The Evolution of the Forest Logging Mechanization in Brazil
The Logging Mechanization Processes and Phases at Rigesa

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ABSTRACT - This document describes the sequence of the major evolution of Rigesa’s logging activities since 1974, when Rigesa’s paper mill initiated its operations in Três Barras, Santa Catarina State, Brazil. These evolution’s can be divided into four phases: Phase I - The first adaptation of small agriculture tractor for tree skidding, and the intense use of labor for felling, delimbing, bucking and manual loading of pallets. Phase II – A period characterized by a transition from a practical mechanical manager to the introduction and addition of a mechanical engineer to develop new equipments. The first engineer established partnership with Implemater to build hydraulic grapple for mini-skidders and construction of a pulpwood loader. Phase III - Year 1993, the period where adapted agriculture tractors for logging operations were abandoned, because the opening for machinery importation with free taxation from the Brazilian Government. Phase IV - The present period, which has been the continuation of the current free tax importation incentives. Period that has leveraged the Brazilian's pulp and paper industry to a worldwide leader in the sector, applying the most advanced mechanization processes available in forestry logging.

The logging mechanization at Rigesa started with the operation of its paper mill in Três Barras, Santa Catarina State, in 1994. During the early 1970’s this region was largely characterized by wood extratevism with a large focus on native species such as Brazilian pine Araucaria and Imbuia. Wood harvesting systems were quite primitive during this period, consisting of chainsaws and agricultural tractors with 85 to 100 hp. Agriculture’s tractor with winches were adapted to reach a total capacity of 15 ton of traction and wood transportation was carried by average truck trailers of two axles with approximately 18.0 ton load which were loaded manually.

In Rigesa’s initial logging activities, only a few items from the local empirical methods were adopted. Chainsaws were used to cut pine plantations, with horses hauling the trees onto the road, and chainsaws again to cut the logs into 1.20 meters long.

At the time of the Três Barras paper mill operation began, half of Rigesa’s logs came from pine plantations and half from residues of Araucaria solid wood. Initial production reached 100 tons of linear board daily compared to our current average of 600. This production demand requires 200,000 and 900,000 metric tons of wood per year respectively.

With continuous increase of paper production we began the process of evolving our logging harvesting system. Although the region had been characterized as being traditional in saw log production of noble species, lacking specialized labor was one of the major limitations to improve logging operations. In efforts to move forward, Rigesa imported labor from up to 200km away. These laborers were managed throughout the week and food, lodging, and an infrastructure to accommodate them were one of the major driving costs for logging operations. The evolution of the logging operation at Rigesa can clearly be divided into four phases:

First Phase

The first phase of the logging mechanization was from 1982 to 1983. With the help of Rigesa’s mechanics and foresters, we developed and adapted agricultural tractors to handle our logging activities at that time. Some major achievements for the time was an adapted third point of a Valmet 65 hp. An iron bar with fissures where chains were attached to handled hauling up to 10 delimbed trees onto the side of the road. Once this was accomplished, trees were bucked with chain saws and loaded manually into iron pallets, which carried up to 6 to 7 tons of wood. These pallets were then pulled onto the loading trucks by winch connected to power take off.

This system was improved significantly with the introduction of hydraulic grapples substituting the iron bars and metal chains. The manual loading onto the pallets was replaced by imported Munck-Johns loaders, which were adapted to Brazilian agricultural tractors. The most difficult barrier of this phase was standardizing the hydraulic grapples that were developed in house. Hydraulic grapple maintenances were difficulty and with a high cost because of the difficulty to find high quality hydraulic cylinders and other spare parts with high
quality also. At that time, Rigesa’s logging system was composed of 36 mini-skidders and 14 Munck-Johns cranes.

Second Phase

The second phase started with hiring of a mechanical engineer for the mechanical maintenance shop, where he was initially involved with developing new systems. In 1994 Rigesa started seeking partnerships from companies in the agricultural field with experience in hydraulic machinery, which led to manufacturing hydraulic grapples for the mini-skidders. This change improved maintenance availability of our logging equipment, reducing cost and increasing our harvesting productivity substantially.

From 1983 to 1993, a partnership was established with Implemater, which resulted in marked improvement for our national brand crane and mini-skidders. They were the first one to introduce the joystick control systems replacing the manual hydraulic commands to control the hydraulic grapples. From our standpoint, Implemater was a pioneer during this period. Caterpillar did not participate directly with these developments because of the high taxation applied on imported equipment at that time.

A remarkable innovation in this period was the Implanor Bell Tricycle. For this important technological advance at the time, we invested $35,000 just for the development that was carried out by Implanor. Implanor was already working a long time with developing equipments for sugar cane harvesting operations in Brazil and already had about 800 units operating. When we started operating our first unit, the mechanical availability was around 25% and it reached 75% at the end of a year. It was the first unit with a directional cutting head coupled with a saw. A Brazilian company located in the northeast of the country was the responsibly for developing this chainsaw cutting head, that for several years was the most mechanically dependable piece in its category. Tricycle replaced five to six chainsaw operators in the tree felling activity.

During this period we redirect and establish a new program for training our logging crews by focusing on selecting operators that could easily adapt to new sophisticated machinery that may be introduced in the future. Along with this training plan, we revised our logging operational planning system to better understand our needs for future necessity of new technology. Obviously, that to introduce this new technologies, we would need to control a range of variables involved in the process, like tree height, minimum/average/maximum tree weight, average hauling distance to the roadside, site characteristics, and several other factors directly involved with logging operations.

A small but important item was also introduced during this period, the Delimbing Gate. The Delimbing Gate was responsible for a significant increase in the productivity of the logging operations at that time.

During this period the pine plantations harvesting system was changed. From the two thinning interventions and the Clear Cut of 20 years old plantations, Rigesa adopted only the Clear Cut at age 18. This change was driven by the focus of only maximize the pine to the Três Barras paper mill. Pine sawlog sales was zero.

Third Phase

Year 1993, the period where adapted agriculture tractors for logging operations were abandoned, because the opening for machinery importation with free taxation from the Brazilian Government. The logging mechanization significantly intensified during this period that started in 1993. Around the same time Rigesa started adopting OSHA safety guidelines, which had more demanding criteria than the Brazilian legislation. Since the mini-skidders were adapted agricultural tractors in a monoblock chassis, our first change was to replace them by Caterpillar articulated skidders (models 518 and 525). The 17 units purchased in that time replaced the 36 mini-skidders units. The next change was to implement a system to mechanically prepare 2.2 meters logs with Prentice loader and CTR hydraulic slashers. With this replacement, manual chainsaw operation was faded out, therefore eliminating a system responsible for the most reportable accidents in the forestry sector. Adopting this system the Rigesa Forestry Division reached more than 365 days without reportable accidents.

Also, in this period we introduced the feller hydro-ax 611 EX tractor with a cutting disk. This feller replaced all Implanor fellers, increasing operational productivities and mechanical availability.

The introduction of these new equipments required an intensive/extensive mechanical knowledge for an area that were continuously demanding more accurate organization and diligence. At this time a new mechanical engineer was hired, along with the restructuring of the mechanical shop and the mechanics involved with the more sophisticated equipment.

Also during this period, a more elaborated PESA – Paraná Equipamentos S/A (Cat dealer) technical assistance was required. At the end of the period (1996/1999), the environmental pressure and the necessity of using logging machinery that would cause
less environmental impact became more primordial. For logging using chainsaws, which were considered to be disturbing to the surrounding environment because there was not a practical way to control where the trees would fall, this way damaging native forest fragments bordering the forest plantations. In order to overcome this problem, fellers could direct the fall of the trees being logged and this way justifying even more the replacement of chainsaws.

Fourth Phase

It started when the pine solid wood market in Brazil became an attractive business. It represented an increase in the return worth for fiber and solid wood production to aggregated value. The market demand for solid wood products was increasing the demand for pine logs becoming a market opportunity for Rigesa, which before 1999 was not a representative. Since 1999 our log sales market share has been increasing and the perspectives for the following years seems promising. In the process of increasing demand for pine logs sales, Rigesa decides improving its logging system. In addition to the need for enhancing the logging operation productivity, problems with the quality of the logs due to damages caused on the first log of the stem by the feller (with cutting disks) and also due to delimbing process using grapple skidders, were the first to be assessed.

After assessing the mechanical and economical issues related with this problem, Rigesa decided giving the opportunity for all forest machinery makers to present a renovating logging system package. This package took in consideration the following requirements:

- Improve the quality of logs for sales;
- Increase the operational efficiency of the skidders currently in use;
- Consider a new equipment for felling that can be used for two working shifts;
- Assurance of compatible return on investment;
- Improve ergonomic features;
- Even if an improved equipment, that the maker would commit to supply the mechanical pieces for replacement in the country;
- Reduce forest residues to less than 2.5% loss;
- Reduce the current loss of productive hours from 8% to the minimum possible related with rain, when compared to the equipment currently being used;
- Cost reduction of US$ 1.00/ton in the logging operation;
- Improve energetic efficiency by increasing the machines operational hour per diesel consumption;
- Increase mechanical efficiency of other aspects involved with increasing the performance of the equipment;

From the several companies that were willing to work on these requirements, the PESA - Paraná Equipamentos S/A and Caterpillar Brazil teams, were the ones that introduced the CAT 320 CL excavator with the harvesting head Logmax-750. The Caterpillar machine was selected for several reasons, but among them was the fact that their excavator CAT-320 CL was totally assembled in Brazil and reached the desired productivity following the ergonomic requirements specified. The logging Logmax head, considered one of the best in the world, fit the criteria established according to the parameters for performance, logging production, and the quality of logs delimbing.

With the introduction of the harvester, the skidders production improved 70% the hauling efficiency, since the delimbing operation no longer required the Delimbing Gate. The new system also reduced the risk of accidents involving back pain with the operators that was caused by the need of operating the skidders forward and backward frequently (now only forward operations). This change has also improved the skidder usage by allowing it to operate in two shifts. The harvester machine has definitely contributed to make the two working shifts possible at Rigesa.

An important factor that counted for the selection of PESA and CAT, was the capability of provide immediate support and its multi-disciplinary team that was always prompt to solve problems and provide technical assistance to their custumers in Brazil. Along with completely fulfilling all the requirements for a new logging system, the commitment with the customer by PESA/CAT was certainly mostly relevant in Rigesa’s evaluation.

Currently Rigesa has four harvester units in full operation and with 2/3 of the logging infrastructure working in two shifts. Rigesa is also currently replacing the Prentices/Slashers with the CAT 320 CL on trails and replacing the slasher CTR by PESA slashers.

Next Changes

Rigesa’s forestry division is currently allocating 1/3 of its wood production to pine logs sales. From the total harvesting operations only 1/5 is produced with our own resources. We believe the next phase will involve the system cut-to-length with the Harvester and Forwarder. In this scenario, a Harvester would select the logs in the field and a Forwarder would haul the logs to the road the log products segregated by different quality classes. In order to adopt this system, the solid wood market will need to reassess the potential value gain that a segregated
product can aggregate to their end product and be willing to pay for this gain in the log purchased.

Rigesa’s main vision for now is to continue focusing on the production of pulpwood for our mill, and embraces new market opportunities for forest products as it unleashes.