StepChange Consulting

Maintain, Improve or Invest? Capture!

By Thomas Teltscher, Project Manager & Alexander Wirth, Senior Consultant

This paper discusses an approach to find the balance through: objective assessment of costs and benefits of maintenance or investment opportunities, fact based prioritization according to return on maintenance investment and efficient execution of maintenance and investment activity. The first step to achieve this balance and to get the most out of available time and capital is the consideration of all available investment options, independently of whether they are classified as OPEX (operating expenditure) or CAPEX (capital expenditure). Both compete for the same resources because they often are substitutes for one another (repair vs. replace) and have a number of overlapping processes. Therefore, maintenance and investment budgeting and planning have to be combined and need to include preventive, predictive and reactive maintenance on the OPEX side and replacement and expansion projects on the CAPEX side.

The right alternative

Typically the main question is repair versus replacement. Two factors influence this decision: the cost difference between repair and replacement and the respective return on investment and the relation of operating life extension through repair vs. the operating life of new machinery.

The answer seems simple. Replacement is more advantageous if repair costs are high and operating life extension through repair is short. In other cases, repair is significantly cheaper than replacement if the estimated extension of operating life and reliability is substantial. The challenge is the estimation of the extension of operating life. While costs can be determined quite accurately (although cost estimates are often exceeded), the extension of operating life is often difficult to estimate – especially if predictive maintenance processes do not exist. Consequently, the objective is to try to form a fact base that supports decision making by obtaining: a comprehensive view on costs and benefits and the best available estimation of operating life extension through repair in comparison to a comparable new asset.

Repair vs. replacement decisions are made every day in the pulp and paper industry. The maintenance and investment budget is one of the biggest spend areas that can be impacted through a sound analytical decision process. Having clear guidelines and principles to maintain spend control is important to maximize benefits.

The ultimate target

The maintenance and engineering functions are among the most critical in a manufacturing environment. However, as margins are tight, these functions also have come more under scrutiny to justify spend. Each organization needs to identify ways to translate this pressure into measurable cost and efficiency improvements. Although approaches may differ, there are a number of topics that all organizations will have to consider in order to optimize the return on maintenance spend (Figure 1).

Definition of Requirements

The basis for ensuring efficient use of capital is clarity on what maintenance and investment requirements are. Naturally, when defining the maintenance and investment requirements, highest priority has to be assigned to stay-in-business tasks. It is important to question and calculate whether all preventive and predictive maintenance activities listed are really mandatory or whether there may be alternatives. Alternatives could be an alteration of frequencies of predictive and preventive maintenance activities; the alteration of routine maintenance tasks; the transfer of responsibilities from maintenance to production employees (e. g. lubrication or predictive maintenance tasks) or even the elimination of certain activities.

After setting priorities on the basis of a standardized cost/benefit assessment process about what must be done, the question is which resources are required to execute tasks. Material and labor costs (internal/external) need

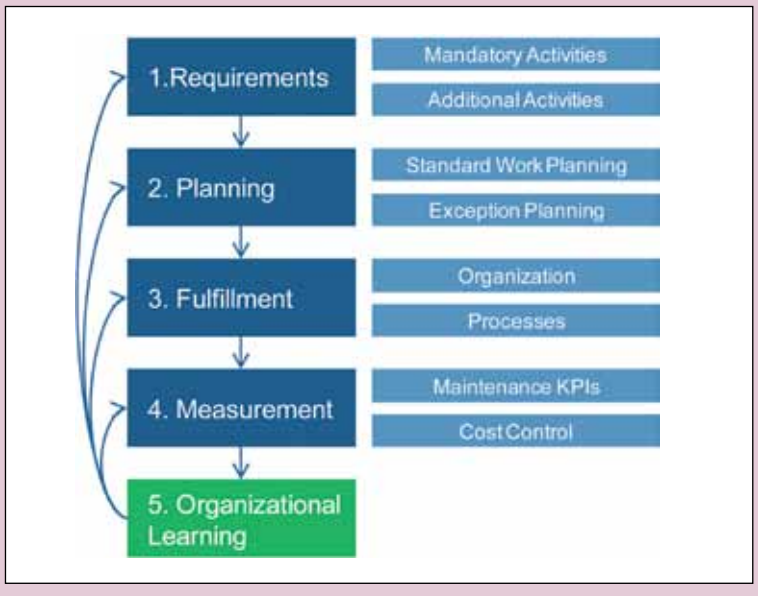

Fig. 1: Major elements of the maintenance & investment function

to be estimated. The result is the base load the maintenance function will have to deliver in the respective planning period (e. g. fiscal year).

Resources that are not utilized for stay-in-business activities can be allocated to additional projects. Careful resource and requirement planning is necessary to get a transparent picture regarding workload caused by mandatory and by additional activities. Additional activities may not necessarily be required to keep operations running (as opposed to the stay-in-business tasks) – they are rather intended to achieve other targets, such as enhanced production efficiency or quality, reduced risks, improved safety, reduced energy usage, increased production volume etc. These projects have to be prioritized to use available resources efficiently. Prioritization is based on the respective project value (e. g. Return on Investment) as well as on non-financial benefits (e. g. improved work safety, reduced environmental risks).

Objectivity is important. Financial and qualitative benefits need to be assessed in an objective manner, based on realistic and consistent assumptions, experience and know-how. Benefits based on additional volume and marginal profitability have to be examined critically since they depend very much on market demand, price development and marginal profitability. For that reason, benefits from cost savings typically need to be prioritized over those from increased sales volumes (as there is typically enough capacity available). In either case, the finance function should support maintenance in the calculation of benefits and risks and monitor spend discipline. All relevant costs need to be included in the calculation.

Often, maintenance plans are based on prior year budgets and extrapolations thereof. Budgetary thinking is quite typical. Tasks that were performed in the past are automatically included in the plans for the near future. However, some of the activities may need questioning: Are they really necessary and do they really need to be prioritized over other activities in terms of cost-benefit-ratio? Are there opportunities to alter the way activities are performed (e. g. different frequency)?

The result should be a clear maintenance & investment plan for the period. Carried out objectively, the result will be the most beneficial combination of eligible actions (both maintaining and investing), providing the basis for maximized return on investment. This analysis will also provide a basis for the necessary internal and external (third party) maintenance resourcing. After defining which activities have to be carried out the next step is to plan the execution.

Planning & planning the unplanned

Once it is known which activities are intended to be carried out during the period, they need to be planned in a

way that makes the most efficient use of resources and corresponds to asset requirements.

The differentiation between "standard work planning" and "exception planning" is important.
➜ Standard work planning will cover the foreseeable activities, such as routine tasks during planned shuts and necessary investment activities.
➜ Exception planning refers to the organization being prepared for those activities that do not fulfill the previously mentioned requirements. As time and duration of the next unplanned shut cannot be foreseen, flexibility and readiness are important. Once an unplanned shut occurs, the downtime should be used to fix the issue at hand and additionally utilize the access to the asset to use downtime for other activities.

A relatively simple and very useful option for work planning is a permanently updated catalogue of tasks – preprioritized according to cost and benefit. This catalogue is used in order to always have an up-to-date view on the activities that should be performed in the near future. Risks or malfunctions should be recorded by all relevant employees whenever they occur or whenever they are expected in order to keep the workbook current.

An important prerequisite is an IT system which ensures access of all employees to the same up-to-date information about the status of activities. Too often a multitude of task lists exist in different versions. This hinders efficient execution and monitoring of prioritized tasks as version conflicts exist and the management of the information becomes a problem. Sophisticated systems enable automatic entries of work orders based on online measurements in addition to manual recording. These systems support grouping of tasks to work packages based on priority, estimated time, necessary resources and materials required.

The catalogue can then be used during the preparation of the next maintenance interval. This helps to manage cost, increase maintenance efficiency and performance and reduce overall downtimes.

Execution and fulfillment
While stage 1 defines which activities should be performed and stage 2 defines work plans, the focus in stage 3 is on execution. The key points are:

➜ Structured interfaces: The basis for successful and timely maintenance execution consists of structured interfaces between the operations functions and mechanical, electrical and instrumentation functions.
➜ S.M.A.R.T. target setting: This methodology should be used to set overall objectives. SMART objectives are Specific, Measurable, Achievable, Realistic and Time-based.
➜ Defined processes: As described above it is essential that clearly defined and synchronized processes are available and that all functions involved follow these processes.
➜ Clear responsibilities and accountability: Every employee involved in maintenance execution must have clear tasks, must be responsible for fulfilling these tasks and must be accountable for performance.
➜ Flexibility: Even though planning work is completed in stage 2, short term needs may change (e. g. in the case of major unplanned downtime). The organization and processes need to be flexible enough to quickly respond to such changes of maintenance requirements.
➜ Controlling and documentation: The completion of tasks needs to be documented accurately by the employees who are responsible for executing them. Furthermore, challenges or unexpected problems must be documented carefully to enable proper preparation in the future. After engineering or maintenance work it is of tremendous importance to know exactly which tasks have been executed successfully and which may still be open and for which reason.

A structured post-work review is necessary to record a proper status, to learn and to prepare upcoming tasks in the most efficient way.

Measurement of performance
A crucial topic, sometimes underestimated and misinterpreted, is measurement of performance. The target is to focus on the essential key performance indicators (KPIs) that can be used to guide the organization into the right direction. The measurement processes should force the identification and resolution of issues in order to support the overall performance monitoring of cost & benefits. There are several key points that need to be covered in the area of maintenance performance measurement and reporting: costs (including the split into the main cost types, e. g. material, external service, etc, and the relevant cost centre), workforce utilization, overtime and call-in costs, planned and unplanned downtime,

Task Name	Type	Time Needed	Cost	Manpower	Required Completion	Status
Task 1	Mandatory	8 h	X €	2 FTE	30.11.11	Next planned shut
Task 2	Mandatory	3 h	X €	1 FTE	15.12.11	Next shut (planned or unplanned)
Task 3	Additional	7 h	X €	4 FTE	–	Open
...	...	...	...	...	...	

Fig. 2: Simplified maintenance task catalogue

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including major reasons and lost contribution margin, machine efficiency, adherence to maintenance plans, i.e. the differential between planned and actual time and costs needed for carrying out maintenance tasks, remedial actions to improve performance based on past experience and measurement of targeted benefits achieved through the work completed.

One topic often discussed is the form in which costs should be presented: should it be total costs, costs per ton produced, etc. It mostly turned out that all calculation methods are useful. A purely total cost based reporting, however, does not show correlations between asset availability, tons/output produced or hours of operation and is therefore not sufficient to evaluate the efficiency of maintenance activities. Furthermore, an isolated total cost view often tends to be heavily budget driven, where meeting or undercutting the budget is rated as success without taking machine availability or produced tonnage into consideration.

At the end of the day all machinery within one market segment (printing/publishing, packaging grades, tissue etc.) is in competition with each other – both internally and externally. Since competition is very much based on price in most markets, each asset needs to compete on a cost/output basis – no matter whether the equipment is old or new and whether it achieves comparatively big or small output. Therefore, the cost/t comparison has proven to be a suitable top level maintenance KPI and benchmark in combination with the total cost/t comparison of other cost drivers.

In addition to the measurement of performance and the identification of root causes of performance gaps, the right incentives need to be defined to achieve the desired results. Incentives for the maintenance function focusing solely on machine availability often lead to increased costs as marginal economics drive costs. An increase of marginal 0.5 % uptime or availability is typically not justified in most market segments in the paper industry. A deliberate balancing of costs vs. benefits needs to be considered and goes back to the original concept of understanding all cost and benefit drivers.

The correlation between availability and maintenance cost per t can be the baseline for an effective target and incentive system. The balance may differ between organizations, depending, on marginal profitability of available time (additional contribution margin for each currency unit spent on maintenance). Therefore, every organization needs to understand the break-even where additional costs in maintenance exceed the benefits of marginal contribution.

Organizational learning

Organizational learning does not imply huge spend on external training. Among the first steps is the availability of relevant information to the respective personnel – not only managers, but all people that are involved in maintenance, engineering and related activities. Talking about errors is not enough – learning from them and implementing mitigating actions is important. Following Kai-Zen principles will help to continuously improve.

The organizational structure of many companies does not support a cross-site installation of best practice maintenance processes whereas engineering (project) functions are often coordinated centrally. In the "traditional" maintenance areas, sites are often left to themselves to optimize processes locally and potentially duplicate efforts that could be achieved through standardized central processes. Guidelines and a process management framework should be provided centrally whereas execution needs to be completed locally. Even special and expert maintenance skills could be pooled centrally in order to ensure common standards and avoid shortage of these skills. Overall many organizations still have big opportunities to capture more value from their maintenance and engineering functions by adapting processes, organization and performance management principles.

Conclusion

Maintenance and investment in technical equipment is one of the cornerstones in the pulp & paper industry. Hence, the necessity and pressure to make the most efficient use of resources is given for this function. Companies need to install processes, structures and performance management principles to obtain transparency about costs and benefits in order to allocate capital and resources to the areas with the highest returns.

Ultimately, maintenance and investments constitute major controllable spend positions – therefore, prudent allocation of resources and the installation of the proper measurement practices is essential. While many organizations have continuously improved performance, big opportunities remain to be captured through a cross-organizational, standardized and holistic approach in this area. ■

Abbreviations

Ill.	illustration	mm	millimetre
cm	centimetre	mmol	millimole
dB	decibel	MVA	megavolt ampere
EU	European Union	MW	megawatt
g	gram	VAT	value added tax
h	hour	m^3	cubic metre
ha	hectare	No.	number
kg	kilogram	km^2	square kilometre
km	kilometre	m^2	square metre
kW	kilowatt	t	tonne(s)
kWh	kilowatt-hour	tds	t by dry solids
l	litre	t/d	tonne(s) per day
m	metre	t/y	tonne(s) per year
max.	maximum	cf.	compare with
mg	milligram	CTMP	chemi-thermo mechanical pulp
MHz	megahertz		