, availability, maintainability, affordability and safety of the railway infrastructure will be compromised.