

PAPER MACHINE MAINTENANCE IN A BRAZILIAN PLANT

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***MAINTENANCE DEPARTMENTS IN BRAZILIAN MILLS FACE A HOST OF CHALLENGES,
FROM THE TROPICAL CLIMATE TO SHORT-FIBER PULP OPERATIONS TO UNIQUE LABOR LAWS.***

THE PULP AND PAPER INDUSTRY IN BRAZIL STARTED WITH small paper machine operations using recycled paper and imported long-fiber pulp. Pulp mill operations came later, producing bleached and unbleached pulp from *Pinus* trees for local papermakers and for export.

In the early days of the industry, Brazilian technicians were aided by pulp and paper specialists from other countries in training local workers for pulp and paper industry jobs. They produced short-fiber pulp and paper from *Eucalyptus* trees.

Since that time, production technology for pulp and paper has been well developed. The new challenge has been the globalization of business, pushing all companies to compete in the world market for short-fiber pulp and paper exports.

Engineering and maintenance procedures have been improved to meet changes in technology and newer high velocity paper machines. Despite modern control instruments and new materials in use on paper machines, maintenance departments have been challenged to increase their performance and the technical quality of services and workers while reducing operational costs.

Today the evolution of modern paper machine technology ensures more reliable operation. The implementation of new management techniques, quality and ISO certification, and the necessity to reduce crews mean that maintenance departments are reviewing organizational programs to look for ways to lower costs. Those ways may include the use of third-party maintenance companies.

But these are only general observations. As maintenance technical people know, each mill has its own needs, and maintenance crews must adapt their structure according to mill location, available resources, and paper machine and equipment manufacturers' requirements.

This article discusses modifications of structure, personnel, and technology that have occurred in recent years and how they have pushed maintenance depart-

ments to change to accommodate them.

Figure 1 shows the locations of the principal pulp and paper mills in Brazil.

ORGANIZATION

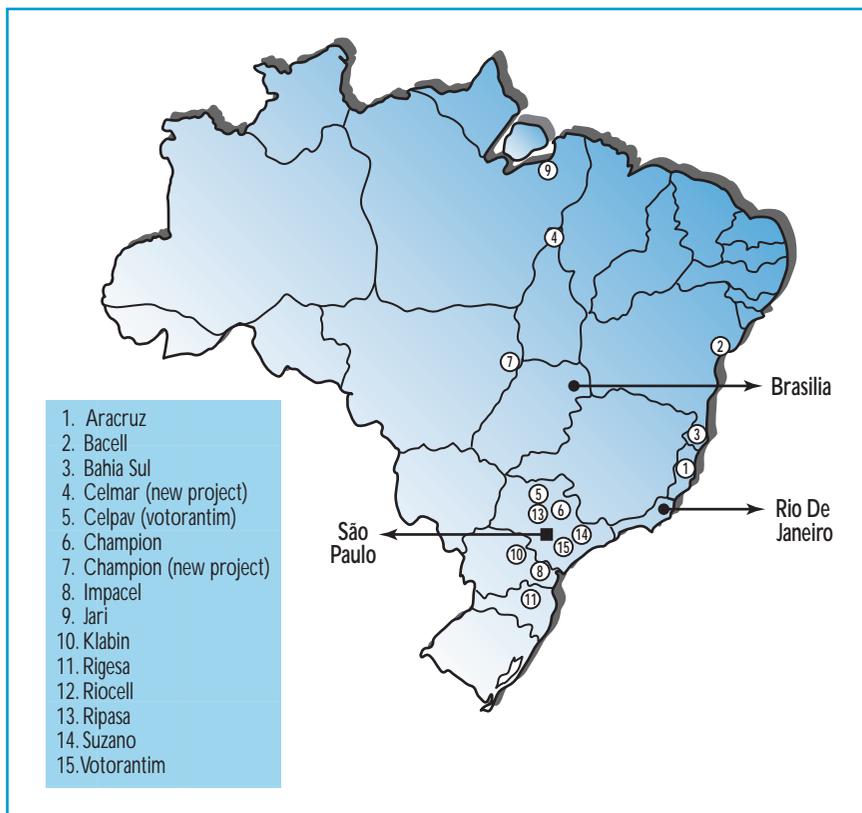
The paper machine maintenance organization must attend to modern standardized patterns, compatible with computerized systems of records and data. In order to do so, the instruction level of workers and supervisors must be adequate. The structure and organization of maintenance departments are completely different from what they were five years ago.

In an integrated mill, paper machine maintenance is a part of the general maintenance structure and normally is supported by the central services shop. Management comes from a central control office that is responsible for the collection and analysis of all maintenance data. With the production sectors, the central control office manages all preventive and predictive maintenance programs.

In the paper machine area, maintenance shifts are programmed for 24-hour services in four shifts, similar to those used in the United States. During the day, additional maintenance workers are stationed around the paper machine and its peripheral or auxiliary equipment. At night and on weekends, a well-defined standby program attends to emergencies and helps with production on specific jobs on the paper machine, such as felt press changes due to changes in paper fabrication grades or type changes.

The structure of the maintenance organization is different from mill to mill, depending on plant type (integrated or not), size of company, and geographic location. Mills located near big cities have more support and resources for everything from equipment and spare parts to worker quality and third-party services. Here it is possible to plan for external support when structuring the maintenance department, and the number of maintenance personnel can be reduced without significant

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1. Locations of major pulp and paper mills in Brazil

Mill	Mill Location	US \$/Ton Paper	US \$/Ton Product
1	North East	35.0	50.0
2	North East	42.9	51.5
3	North East	37.8	39.4
4	North East	35.7	34.8

- Values from four integrated paper mills in Brazil.
- Costs rated using costs of salaries, 3rd services, and materials.
- Average calculated is in general over the total costs.

Salaries	40%	47%
Material	27%	32%
3rds/Services	33%	21%

1. Maintenance costs for four integrated paper mills

problems. But paper mills located far from more developed cities must review the resources and facilities available in their areas. The number and size of internal maintenance crews may have to be increased, and costs of comprehensive training programs may have to be included in the budget. A strong training program is necessary so that locally hired workers can be trained for jobs in the mill, particularly in maintenance positions.

In Brazil, the pulp and paper plants located in the southern and northeastern states where industry is more active can use third-party companies for maintenance programs. These companies can provide specialized services at relatively low cost. However, newer projects

located close to forests but far from industrialized areas have a more difficult time developing maintenance programs with qualified workers, and their maintenance budgets will be higher. In the early years after startup, these plants will have higher maintenance costs, and their turnover will be higher than is standard in other areas of the world.

A big challenge for human resources is new investment in plants constructed in the north and central inland areas of the country. Here the maintenance organization must create a different structure that can be adapted to any project. Maintenance programs are reviewed constantly to ensure technical quality, adequate material resources, and experienced and capable personnel.

When compared to maintenance organizations in place ten years ago, today's organizations have a strong maintenance core control

using computerized records and data services, personnel with a high level of technical skills, reduced field crews, and centralized service shops. Equipment suppliers are selected on the basis of their low-maintenance products made of materials that are likely to withstand damage and corrosion.

The maintenance level in medium and large integrated mills in Brazil is similar to that of pulp and paper plants in other parts of the world. For smaller companies with two or three small paper machines, the maintenance structure is very simple. There is usually a chief engineer in charge of production and maintenance who is subordinate to the mill superintendent in charge of the plant. In these smaller companies, more field workers are used in maintenance.

Table I presents information about four integrated mills and their maintenance costs. Mills 1 and 2 have a traditional structure. Figure 2 provides an organization chart for Mill 1, while Figs. 3-5 are organization charts for Mill 2.

Mill 2 uses a separate organizational structure for paper production (Fig. 4) and the finishing department (Fig. 5). Maintenance service is integrated with production, but all these areas are under the industrial directory (Fig. 3).

Mill 3 has a different organizational structure and integration of mill departments. The departments are organized as cells and managed by the industrial directory, as shown in Figs. 6 and 7. Here the mainte-

nance department has responsibility for environmental administration, the laboratory, standardization, and research and development in a new department or cell of general technology of application management. This cell has 1305 employees, with 380 assigned to maintenance.

In this mill, the network integrated system is open to all departments. Interactive capabilities make it possible for users to schedule, modify, and obtain information about all services.

The paper machines in this mill have achieved a Paper Machine Total Efficiency of 96% as of April 1997.

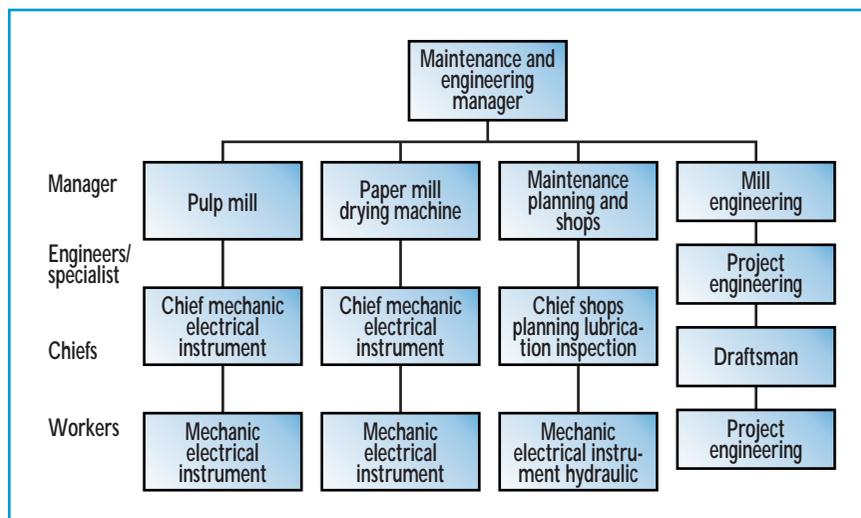
In Mill 4, the organizational structure is by cells, as shown in Fig. 8. The structure permits control of four different mills in different cities. The organization follows the flow of the maintenance concept. Figure 9 shows the steps and activities of production, maintenance, and engineering in prevention, diagnosis, and correction for all maintenance services at the mill.

MAINTENANCE PROCEDURES

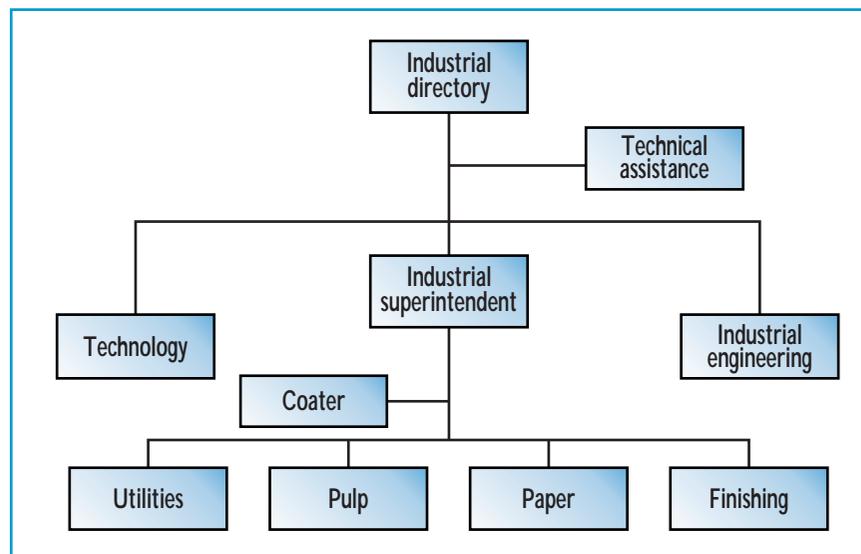
Brazil uses the metric system. The Brazilian Standards Association (ABNT) has established standards that are compatible with those in use in other countries for construction, inspection, operation, and engineering procedures.

The largest worldwide equipment suppliers have offices in Brazil, and their equipment and systems are adapted for use in Brazilian plants.

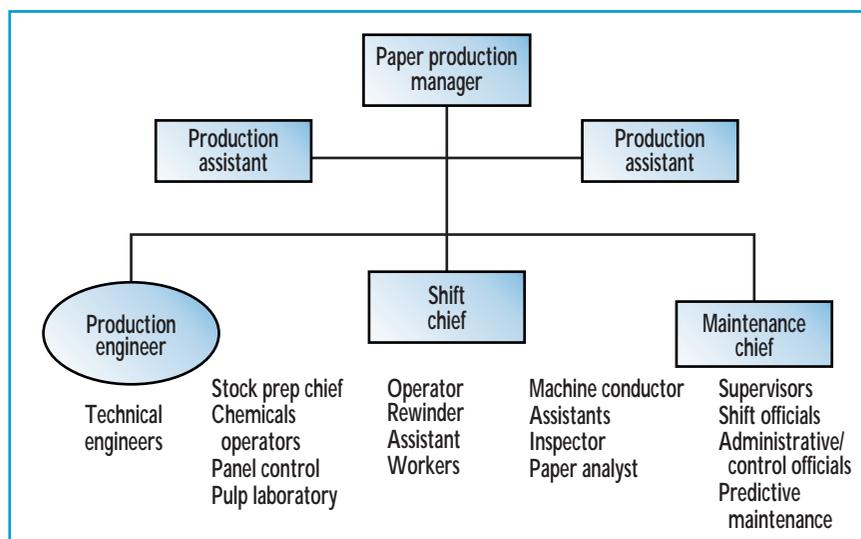
Types of equipment that are often imported for use in Brazilian paper mills include instruments made of sophisticated material such as titanium, stainless steel, and exotic alloys; drilled vacuum press rolls; expandable cylinders with crown variations; and special equipment for filtering and pump screening, as well as sand separators and high capacity fan pumps.



2. Organization chart for Mill 1

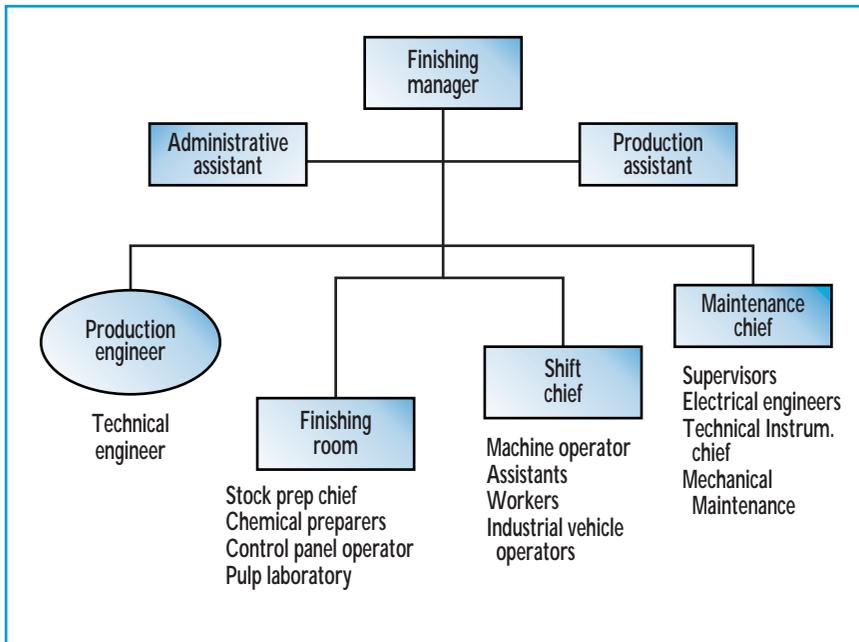


3. Organization chart for Mill 2's industrial directory

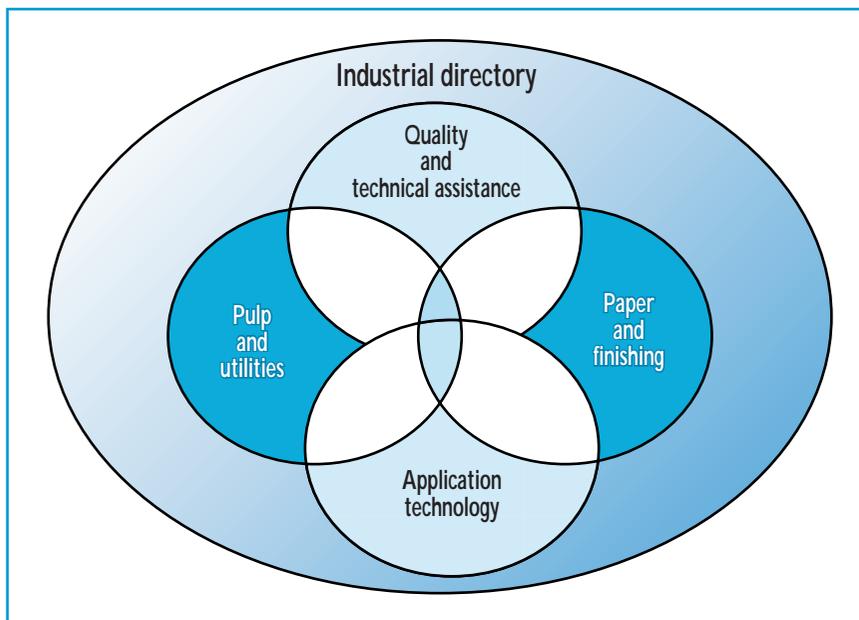


4. Organization chart for Mill 2's paper production

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5. Organization chart for Mill 2's finishing department



6. Organization chart for Mill 3's industrial directory

Equipment for grinding, inspection, welding, and metal spray protection, as well as synthetic and plastic components, are generally similar in Brazil to those in use elsewhere in the world.

External technical support sometimes is needed initially for electronic control and process equipment, but local maintenance technicians can usually maintain the equipment after startup.

The biggest differences between maintenance employees in Brazil and in the United States and Canada

are the Brazilian worker's association, or union, and related internal social laws. The social laws are in transition, awaiting the outcome of government proposals, but the main issue is the cost of social law. This cost can run 89% to 92% over an employee's gross salary, in addition to income tax. As a result, there have been some disagreements between companies and unions, with different results coming from each negotiation.

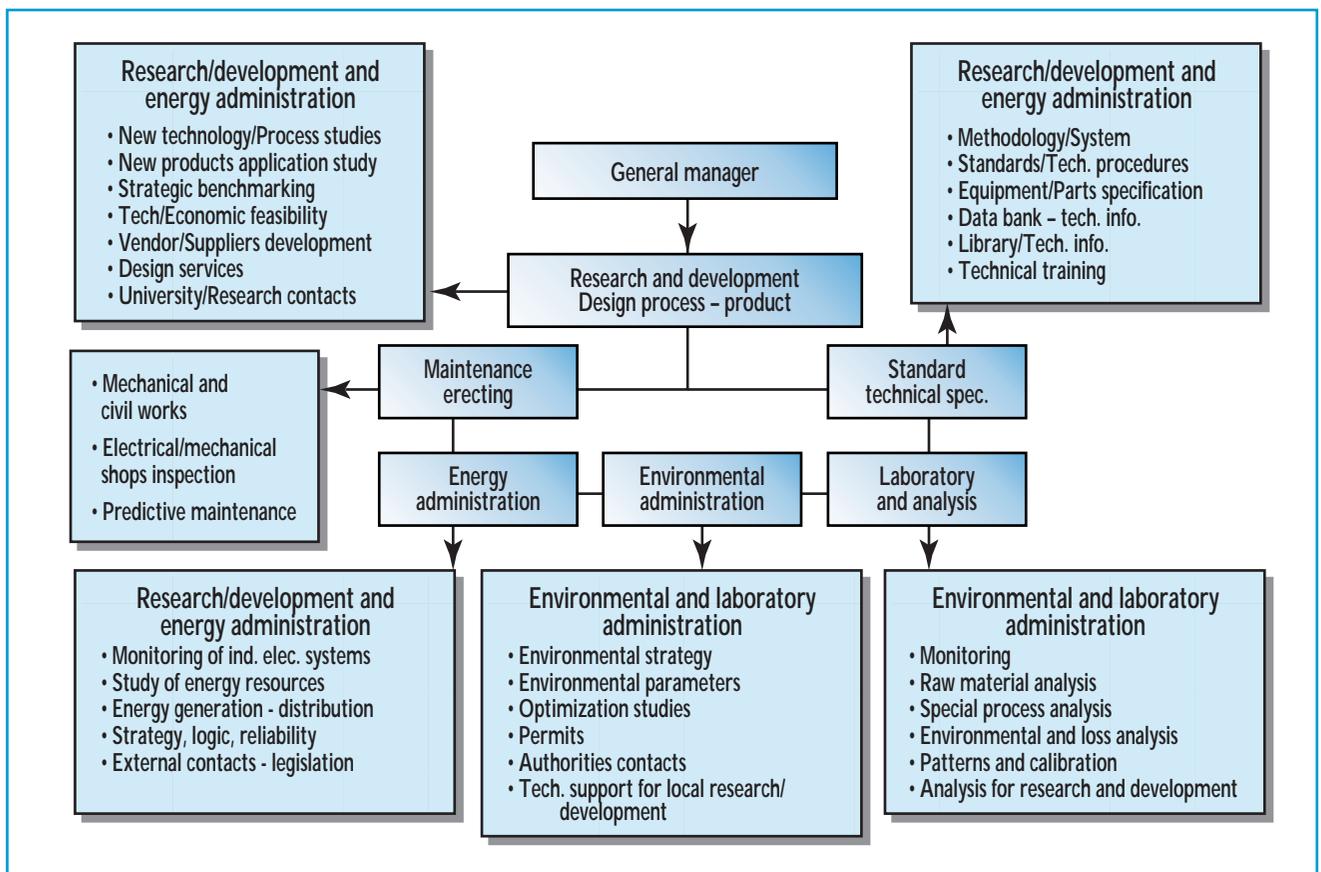
On the technical side, engineers and maintenance workers are well versed in specifications and techniques, having learned them from equipment suppliers' engineering departments as well as internal training departments.

The use of consulting engineering companies for maintenance services is not yet common practice in the Brazilian pulp and paper industry. Only the largest companies have contracts with specialized maintenance suppliers for specific services, such as maintenance of electrical drive motors, mechanical and electric instruments, and multiple shops services. These maintenance suppliers may also provide additional workers for sector and general shutdowns.

Process specialists from consulting engineering companies are hired to perform studies or analyze optimization and performance of systems or specific equipment. A few years ago, some paper mills in Brazil had problems with stock preparation, screening, refining, headboxes, and dewatering because the equipment was not designed to handle

short-fiber pulp exclusively. Today traditional equipment suppliers, aided by local production engineers, have learned how to modify equipment for 100% short-fiber pulp. Almost all paper types are produced in Brazil, from long-fiber newsprint to fine papers for copiers and currency.

Maintenance procedures are almost the same as those used in the United States and Canada. The same technologies, equipment improvements, and chemicals



7. Organization chart for Mill 3's process unit

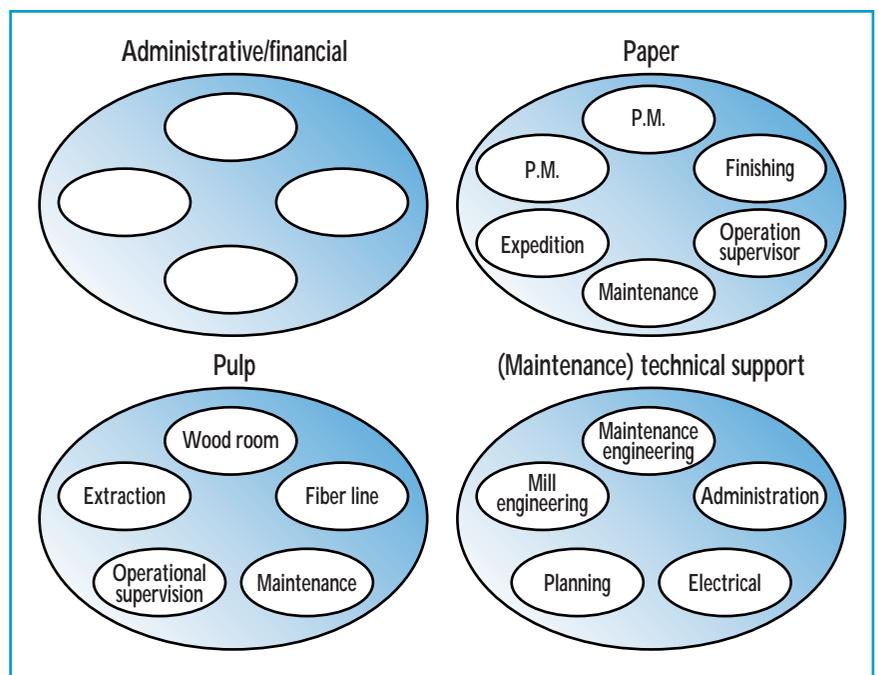
are available in Brazil. One additional engineering and maintenance service needed in Brazilian mills is the “tropicalization” of imported equipment when necessary to adapt to local conditions and sometimes to the use of local components.

With more than two generations of papermaking experience in Brazil and the ability to speak and read English, there is no major difference in production and maintenance procedures in Brazil from other parts of the world.

MAINTENANCE ORGANIZATION STRUCTURES

Brazilian paper mills have two distinct maintenance organization structures: the structure of integrated pulp and paper mills and the structure of small mills that produce paper from pulp supplied by other local producers, as well as from recycled paper.

The largest companies have a well defined structure, supported by central maintenance shops. They may have



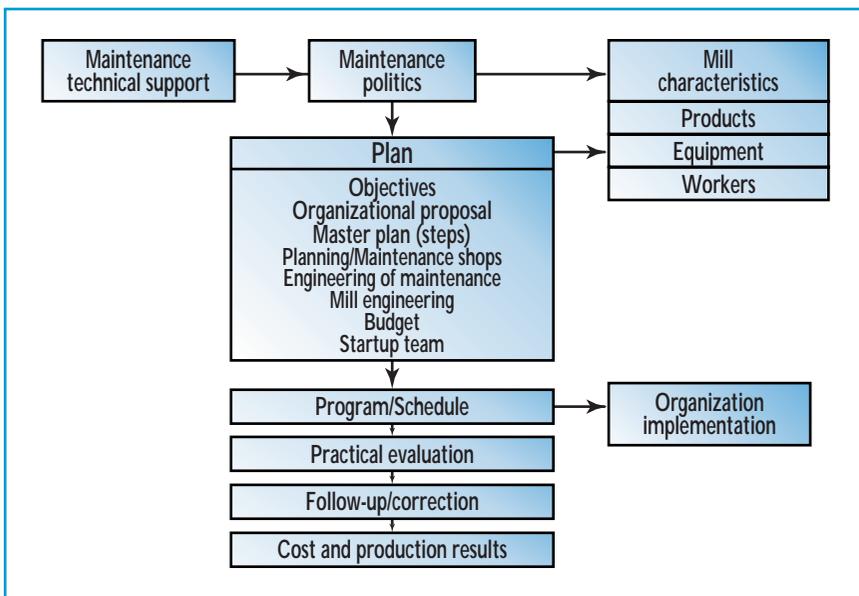
8. Organizational structure of cells in Mill 4

new organizational “cells” type management, with a reduced number of management levels.

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Planned maintenance				Responsible		
Activities	Prevention	Diagnosis	Correction	Worker	Technician	Engineer
Typical activities from production/operation	Operation	Correct operation Set-up and adjustment		X		
	Daily conservation	Clean, lubricate, and tighten parts	Inspections of use, conditions and wear	X X X X X	X	
Typical activities from maintenance	Periodic preventive maintenance	Use condition inspection and wear	Test and Examine		X X	
	Conditional preventive maintenance	Inspection with instrument	Tendency Analysis		X	X
	Breaking and unexpected maintenance	First diagnosis - act quickly to correct		X	X	
Typical activities from engineering (maintenance)	Reliability improvement	Occurency prevention (fault analysis) Control and precision improvement Analysis and improvement of strength of materials	Procedures revision Projects design revision	X	X X	X X X
	Improvement of maintenance capability	Analysis and load distribution improvement Improvement of techniques for conditional preventive Improvement of action techniques Maintenance services quality increase	Training and capacitation		X X	X X X

9. Classification of maintenance activities for Mill 4



10. Planned maintenance action flow for Mill 4

Small papermaking companies, normally with two or three paper machines, have a different structure. There is a maintenance engineer responsible for utilities, engineering, and paper machine maintenance. The maintenance engineer is supported by an electrical/electronics engineer. His superior is the mill superintendent, who

has responsibility for production and maintenance. These crews are small, and the use of local third party companies for shutdown and work order modifications is common.

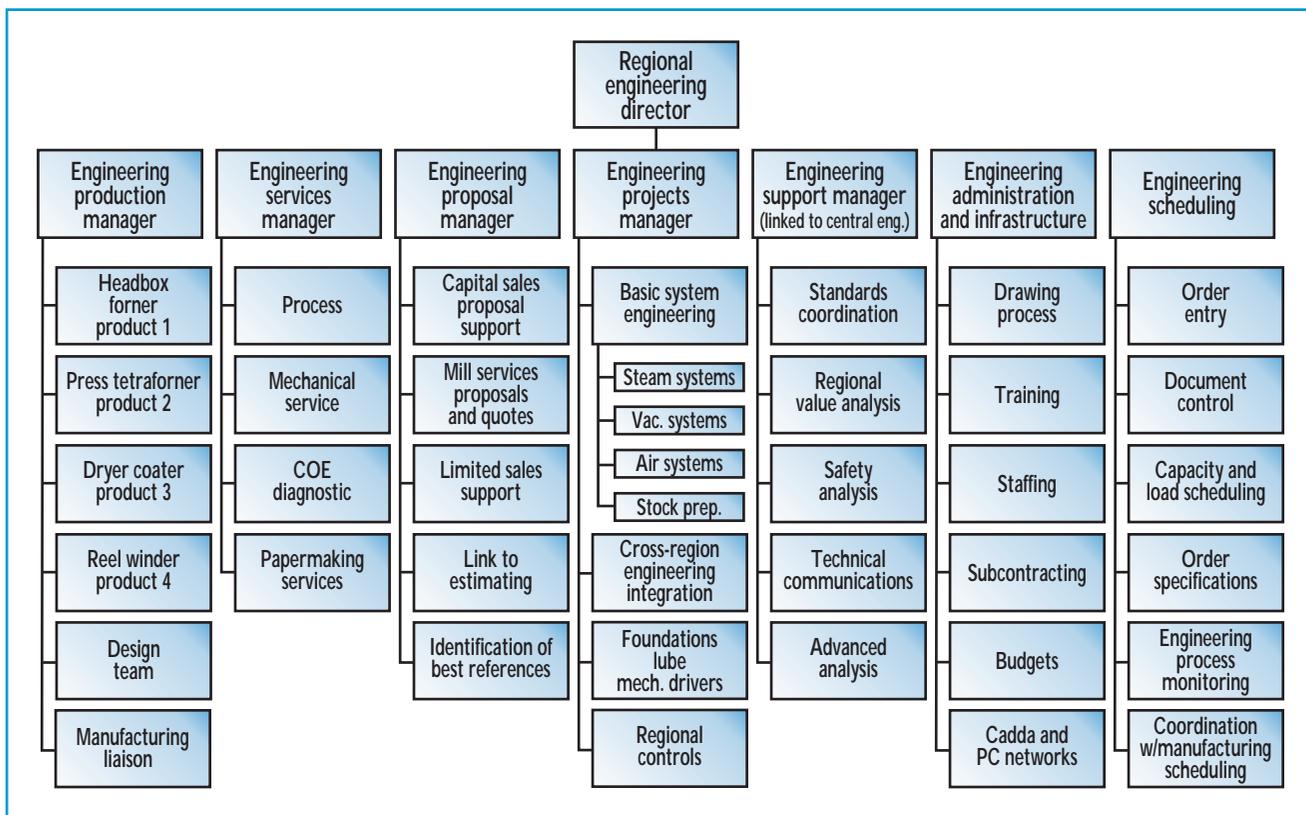
Modern maintenance is based on records and data collected on a daily basis. This information is analyzed for preventive and predictive maintenance programs.

The support of the engineering department or outside engineering companies is vital for maintenance management and operations.

Data records of all equipment, technical specs, and material selection information must be available for use every day to improve maintenance records.

To comply with quality programs and ISO certification, as well as when using third party companies for maintenance services, the organizational structure must be verified and defined for each company, paper machine, and location.

The usual parameters to evaluate maintenance efficiency are maintenance costs per ton of paper produced in a specified period—normally one year but registered



11. Brazilian engineering organization structure for paper machine manufacturer

and controlled monthly—and shutdown hours rated daily, monthly, and yearly. These measurements show the mill management peaks in cost variations, discrepancies, and participation in the mill budget. These figures are often compared to those of other mills, but one must take care in making comparisons, as cost calculation criteria may differ from mill to mill.

The specific cost is calculated using the formula

$$\text{Total cost/Total production} = Cs \quad (1)$$

Total cost is defined as the salaries of maintenance personnel plus cost of social laws, spare parts, maintenance materials used, and cost of third party companies used to support maintenance services. Expansion costs, optimization plans, and new equipment value are not considered in determining specific cost.

Table I shows the maintenance costs of some Brazilian integrated paper mills. These figures can be compared to those of paper mills in other countries.

Control of paper mill downtime is the second form of controlling, analyzing, and correcting maintenance action and efficiency of paper machine performance. In this case, only the hours related to maintenance service inspection and corrective maintenance are logged in the maintenance records. Normally, these data are recorded by the production controller, but the maintenance manager must agree with the reports to prevent errors. Reports are generated hourly, 24 hours per day, by the

preventive maintenance computer.

This is a good control for correct evaluation of maintenance and production action. It can give high level mill management information for internal optimization plans and preliminary payback calculations for specific equipment and modernization changes.

Paper machine maintenance control, records, and data are used for developing the general shutdown schedule and program. This is done jointly by the production, engineering, and purchasing departments.

Modern paper mill maintenance departments require well-controlled maintenance schedules, with strong support of detection and data records events for predictive maintenance. They must be prepared to act when production changes or corrective maintenance occur. The spare parts inventory must be kept to a minimum yet meet the maintenance needs of the paper machine.

A partnership between the operating crews and suppliers for the paper machine and secondary components is a strong tool and a necessity in effective maintenance. A strong partnership can ensure the supply of materials, reduce shutdowns, and help provide the correct technology to address operation and maintenance procedures.

MAINTENANCE PROBLEMS

In our contact with the mills, the most frequent maintenance problems we encountered involved failure of

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rubber rolls due to different causes, including composition, hardness, and deformation. Another issue is equipment suppliers' support for technical assistance at the mill, especially mills located far from the larger cities. A chief problem is long response time to assist the client. Another problem in some cases is a low level of technical assistance.

In several companies, such as Mill No. 4, permanent committees were created, with participants from all over the company working together to study, search, and correct these problems and to track the maintenance services with the highest costs. **Figure 10** shows the planned maintenance action flow at Mill No. 4.

Some of the items presently under study for paper machines are:

- Rubber roll recovery
- Electrical motors
- Electronic drive control systems
- Bearing failures
- Monitoring of rotary parts and equipment
- Instrumentation and electrical/electronic parts
- Corrosion prevention
- Painting systems
- Efficiency and quality of lubricants
- Gaskets and anti-leak material.

ENGINEERING SUPPORT OF SUPPLIERS

Large equipment suppliers and paper machine manufacturers have established offices in Brazil to offer technology and assistance to clients. Despite the presence of these local offices, the maintenance departments of all the mills we contacted severely criticized the assistance the suppliers and manufacturers offered.

However, one paper machine manufacturer in Brazil has developed a new action plan for this market. The manufacturer is in an implementation phase of a new maintenance plan for its paper machines that will offer help to clients. Its engineering department, as described in the organization chart in **Fig. 11**, intends to teach maintenance crews the techniques for working on its paper machines and help the companies' technical personnel learn correct maintenance procedures, organization of maintenance systems, and maintenance management. In the process, the manufacturer intends to be present at the mills to help clients with their maintenance needs.

SUMMARY

Many points must be addressed for the successful operation of a maintenance department in a paper mill. The engineering department needs strong technical data and capabilities. Equipment suppliers must provide spare parts and shop support. Overall, a spirit of unity from all mill colleagues, working together, is necessary for successful performance. TJ

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