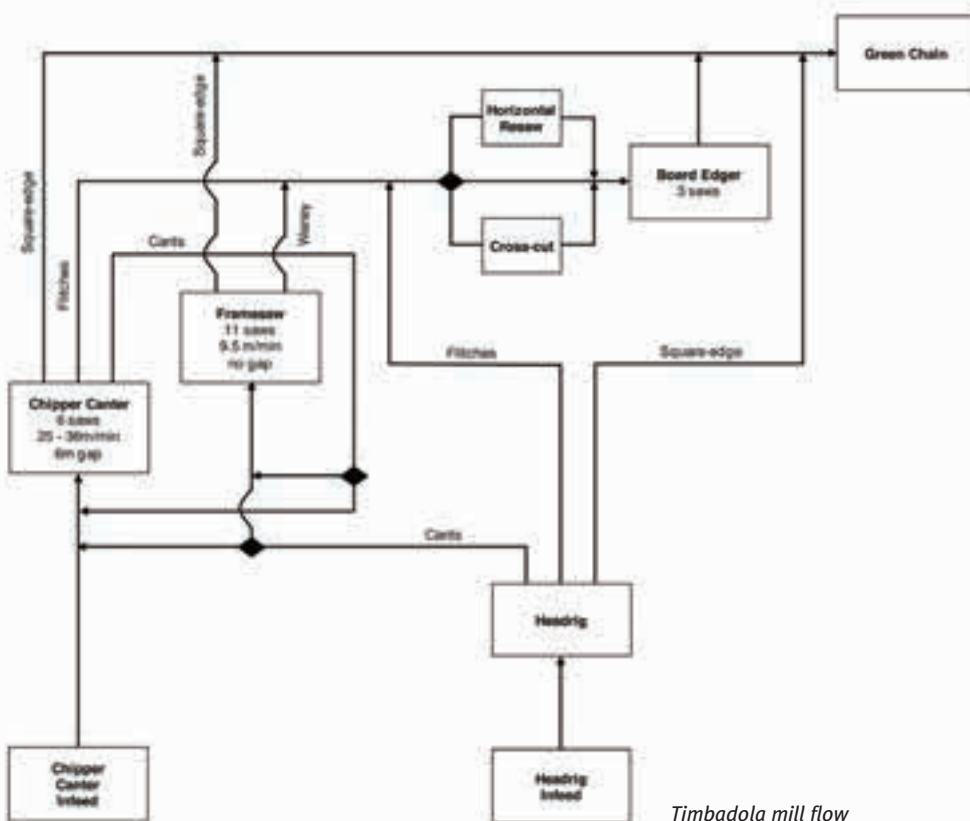




The metric that matters

When the South African forestry and sawmilling company Komatiland Forests went looking for a production planning optimisation system to improve its operations, it hardly expected to find that ideal system half-way around the world. But a chance meeting with HALCO Software Systems of Vancouver, Canada, led to an interesting and ultimately very successful collaboration and a sharpened focus on “the metric that matters”



Timbadola mill flow

The Timbadola sawmill

Komatiland's Timbadola sawmill is located in Limpopo province, in the far north of South Africa. The mill processes pine, primarily *P. patula* (Mexican weeping pine) and *P. elliottii* (slash pine), from plantations managed by the company. The pines grow very well in this region, with a final clearfell at 30 years, and with sawlogs recovered from thinning operations as early as 12 years. The majority of the mill's production is structural products, along with some industrial and packaging, primarily for the domestic South Africa market.

The Timbadola mill has a capacity of 120,000 m³. Logs arrive at the mill in cross-cut lengths from 2.7-6.6 m, with diameters from about 13-50 cm. In the logyard they are generally sorted to 2 cm diameter classes and within some diameter classes also into two length classes. The sorted logs are then fed to one of two sawmill processing lines.

The sawmill equipment is primarily European, and consists of two primary



Komatiland Forests Sales and Processing Manager, Francois de Villiers



In March, the end of our financial year, we recorded our best month in the history of the mill, which was by then operating near the capacity the software suggested was possible – Forests Sales and Processing Manager,

Francois de Villiers



breakdown machines, a chipper-canter and carriage headrig. Cants from both machines may be processed at a downstream framesaw, and in addition cants may also pass through the merry-go-round feed to the chipper-canter.

Downstream from the sawmill, kiln-dried material is destacked manually, and then processed in one of two separate finishing mills, the planer mill and the VAP (value-added process). The finishing processes have significant flexibility to transform the rough-sawn products, by:

- Ripping (splitting into two or three narrower products)
- Finger-jointing to produce longer products from shorts.

The challenges

Like most of the world, South Africa's domestic timber market was impacted heavily by the global financial crisis, and this in turn had a significant impact on Timbadola's operations.

"We had made the decision to bring sawlog prices into line with international prices, making them the most expensive in South Africa," Komatiland Forests Sales and Processing Manager Francois de Villiers told *International Forest Industries*. "Because we were buying all our own logs this added to the pressure considerably and we found ourselves in an extremely challenging situation."

Like many sawmills, the production focus at Timbadola had historically been on maximising volume recovery. As timber markets became tighter, the mismatch between production mix and market demands resulted in significant increases in the finished stock inventory. Excessive inventory typically has a cost



The Timbadola mill site

much greater than just the carrying cost, as significant price discounts must ultimately be given to clear stock.

In addition to the need to better match production mix to market, the Timbadola process flow presents a number of production planning challenges, and hence optimisation opportunities. The sawmill flow is very complicated; the framesaw has a recovery advantage from curve-sawing and runs with no gap, but is very slow and has fixed saw spacings. Conversely, processing cants

through the chipper-canter is much faster and gives the opportunity to set some board thicknesses. However, the gap required for setting reduces its speed advantage, and while cants are being processed no logs are processed.

The ability to rip and finger-joint in the finishing operations give significant flexibility, but each has implications regarding production rate.

Above all, as with most sawmilling operations the overall process, considering log purchase

options, sawing pattern selections, timber finishing options, and timber sales focus is extremely complicated, such that it is very difficult to know whether one is truly doing the right thing.

Komatiland management believed that significant benefits could be realised by developing optimised production plans that would better tie production mix to market demands, and at the same time used the capabilities of the sawmill and finishing operations in the most efficient way.

"We had been looking at optimisation systems for a few years and when the global economic crisis hit we just knew we had to do things differently," de Villiers said.

Contact with HALCO

In late 2008, several Komatiland personnel including Gys Wessels, then Komatiland's head of strategy and planning, and Francois de Villiers, head of marketing and processing, were in North America. While in eastern Canada, they were introduced to J.D.Irving, a long-time HALCO client. And while the HALCO optimisation model in use at J.D.Irving is somewhat different (it considers log sorting and allocation from many forests to feed multiple sawmills, chip mills and pulp mills), the Irving personnel assured Komatiland that HALCO had the expertise to optimise 'from the log to the customer'.

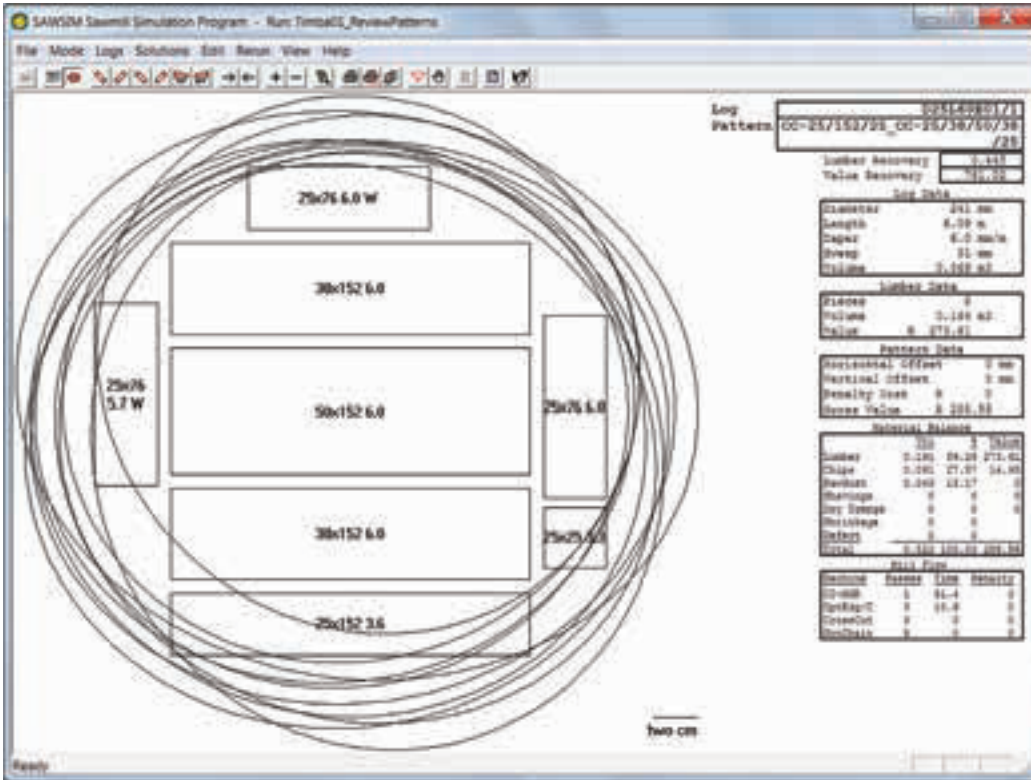
"We'd been looking around on the internet for optimisation companies and had seen the HALCO name appear," de Villiers explained. "We also were in touch



The Timbadola mill at night



A South African pine tree



SAWSIM® plot of Timbadola chipper-canter pattern



We had been looking at optimisation systems for a few years and when the global economic crisis hit we just knew we had to do things differently

– Francois de Villiers



with a consulting group who had recommended HALCO and then we were introduced to J.D.Irving – everything was pointing to HALCO.”

From eastern Canada the Komatiland personnel were travelling to Vancouver to attend a conference, and so the companies met.

Fast-forward to early 2011, and after some corporate changes at Komatiland they were again ready to address the Timbadola mill operation challenges, and so made contact once again with HALCO.

HALCO Software Systems has

been around for many years; in fact they will celebrate their 25th anniversary next year. HALCO is perhaps best known for the SAWSIM Sawmill Simulation Program. And while the majority of its work is in North America, they are no strangers to international projects, including one previous project in South Africa.

The proposed solution: linear programming optimisation

The solution proposed by HALCO to Komatiland was the SAWSIM-LP Production Planning Optimisation System. SAWSIM-LP combines the



The mill's optimised edger



Logs en route to the mill

SAWSIM program with linear programming optimisation in a fully-integrated application.

“Linear programming (LP) is a widely-used mathematical method to determine optimum allocation of raw materials and production methods to optimise the overall profitability of manufacturing processes,” HALCO Principal Brad Turner explained to *IFI*. “It is attractive for applications such as this because it is simple, robust, and can handle large, complex problems.”

While linear programming has been employed most heavily in industries other than wood products, notably in the petrochemical industry, the

industry in which it was first applied was in fact the wood products industry. Leonid Kantorovich, a Russian mathematician, was given the task of optimising production in the Soviet plywood industry in the 1930s, and in the course of this work invented the technique today called linear programming. For this he was awarded the Nobel Prize in Economics in 1975 – the only winner of this prize ever from the USSR.

The metric that matters

In a complex operation like a timber mill, with many interrelated functions (log procurement, sawmill operations, finishing



Optimisation
Analyst Kira Ross



It's important to recognise, however, that none of these metrics on their own directly reflect the metric that really matters – profit – HALCO Principal, Brad Turner



Greenchain stacking

operations, and timber sales), many metrics are applied to measure the performance of each function. For example, delivered log cost for log procurement, and per cent recovery for the sawmill operations.

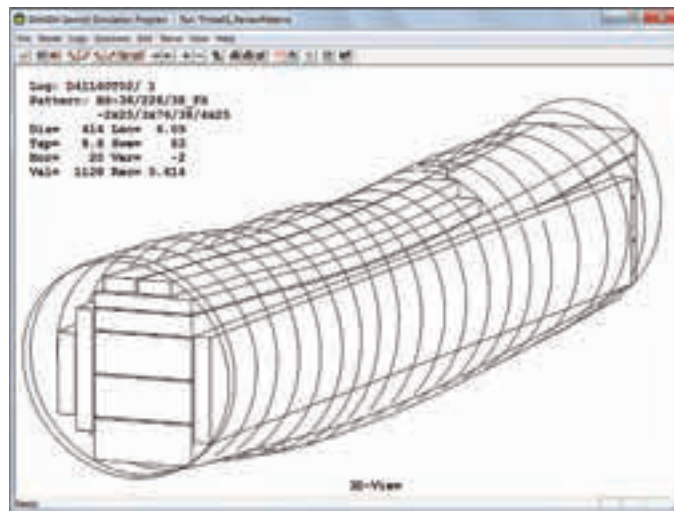
"It's important to recognise, however, that none of these metrics on their own directly reflect the metric that really matters – profit," Turner emphasised. "For example, buying smaller logs may reduce the delivered log cost, but if they reduce production rate, recovery, or the ability to recover higher-valued wider products, it may not be the right decision. Similarly, a singular focus on recovery or production rate in the sawmill will be for naught if the resulting production mix is not saleable."

A fundamental component of an LP model formulation is the objective function, which is the function to be maximised in the optimal solution. In SAWSIM-LP, the objective function is income before fixed costs. The beauty of the LP solution is, therefore, that it cuts through all the complexity to produce a coordinated, operations-wide solution that maximises the "metric that really matters".

Project development

Before submitting a final project

proposal, Brad Turner and Alex Gerbrandt of HALCO made a one-week site visit to meet with Timbadola mill staff and discuss



SAWSIM® plot of headrig + framesaw pattern

the mill operation in detail. The week spent at the mill guesthouse also allowed them to become very well acquainted with the traditional South African 'braai' – grilling meat over the glowing coals of an open wood fire.

Also while on site, the Timbadola staff was trained in HALCO's log measurement procedure. As the current mill does not have full-profile log

scanners, a manual measurement procedure was required to collect data on the typical log form characteristics. The HALCO measurement procedure includes use of tape measure, calipers, and a laser instrument and target board, and provides good form data including sweep, crook, ovality, and variable taper. Ultimately, Timbadola personnel measured a total of approximately 250 logs from all processed species. Referencing this data, HALCO's 'log cloning' software was used to generate log samples covering the entire species/diameter/length mix processed in the mill.

"They showed us how they wanted a number of logs measured and they also left us with quite a bit of homework to do

possible sawing pattern to each log class, along with the processing time requirements in each machine centre.

The final development stage was the LP model development. The LP solution combines the SAWSIM results with data defining such things as:

- The log mix to be processed in the mill (this data is drawn from the mill's log scale database system)
- Processing time constraints, including consideration of overtime availability and cost
- Yields of finished products (size, length, and grade), from application of each 'finishing method' (simple planing, planing plus ripping, finger-jointing, etc) to each rough-sawn size and length
- Timber and by-product sales prices
- Constraints on the timber mix that may be sold.

Defining the timber sales mix constraints is critical to the optimised production plan matching market demands. The constraints were defined to allow specification of the minimum/maximum sales mix percentages by size, and by length (shorts versus longs) within each size, in three markets: local to mill, domestic South Africa, and export. Separate sales prices are also specified by market.

While the SAWSIM-LP system software was fully developed prior to the project, every application is different, and program modifications were required to suit some Timbadola-specific requirements. For example, modifications were required to support the Timbadola log sorting methods, with some diameters sorted by length, others not. This ensured that the optimised production plans developed by the system could be implemented in practice.

"Brad told us that we made



more changes to the software than any other customer they'd had," Optimisation Analyst Kira Ross said. "That was mainly because of our mix of products and grade, I think.

"The software was originally set up to run bi-monthly or quarterly but we actually wanted to run it on a more regular basis because our production planning sometimes varied over a week or even a day depending on what logs are coming in. We made alterations to run the HALCO system on a shorter term basis to determine the exact cutting patterns, which took a lot of work.

"This also helped us to calibrate the system because if you're planning over a shorter time you can compare your results a lot sooner, which allows you to fine tune it even more and over a shorter time.

"The other main thing we changed was to allow us to look at our log intake history because that allowed us to calibrate what we would cut in the future by referring to this database. This works in two ways: the previous month is often an indicator for what will be coming in the current month; and the intake can be managed against what is already in the logyard to deliver on customer orders."

The SAWSIM-LP solution is presented in the form of reports, from which operating plans can be made:

- Sawing patterns to be used for each log sort, for sawmill planning and scheduling
- Finishing operations to be applied to each rough-sawn product, for dry-end planning
- Timber sales mix summary, to give direction to lumber sales personnel.

Implementation and results

Turner returned to South Africa for a week-long implementation and training session (and more braai ...). During the session, initial system runs were conducted and results were reviewed by the Komatiland management group. The process led to various data refinements and several 'on-the-fly' model revisions.

"The session was quite intense,

but by the end the model was ready for handover," Turner said. "While Timbadola's equipment may be far from state-of-the-art, the skill of the Komatiland analysts, in particular Ross and Steenkamp, is without question world class. This, along with the commitment from upper management on down to the mill crews to embrace and implement change has been key to the project results."

Komatiland was equally glowing in its assessment of Turner and his team over that period and throughout the whole process in general.

"They spent more than two weeks with us on site learning about our process and our people," Ross said. "After that, we kept in touch with email and we found that they were able to give us really good, individualised support in that way.

"There were sometimes problems that they hadn't encountered before because of the specific issues with our mill but they were happy to work through those to find solutions – they had remote access from Canada, which helped."

And what of those results?

"We were told that most customers receive payback on their investment within six months," de Villiers said. "We felt if they could achieve that at Timbadola, which was making a loss, we'd be beside ourselves.

"Initially, the program came back with results that seemed counter-intuitive to us, such as saying the mill could produce 50% more than current capacity and more profit would be made with a



The wet stacks



Products are destacked in the drymill

different product mix.

"But we couldn't do worse so we committed fully in November last year and, despite a few breakdowns, made a big enough profit to pay back the project cost in two months. December and January are traditionally low months but in March, the end of our financial year, we recorded our best month in the history of the mill, which was by then operating near the capacity the software suggested was possible."

In addition, this production was in sizes demanded by the market, resulting in an increase in average



Linear Programming is attractive for applications such as this because it is simple, robust, and can handle large, complex problems

– Brad Turner



Fingerjointing remains an important part of the process at the Timbadola mill

sales value and a decrease in finished stocks. These improvements resulted primarily from improved sawing pattern selections, which enabled production of in-demand products while managing the complex flow constraints of the sawmill.

Turner said the SAWSIM-LP system had provided a structured and systematic way to make ongoing routine production plans,



RunTime	Unit	LogType	Species	20m	30m	40m	50m	60m	70m	80m	90m	Total
Jan012_Plan	Timbada	11m	CC_SawB	102								102
Jan012_Plan	Timbada	11m	Total	102	0	0	0	0	0	0	0	102
Jan012_Plan	Timbada	11m	CC_SawB			236	176	2	5	0	0	419
Jan012_Plan	Timbada	11m	CC-114,CC-18	207	87	87	40	1	0	0	0	382
Jan012_Plan	Timbada	11m	CC-114,PS-205,PS-505			133	84	1	0	0	0	218
Jan012_Plan	Timbada	11m	Total	207	87	406	304	3	5	0	0	1,003
Jan012_Plan	Timbada	11m	CC_SawB	2,084	526	1,583	1,400	871	1,562	1,090	5,942	12,069
Jan012_Plan	Timbada	11m	Total	2,084	526	1,583	1,400	871	1,562	1,090	5,942	12,069
Jan012_Plan	Timbada	20m	CC_SawB			817	803	89	1,083	1,038	4,768	9,757
Jan012_Plan	Timbada	20m	CC-152,CC-18	324	251							575
Jan012_Plan	Timbada	20m	Total	324	251	817	803	89	1,083	1,038	4,768	9,757
Jan012_Plan	Timbada	20m	CC_SawB	303	271	375	405	406	1,240	1,270	4,888	10,068
Jan012_Plan	Timbada	20m	Total	303	271	375	405	406	1,240	1,270	4,888	10,068
Jan012_Plan	Timbada	20m	CC-114,CC-18	714	87	83	363	373	1,070	886	3,331	6,307
Jan012_Plan	Timbada	20m	CC-114,PS-205,PS-505	33	40	142	122	16	370	324	1,294	2,341
Jan012_Plan	Timbada	20m	Total	747	127	465	485	379	1,440	1,210	4,625	8,648
Jan012_Plan	Timbada	20m	CC-152,PS-205,PS-505	25	18	76	62	48	10	63	339	639
Jan012_Plan	Timbada	20m	PS-301,PS-315,PS-330,PS-345	82	82	270	175	137	813	877	3,736	6,307
Jan012_Plan	Timbada	20m	PS-301,PS-315,PS-330,PS-345	15	12	30	42	33	102	138	411	639
Jan012_Plan	Timbada	20m	Total	97	80	306	217	170	814	814	2,747	6,307
Jan012_Plan	Timbada	20m	CC-152,PS-205,PS-505	44	48	241	206	146	342	333	1,568	3,508
Jan012_Plan	Timbada	20m	PS-301,PS-315,PS-330,PS-345	8	7	89	38	21	74	61	262	539
Jan012_Plan	Timbada	20m	Total	52	55	330	244	167	416	394	1,830	4,047

Operation	ProfitCenter	MaterialType	Transaction	RunTime	CostClass	Units	Volume	Revenue
Timbada	LumberSales	Lumber	Sales	Revenue		m3	4,908	12,102,004
Timbada	LumberSales	Lumber	Sales	Shipping		m3	4,908	-623,344
Timbada	Chips	PrimaryChips	Sales	Revenue		m3	2,154	303,348
Timbada	Byproducts	DryResidues	Sales	Revenue		m3	4,133	41
Timbada	Byproducts	DryResidues	Sales	Revenue		m3	7,884	94,733
Timbada	Byproducts	Timbada	Sales	Revenue		m3	7,225	71
Timbada	Logand	Blocks	Logand	Materials		m3	10,000	-4,000,000
Timbada	Sawmill	Lumber	Coamp/iv	Other		m3	6	-12,470
Timbada	Sawmill	FeedTime	Production	Feed/Cash	Month	1	-4,000,000	
Timbada	Sawmill	FeedTime	Production	Feed/Cash	Month	1	-4,000,000	
Timbada	Wetmill	Time	Production	Other	Hours	407	-37,881	
Timbada	Kiss	Time	Production	Other	Hours	466	-5	
Timbada	UpFinishing	Lumber	Feed/Finishing	Materials	m3	336	-104,679	
Timbada	UpFinishing	Time	Production	Other	Hours	800	-1,014	
				Income:				7,888,888



The software was originally set up to run bi-monthly or quarterly but we actually wanted to run it on a more regular basis because our production planning sometimes varied over a week or even a day depending on what logs are coming in – *Optimisation Analyst, Kira Ross*



allowing the mill to respond to changes in the marketplace. And so the improvements won't be a "one-time shot". The mill remains profitable today.

In addition, the system is truly a model of the entire operation, from logs in through to finished product sales. It is therefore useful for producing annual budget plans, and for capital project evaluations. "In August this year, we got back in touch with HALCO to help us with the design and optimisation of our current project that should see a doubling of production at Timbadola," de Villiers said.

And so Komatiland is now using the system to model the benefits from some capital project plans, to push the mill performance – and the metric that matters – even further. **F**



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Jan012_Plan	11m	CC-114,PS-205,PS-505			133	84
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Jan012_Plan	20m	CC-114,PS-205,PS-505	33	40	142	122
Jan012_Plan	20m	Total	747	127	465	485
Jan012_Plan	20m	CC-152,PS-205,PS-505	25	18	76	62
Jan012_Plan	20m	PS-301,PS-315,PS-330,PS-345	82	82	270	175
Jan012_Plan	20m	PS-301,PS-315,PS-330,PS-345	15	12	30	42
Jan012_Plan	20m	Total	97	80	306	217
Jan012_Plan	20m	CC-152,PS-205,PS-505	44	48	241	206
Jan012_Plan	20m	PS-301,PS-315,PS-330,PS-345	8	7	89	38
Jan012_Plan	20m	Total	52	55	330	244

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