THE SUGAR LOGISTIC IMPROVEMENT PROGRAMME (SLIP): AN INITIATIVE TO IMPROVE SUPPLY CHAIN EFFICIENCIES IN THE SOUTH AFRICAN SUGAR INDUSTRY

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Abstract

A logistics chain in the South African sugar industry has been defined as the different agents responsible for growing, hauling and milling sugarcane.

Inefficiencies in a logistics chain can be broadly classified into two categories:

- Individual inefficiencies associated with an inappropriate technology and/or the management practices of individual members of a logistics chain.
- Collective inefficiencies associated with inadequate teamwork and a lack of co-operation between members of a logistics chain.

Inadequate information is usually the primary reason for both inefficiencies. Supplying best practice information to individual logistics chain members will to some extent alleviate individual inefficiencies, where adoption rates will be demand-led, i.e. the decision to 'change' is made by the individual. Supplying best practice information and mill area comparisons will also help alleviate collective inefficiencies, but adoption will need to be supply-led, i.e. the decision to 'change' needs to be made by the logistics chain as a group. This necessitates some degree of proactive leadership.

The Sugar Logistics Improvement Programme (SLIP) was designed to capture logistics chain information in a number of different mill areas, and to identify best practice. Dissemination of this information via various reports to individuals in the logistics chain is intended to address inefficiencies by meeting information demands. Collective inefficiencies are addressed through the establishment of local mill area 'Efficiency Committees' (comprised of growers, hauliers and the miller), which empower local leadership to make beneficial changes to the logistics chain that will foster improved team work and co-operation between individual logistics chain members.

This paper describes how SLIP evolved, how data is collected, analysed and disseminated, and some of the progress made to date in terms of efficiency improvements. Some of the more innovative best practices are described, and new developments are discussed.

Keywords: sugarcane, logistics chain, SLIP

Introduction

Crickmay and Associates (CA) initially started their benchmarking initiatives in the South African timber industry, where they currently monitor 90% of the pulpwood moved in South Africa. As a consequence of this and other initiatives, the South African timber industry has been successful in reducing transport costs, showing a 30% real reduction in rates over the past 10 years. Timber transporters who also move sugarcane encouraged Crickmay and Associates to formally introduce their benchmarking systems to the sugar industry, which gave rise to the Sugar Logistics Improvement Programme (SLIP). The objectives of SLIP are to motivate participants to measure their operations, highlight areas of inefficiency and facilitate change towards best practice through information provision and promoting team work.

The SLIP database is also being used to review cane supply logistics in the South African sugar industry, with the objective of making policy changes in the form of a Strategic Plan that will enhance efficiencies for cane growers and the industry. The Strategic Plan and SLIP form the two legs of the Value Chain Improvement Programme (VIP), which was funded by the South African Cane Growers Association and the Sector Partnership Fund, a division of the Department of Trade and Industry, for two years, terminating in March 2004.

Methodology

Basis of measurement
A logistics chain in the sugar industry comprises an allocation group supplying cane to a specific mill using a specific haulier. The allocation group is an association of growers that can supply the mill with a rateable supply of cane during the course of the season. Large scale growers in many instances constitute their own allocation group. During the 2002/03 season, an average of 356 logistic chains were measured in seven milling regions.

Data collection
Data from all members of a logistics chain (grower, haulier and miller) was required. Where this was not available, the entire chain was excluded from the analysis. The study covered seven mill areas, *viz* Sezela (SZ), Noodsberg (NB), Maidstone (MS), Darnall (DL), Felixton (FX), Pongola (PG) and Malelane (ML). Data was centrally captured on a continuous basis at each weighbridge, using the Laboratory Information Management System (LIMS). This information made up the majority of the information requirement.

The grower
Growers were responsible for supplying harvest times (either time of burning or time of trashing) for at least 10% of the fields harvested, which was recorded by the grower on the cane delivery notes. The information was subsequently captured centrally at the weighbridge, using LIMS. Initially, 28% of all deliveries entering the seven mill areas had the harvest times recorded. This increased to 66% by the end of the 2002/03 season.

The haulier
Hauliers were responsible for providing loading times, mill queue delays, type of vehicle(s) used, lead distance and other information. Initially the information was required monthly but has subsequently been streamlined into an annual questionnaire, due to the relatively static nature of the information over time.

The sample size over the seven mill areas at the start of the project was 35.5% of cane delivered, reaching 43.5% by the end of the 2002/03 season. Recently most of the data has been recovered automatically off the weighbridge, increasing the response to 80% in most mill areas.

The miller

Each of the seven mills provided a list of growers who are grouped into the relevant allocation groups and linked to the relevant haulier responsible for the delivery of the sugarcane. This information was used to set up the basis of the measurement – the logistics chain.

The laboratory information management system (LIMS)

Most of the required data was sourced directly off the weighbridge, where delivery and quality data were captured onto the LIMS database. This information included source of the cane, the haulier, vehicle, tare weight, gross weight, mill arrival time, mill depart time and cane quality (RV%).

General problems in the supply chain

The cane supply chain

Cane supply chains can vary significantly, and Figure 1 shows the two most common types of supply chains in the sugar industry: (i) transhipment on a zone, and (ii) infield direct.

In some instances the grower and the haulier might be a single entity. In terms of sugar industry legislation, growers are responsible for the delivery of their cane to the mill weighbridge for cane payment purposes. In many instances growers transfer this responsibility to independent contractors, who may undertake some or more of the following: cane harvesting, haulage infield and direct to the mill, haulage infield to a zone, transhipment on the zone and haulage from the zone to the mill. Conversely, the mill is responsible for ensuring availability of suitable offloading facilities at the mill and that the delay inside the mill is kept to a minimum.

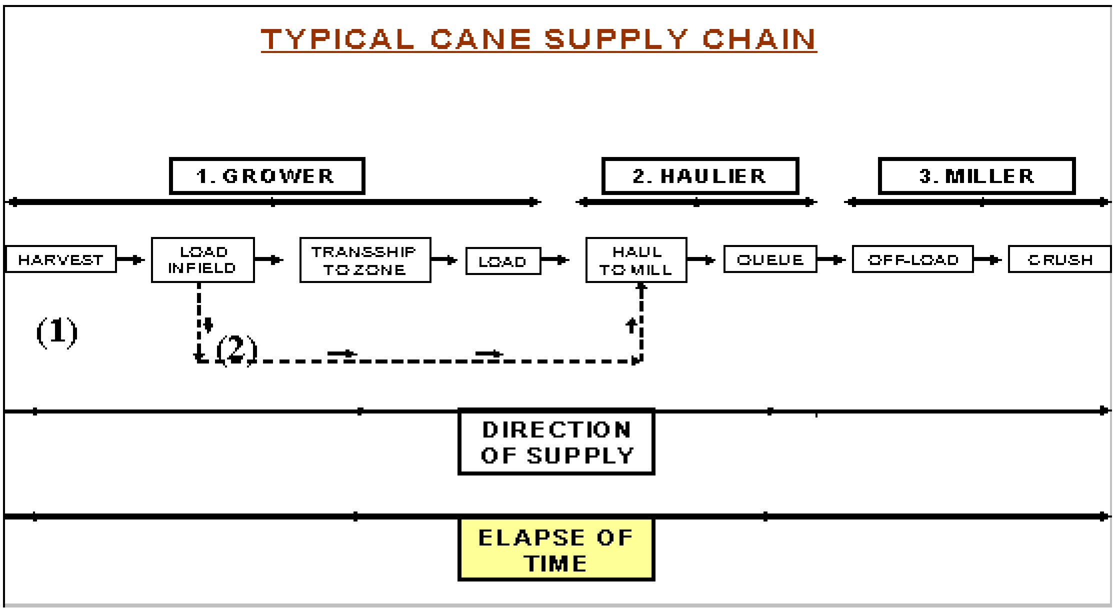

Figure 1. Typical flow of material in a sugarcane supply chain.

The functionality of logistics chain members (grower, haulier and miller) are interdependent, as the interaction between logistics chains in a mill area influences the overall effectiveness of the chains. For example, if the mill stops crushing due to technical reasons there will, in most cases, be a build-up of cane in the system, either infield, on zones or in vehicles (usually at the offloading points resulting in long mill queues). This type of scenario means a loss of capacity for the mill, an increase in stock for the grower which results in higher burn to crush delays (lower cane quality) and the disruption of scheduling, resulting in lower vehicle utilisation and less efficiency for the haulier.

This example highlights the vital importance of co-operation and team work required between parties, to minimise disruptions in the system that have negative financial implications for the participants as a whole.

Problems identified in the cane supply chain

There are a few general but fundamental problems identified in the different supply chains entering each mill.

The most important of these include:

- The growers, hauliers and miller are generally only concerned about their own operations. This affects team work and results in inefficiencies. The main focus of SLIP is to break down these barriers and get the supply chain to resemble a pipeline (Christopher, 1999) instead of a broken chain.
- The participants are often uninformed. This leads to a breakdown of team work and the adoption of inappropriate practices.

Inadequate information and communication bottlenecks are partly responsible for the following inefficiencies:

- Poor vehicle utilisation and over-fleeting
- High mill queue delays
- Low vehicle efficiencies
- High burn to crush delays.

SLIP is designed to capture and present appropriate information and address any communication bottlenecks. The Strategic Plan is intended to highlight these issues and others in a holistic approach with the intention of improving efficiencies and reducing costs.

Results and discussion on inefficiencies identified by slip

Poor vehicle utilisation and over-fleeting

If there are more vehicles than required to deliver a certain tonnage of cane, the extra capital in the system is costing the supply chain money. This inefficiency leads to other problems down the chain, such as poor scheduling, no cane stops and long delays for the vehicles at the mill.

Figure 2 shows that Malelane (ML) has the best utilisation of vehicles, as each vehicle is delivering a higher tonnage of cane over the measurement period.

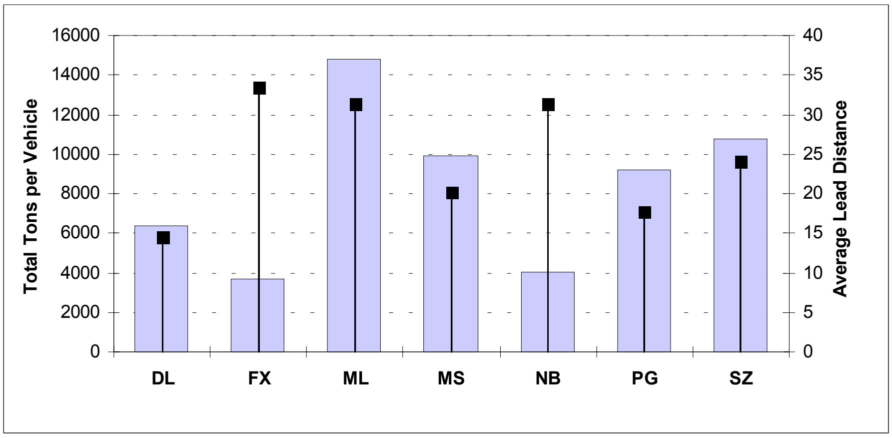

Figure 2. Total number of tons delivered per vehicle per mill area from July 2002 to the end of the season.

Poor utilisation leads to over-fleeting and other problems associated with an ability to schedule vehicle arrivals at the mill, resulting in either lengthy mill queue delays or no cane stops at the mill. Figure 3 shows the number of arrivals per hour per mill area over 24 hours averaged over the 2002 season. A co-ordinated and balanced supply chain would have the number of arrivals per hour represented as a straight line.

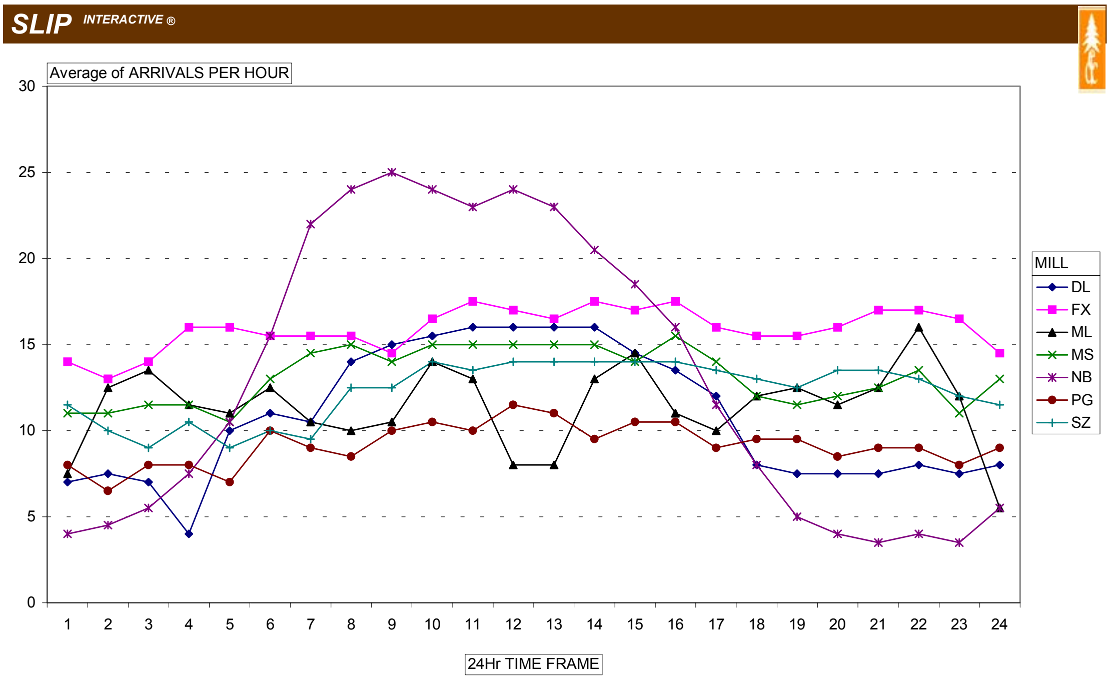

Figure 3. Average number of arrivals per hour per mill.

High mill queue delays

High mill queue delays are often as a result of the over-fleeting situations at each mill. One of the large influencing factors of this is the crush rate fluctuations of the mill, as well as the scheduling systems employed by the hauliers and the type of scheduling system employed at the mill. When the crush rate of the mill varies significantly, mill queue times often rise due to inadequate communication with hauliers and their ability to adjust their scheduling systems.

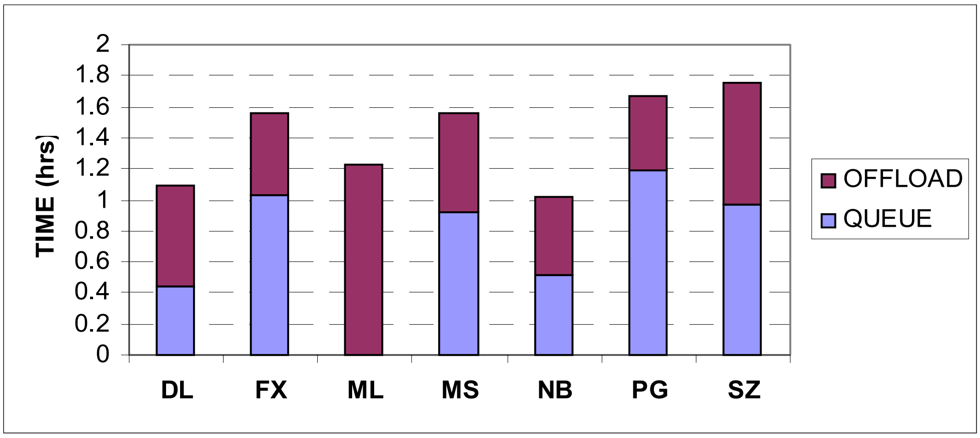

Figure 4. Average time (hours) spent by hauliers at the mills during the offloading process (averaged for the 2002 season).

Figure 4 shows the total time spent at the mill by transporters. The mills with the highest mill queue delays generally experienced high mill crush fluctuations. The two mills (DL and NB) with the lowest mill queue delays both have a storage facility that buffers the effect of the variable crush rate of the mill.

Low vehicle efficiency

Vehicle efficiency in the SLIP programme is defined as being, 'how well the haulier uses his vehicles when the vehicles are being utilised'. The type of vehicle and the vehicle's operating environment have the largest influence on efficiency. The unit used to measure vehicle efficiency is 'tons delivered per hour', which means the vehicle's payload and cycle time are the factors driving its efficiency, i.e. increasing payload and decreasing cycle time are the main drivers.

Vehicle efficiency in the sugar industry varies considerably from mill to mill as well as within mill areas, even after lead distances have been taken into account. The main reason is the vast number of different types of vehicles being used and the different environments in which they are operating.

Figure 5 shows the efficiency of vehicles per lead distance category. The graph is further categorised into payload categories which show how the type of vehicle will affect efficiency. In most cases the further the vehicle has to transport the cane, the more important the payload becomes. The inefficiency shown here is the inability of the transporters to use the correct vehicle for specific lead distances.

High burn to crush delays

High burn to crush delays seem to be influenced by the type of farming practice employed, although in many cases a high delay cannot be avoided due to cost, terrain and other barriers set in place by the supply chain itself. The higher the delay the lower the cane quality, thus it is in the best interests of the grower and the miller to ensure this time is reduced to a minimum (Loubser, 2002). Figure 6 shows the average delay from burn to crush in the seven mill areas. As seen in the graph, the longest delay experienced is from the time of burning or trashing the cane until it is loaded onto the haulage vehicle. The worst average delay for a mill from the time of harvest until being loaded onto the truck was 70 hours (3 days) for the 2002 season!

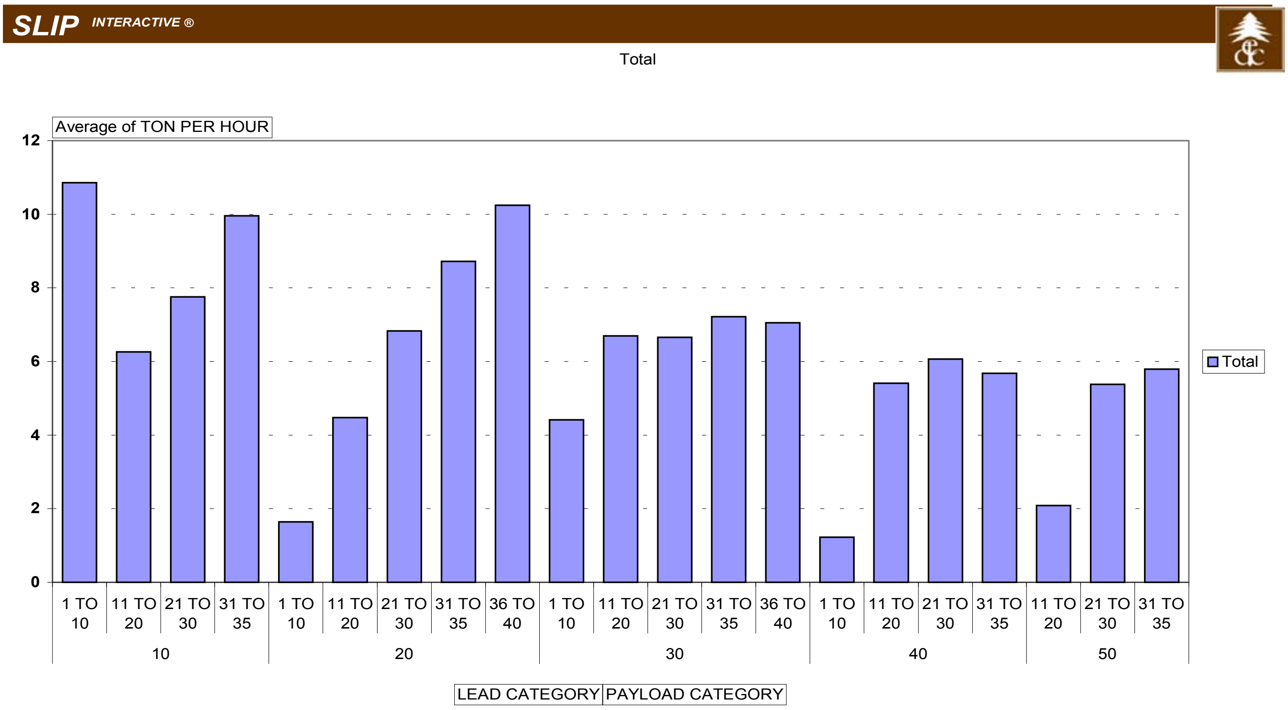

Figure 5. Average vehicle efficiency (tons per hour) per mill area categorised into payload and lead distance (averaged for the 2002 season).

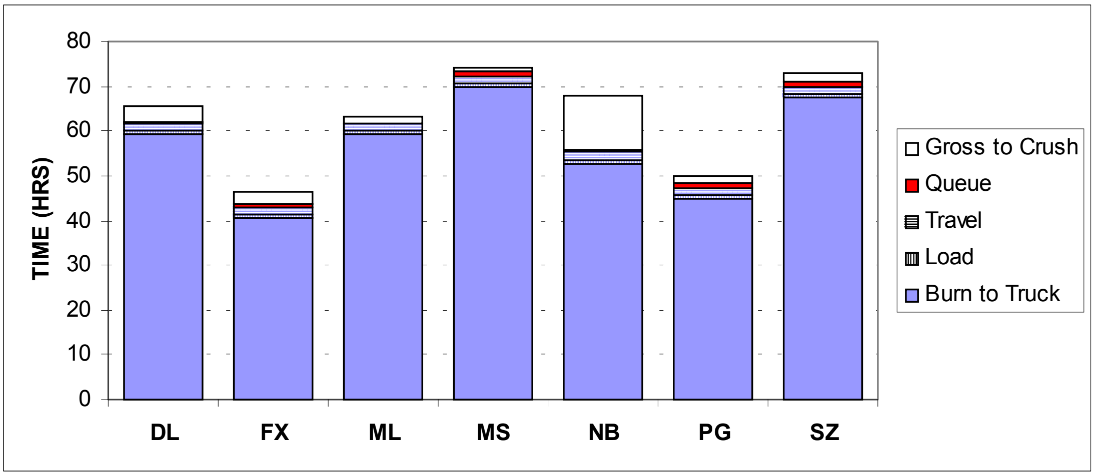

Figure 6. Burn to crush delays for cane in the seven mill areas. The delay is split into: burn to the truck, loading time, travel time, mill queue time and storage time in the mill before being crushed (gross to crush) (averaged for the 2002 season).

How slip proposes to resolve key problems identified

SLIP is designed to overcome the information bottleneck by disseminating reports that highlight the difference between average and best practice (create a need to change), and through the setting up of Efficiency Committees to help workshop the information and to facilitate team work in solving the problems in each mill area.

Reports
Separate reports are produced for growers and hauliers. Both reports contain information that relates to all three participants (grower, haulier and miller) in the supply chain. This means the person reading the report is able to identify which participant in the chain is responsible

for inefficiencies. The intention is to encourage participants in a logistics chain (grower, haulier and miller) to discuss the content of the reports in a transparent manner.

The grower report does not contain as much detail as the haulier report. It is made up of ranking schedules which rank the grower's logistics chain according to various performance factors. Table 1 shows the ranking schedule focusing on the efficiency of the haulage system.

Table 1. Ranking schedule for vehicle efficiency. This logistics chain is found in a lead distance category of 10 to 20 km (averaged for the 2002 season).

Allocation group	Ranking schedule: Lead category (10-20 km)							
	Payload STD Dev	**Tons per hour**	Ave payload	% trips overloaded	Ave speed loaded	Ave cycle time	Fuel cons.	Value lost
ML20	134	**116**	135	57	73	82	153	129
Sample Size	**158**							

The haulier receives the ranking table and the actual data. This was done for two reasons. Firstly, it was found that the growers were not overly concerned with detail and preferred a shorter report, and secondly, communication is promoted if the grower wants more detail because contact must be made with the haulier.

Table 2 shows the actual detailed table of the ranking schedule found in Table 1, which the haulier receives.

Table 2. Details of the ranking schedule found in the haulier report.

Lead distance category: 10-20 km					Factors affecting tons per hour moved					
Allocation Group	Haulier Pin	Destination	Tons Per Hour		Payload STD DEV	Ave payload (tons)	% Trips over-loaded	Ave speed loaded (km/h)	Ave cycle time in hours	Ave fuel cons (L/100 km)
			Current	YTD						
ML20	**180**	**ML**	**5.81**	**6.77**	**4.2**	**22.5**	**36.5**	**20.6**	**3.9**	**80.0**
Best Practice (Malelane)			6.96	6.96	3.4	25.5	6.8	27.4	3.7	73.6
Best Practice (All Mills)			9.59	9.59	2.2	22.5	0.0	24.0	2.3	60.0
Best Practice (Transport From Zone)			8.38	8.38	4.3	30.8	0.0	11.1	3.7	73.2
Best Practice (Transport From Infield)			7.92	7.92	1.8	20.9	0.8	32.8	2.6	62.0
Best Practice (Burnt Cane)			9.59	9.59	2.2	22.5	0.0	24.0	2.3	60.0
Best Practice (Trashed Cane)			6.77	6.77	3.3	25.8	1.0	19.5	3.8	67.0
Best Practice (Spiller)			9.59	9.59	2.2	22.5	0.0	24.0	2.3	60.0
Best Practice (Bundle)			7.92	7.92	1.8	20.9	0.8	32.8	2.6	62.0
Industry Average			5.77	5.77	3.0	23.4	0.8	22.1	4.4	64.1

Highlighting best practice

One of the main objectives of SLIP is to encourage participants to adopt more efficient practices willingly. SLIP does this is by highlighting actual performance against best practice. To date the difference between average performance and best practice has been large, indicating that significant improvements can be made. Many project participants have achieved, or are in the process of achieving, more efficient practices.

To highlight the difference found between average practice and best practice, Figure 7 depicts the average vehicle efficiency (tons per hour) per mill area per lead distance category averaged for the 2002 season. In each lead distance category there is a difference of at least three to four tons per hour between best practice and the mill average.

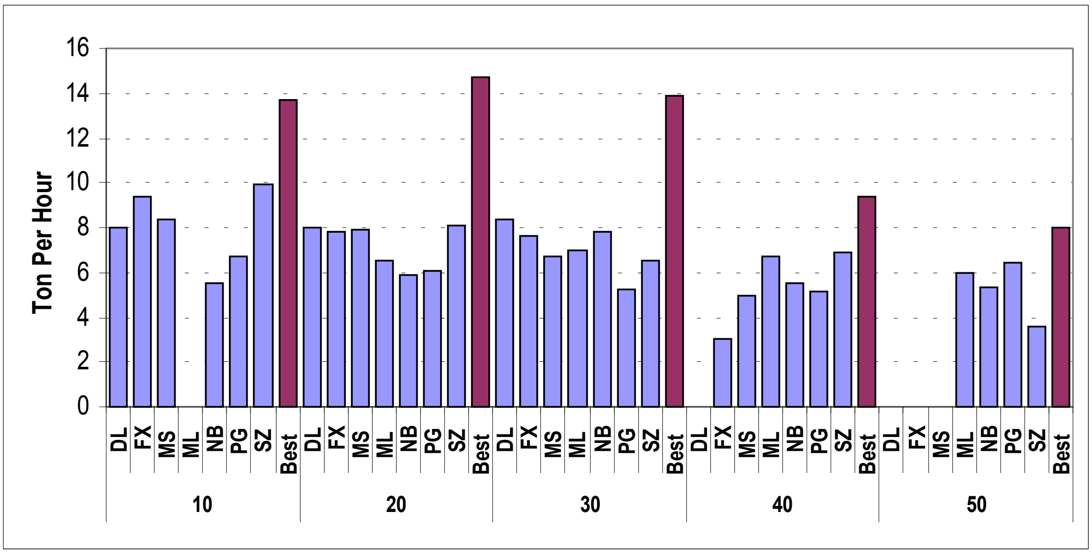

Figure 7. Vehicle efficiency per mill area per lead distance category compared with best practice (averaged for the 2002 season).

After best practice systems were identified, Crickmay and Associates completed a costing analysis of the best system, using their CaneGap program. This analysis was done mainly due to participants wanting to know the costs and to see whether being efficient could mean doing it at a lower cost. The results that came out proved this to be correct.

Efficiency committees

The final way in which SLIP will break down the bottlenecks and improve efficiencies is by setting up a forum at each mill area, to:

- Interrogate the SLIP data as a group using the SLIP database and to make recommendations to the Mill Group Board (MGB) regarding generic mill area efficiency improvements.
- Highlight best practice systems and communicate them to mill area stakeholders.
- Facilitate two annual mill area workshops involving presentations from Crickmay and Associates.
- Raise finances through levies to fund necessary efficiency programmes.
- Encourage and support haulier/grower study groups to study their logistics chains in more detail.

These committees are vital as they will be the driver for breaking down the primary bottleneck – lack of communication and information flow.

The tool that will be used by the committees is the ***SLIP**^interactive^* management tool, which gives the users the power to draw any information from the SLIP database, categorise it and display it as a graphic at the touch of a button. This tool has proved to be very powerful when used in a group forum.

Progress made

The following figures show some of the improvements made in various mill areas. Figure 8 shows the best vehicle efficiency improvement in the lead distance category, with Felixton showing an improvement of almost 14%. The reduction of 9% in burn to crush delays at the Maidstone mill (Figure 9) is particularly noteworthy, and one of the most impressive improvements is the 40% reduction in mill queue delays at the Felixton mill (Figure 10).

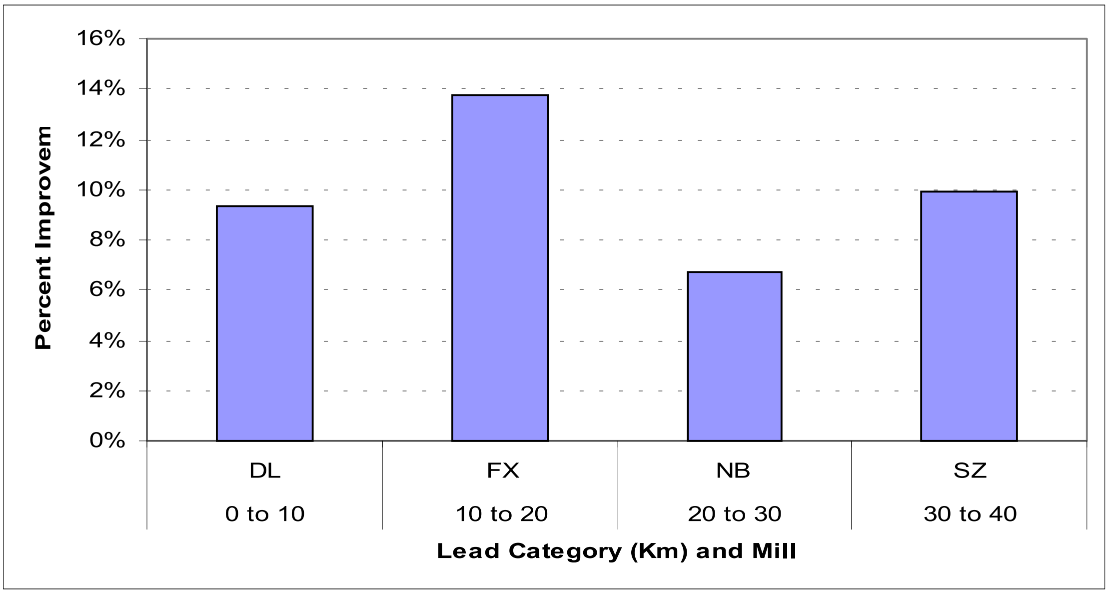

Figure 8. Best vehicle efficiency improvement in the lead distance category (averaged for the 2002 season).

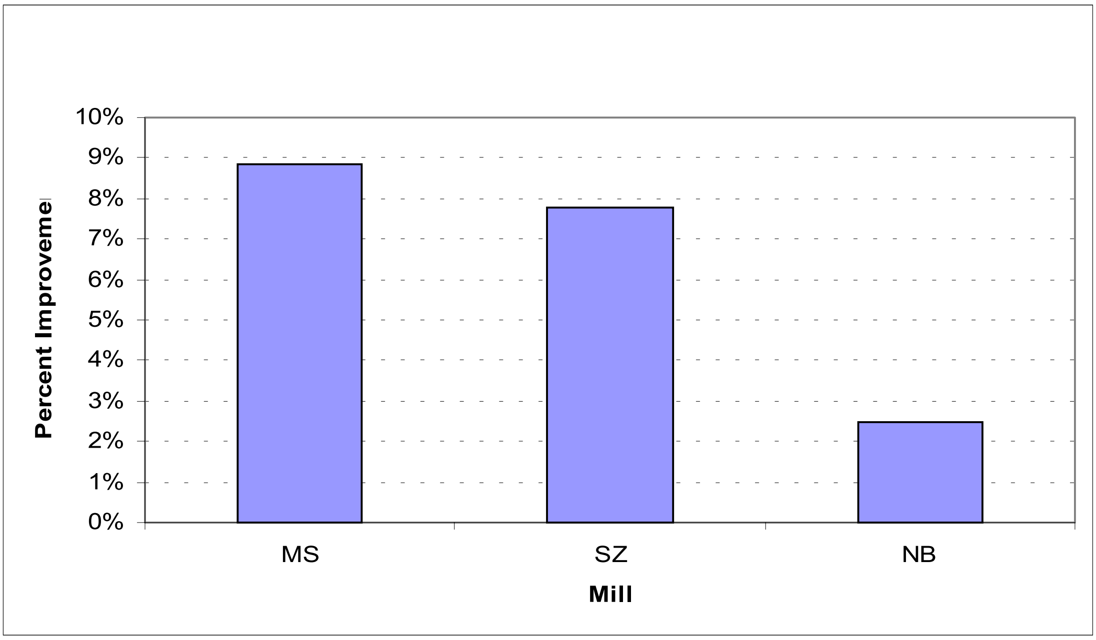

Figure 9. Mills showing improvement in burn to crush delays (averaged for the 2002 season).

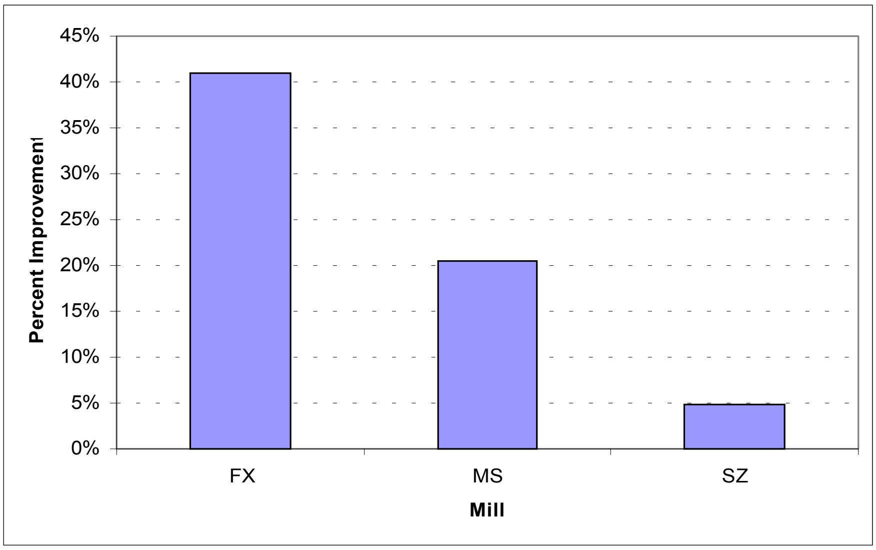

Figure 10. Mills showing improvement in mill queue delays (averaged for the 2002 season).

An innovative best practice called the 'Dolly System' was identified for vehicle efficiency.

The 'Dolly' fleet consists of two truck-tractors and three sets of interlink trailers (a standard system would require four truck-tractors and four sets of trailers to move the same amount of cane) that operate as follows (see Figure 11):

- The truck-tractor arrives at the zone with an empty set of trailers (1) which are replaced with loaded trailers waiting on the zone (4).
- The empty trailers are split and two tractors with the special adaptor dolly (hence the name 'Dolly' system) take the trailers into the field to be loaded (3).
- When the trailers have been loaded infield, they are taken back to the zone, where they are re-coupled. The process is then repeated.

This very efficient system has attracted significant interest in the industry. The efficiencies associated with this approach have the potential to significantly improve vehicle efficiencies if widely adopted.

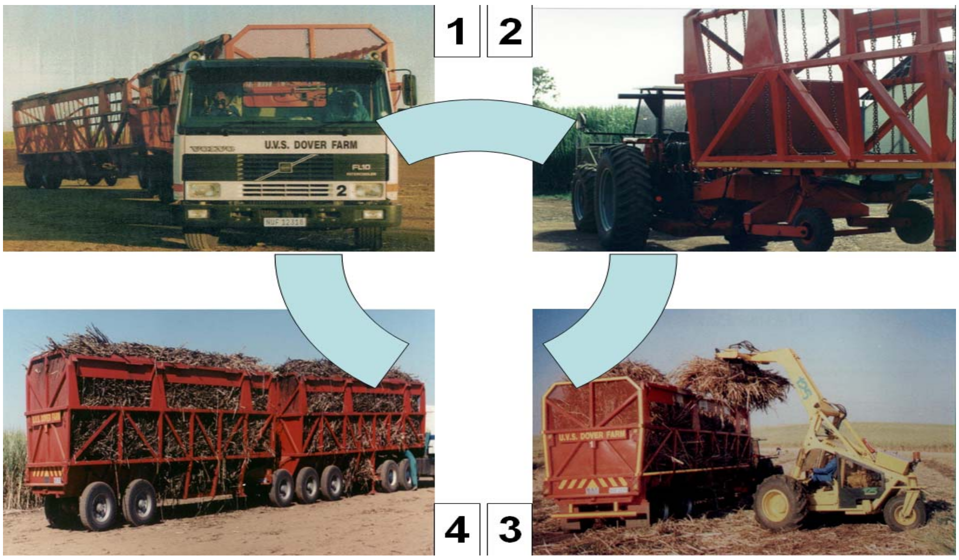

Figure 11. The operating cycle of the 'dolly' system.

Conclusion

The formation of the SLIP efficiency committees is the first step towards achieving long term commitment to the program in each mill area. SLIP needs to continuously measure progress being made and continuously highlight successes to drive and increase the momentum of change. Internationally, the goal for SLIP is to benchmark the cane supply chains against other cane growing countries. This ultimate goal will be able to provide best practice benchmarks that could enhance the supply chains of cane producing countries and provide international standards to promote globally efficient operations.

Acknowledgements

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