

## Description

- Maintenance cost management defines the steps to plan, control and forecast maintenance expenses in order to reach the business targets through cost optimization ensuring the required sustainable equipment reliability.

This process is based on the standard LafargeHolcim Maintenance Management System.

## Objectives

- Support the company to achieve its financial targets by setting the necessary steps and levers for budget, cost control and forecast of the maintenance expenses.

## Key Performance Indicators

- Actual cost vs budget [RC]
- Shutdown cost vs Shutdown budget [RC]
- Actual specific maintenance cost versus Reference Value (RV) [RC]
- Forecast accuracy [%]



## 1. Objectives

The process of the maintenance cost management supports the company to achieve its financial targets by setting the necessary steps and levers for budget, cost control and forecast maintenance expenses.

## 2. Applicability

The maintenance cost management process is applicable to integrated cement plants, clinker plant, grinding and blending stations with a permanent and yearly review.

## 3. Prerequisites for Implementation

### 3.1 Processes

- LafargeHolcim Accounting and Reporting Principles (LHARP)
- CIF Production planning
- CIF Work Order System
- CIF Preventive Maintenance
- CIF Equipment replacement strategy
- CIF Shutdown Management
- Plant Development Plan (PDP)

### 3.2 Tools and systems

- LafargeHolcim Asset Coding System (ACS)
- Computerized Maintenance Management System (CMMS) - SAP Plant Maintenance (SAP PM) module with SAP Maintenance standard customization or equivalent integrated Enterprise resource planning solution (ERP) replicating the SAP Maintenance standard requirements

## 4. Process Description

The maintenance cost management process is an integral part of the plant budgeting process and the LafargeHolcim Business Management cycle.

Following the yearly business cycle pattern, this process covers

- maintenance budgeting,
- maintenance cost control and forecast,

applied at plant level.

This process is based on the standard LafargeHolcim Maintenance Management System. The maintenance manager role is accountable for the maintenance cost process.

### 4.1 Maintenance budgeting

Maintenance budgeting considers the combined inputs from Sales and Production departments, general business conditions, and the outcomes of the maintenance analysis on the plant equipment condition. It has as output an accurate planning for allocation of maintenance equipment and tools, financial and human resources, throughout the entire yearly business cycle.

Maintenance budget development is under the responsibility of the preventive maintenance manager.

The maintenance budgeting process consists on the following steps as shown in the figure 1.

#### 4.1.1 Production input

Production plan for the budgeting year is used as input for maintenance budget development considering:

- Production capacity to be used, increase or decrease compared previous year.
- Equipment to be operated.
- Equipment operating schedule.

- Distribution of the planned production volumes through the year.

#### 4.1.2 Assessment of the equipment

Based on the detailed production planning and established operating schedule, the maintenance department collects all necessary information about equipment to be operated during the budgeting year.

This information is coming from:

- Equipment condition, as outcome of preventive maintenance program
- Preventive maintenance program, planned for the budgeting year
- Pending maintenance activities (maintenance backlog),
- Equipment history, covering the failures and maintenance activities performed in previous years
- Tools and maintenance equipment replacements and/or new acquisitions required,
- CAPEX plans for CAPEX to maintain or expansion,
- Improvements required for existing equipment,
- Compliance with environmental and safety requirements and standards.

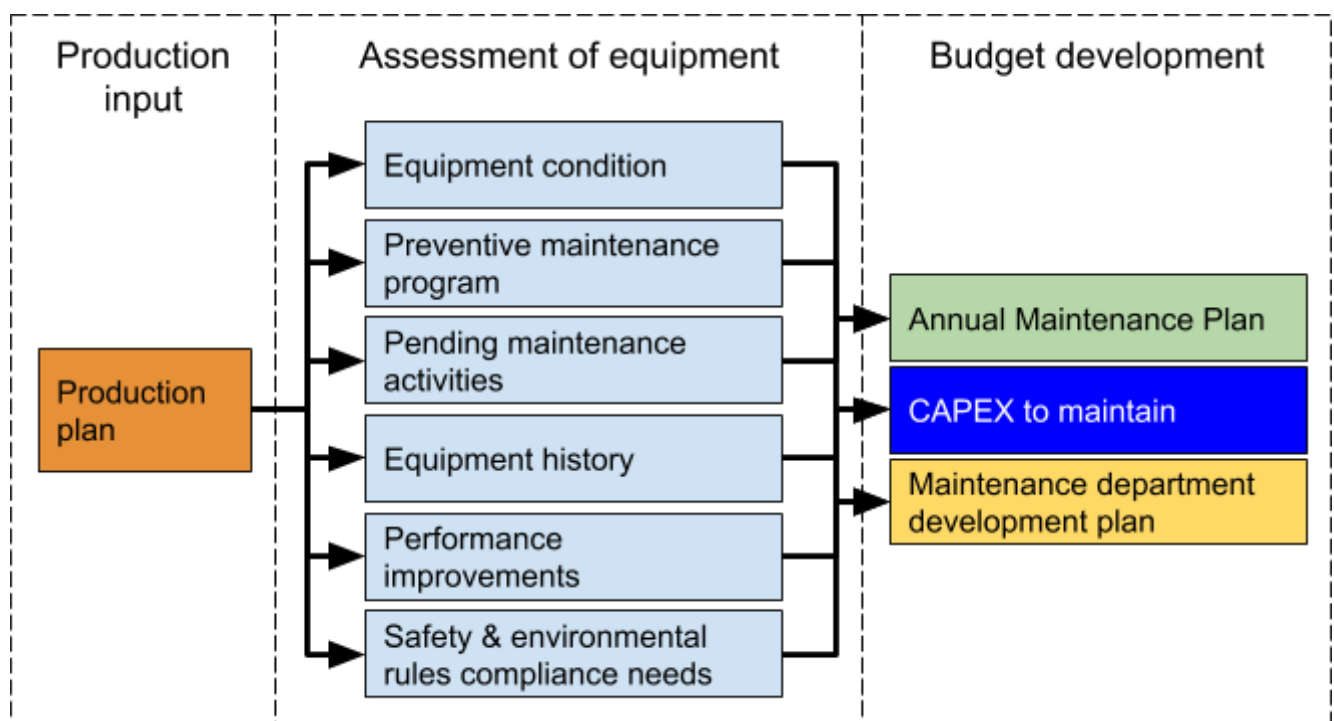


Fig. 1. Maintenance budgeting process flow

#### 4.1.3 Maintenance budget development

With all collected information, the budgeting process moves to the planning phase, where three streams must be considered:

- Development of the **Annual Maintenance Plan** covering the day to day maintenance and all major shutdown activities.
- Based on applicable LHARP capitalization rules all **CAPEX to Maintain** projects will be extracted from this list and their costs will not be included in maintenance budget.
- Maintenance **department development plan** in terms of personnel and technical capabilities.

The **Annual Maintenance Plan** covers all maintenance tasks which are supposed to be performed during the budgeted year, considering the day to day maintenance activities and all major shutdowns, for existing equipment and new equipment to be installed and used.

In alignment with LHARP reporting rules, the annual maintenance plan includes as well all maintenance activities performed or coordinated by other plant departments than maintenance. This covers activities as for example installation of refractories, quarry and plant mobile fleet maintenance, maintenance internal expenses.

Depending on its type each activity is allocated to an area, production line, functional location or equipment. These activities can be grouped as:

- **Preventive Maintenance**, covering:
  - conditioning monitoring routines,
  - time based maintenance activities and
  - service preventive maintenance routines
- **Specific maintenance activities** - groups maintenance works, significant in size, cost and/or execution time required, which can be predicted as occurrence.  
These list of activities are not part of **CAPEX** or **CAPEX to Maintain** projects and their cost are not reaching the conditions for capitalisation set by LHARP.
- **General maintenance activities** - cover all day by day maintenance activities, besides preventive maintenance routines, performed during the year, in order to maintain, or restore, the equipment state to perform its required function.  
Such activities are considered in budget as lump sums, split as relevant, per areas, production line or functional locations, distributed through the year by using an even allocation for each month, or following the historical or presumed pattern of occurrence.

The cost of **Preventive maintenance** and **General maintenance activities** sum up the maintenance **Base load**, and specific activities represents the **Shutdown** cost.

The **Maintenance department development plan** covers the future general maintenance needs of the plant:

- **Tool and equipment, to be replaced or newly purchased** to cover the current need or planned deployment of new maintenance techniques during the budgeted year,
- **Personnel development and training** covering new maintenance techniques, introducing additional tasks, improving overall performance of the crew and development of individual workers.

Aligned with LafargeHolcim Accounting and Reporting Principles (LHARP) rules the maintenance department development plan related expenses are on cost center level and will be budgeted there. These costs are not part of Maintenance budget.

The costs for each activity included in the **Annual Maintenance Plan** is detailed per cost type as per LHARP definition:

- Maintenance own,
- Maintenance subcontracted,
- Third party services maintenance,
- Maintenance materials,
- Wear parts.

Assigned to the month of their estimated occurrence, or distributed through several months if the related activity covers more than one time execution.

The consolidation of the Annual Maintenance Plan with the estimated costs for execution, splitted per cost types and distributed through the entire year based on their occurrence pattern represents the **Maintenance budget**.

#### **4.1.4 Budget validation and approval**

Maintenance budget target is established through the MTP process, as part of approved budget for the plant. The Maintenance reference value calculated for each plant on corporate level is used as guidance on assessing the plant progress on managing their maintenance costs.

The consolidated budget goes through the approval process which involves necessary iterations of budget scope review. Priority based risk re-assessments of the planned activities and their individual impact for the plant reliability will be done to decide on changes to the maintenance plan. Decisions on risk taking are documented and communicated to the plant management.

The budgeting process ends with the budget's final approval.

With the maintenance budget approved, critical spare parts availability and the lead time for purchase such spare parts are to be checked. Purchase process for critical spares must be started in due time.

The same is required to be done for third party services with significant complexity and low availability.

## 4.2 Maintenance cost control and forecast

Maintenance cost analysis are performed based on monthly / yearly financial reports, detailed cost posting accounting transactions and related work orders with operations and goods movement. Good movements cover all cost postings for used maintenance materials, wear parts and as well paid maintenance third party services

The development of this analysis is under the responsibility of Preventive Maintenance Manager. The Maintenance Manager ensures that the results of the analysis are used to establish and put in place the required corrective actions to maintain the equipment reliability within the approved cost frame.

Analysis covers:

- Actual versus budget for absolute and specific maintenance costs per cost elements at plant and main cost centers based on 15A aggregated data.
- Performed activities versus budgeted annual maintenance plan.
- Detail actual cost per:
  - posting method (direct posting or through work order)
  - main cost centers,
  - cost elements,
  - functional location,
  - equipment group, types and individual equipment,
  - materials group, material type and individual items,
  - third party services maintenance,
  - shutdown.

The Fig. 2. is showing how all these analysis elements mentioned above are interlinked.

Cost analyzes frequency and targets are given by the plant needs. Minimum level for cost analysis frequency is monthly, covering the current month and year to date data. When short interval controls are required, targeted analyzes are prepared on weekly basis and reviewed during weekly performance meeting.

Improvement actions are established and implementation is followed-up by the maintenance management team for all identified deviations.

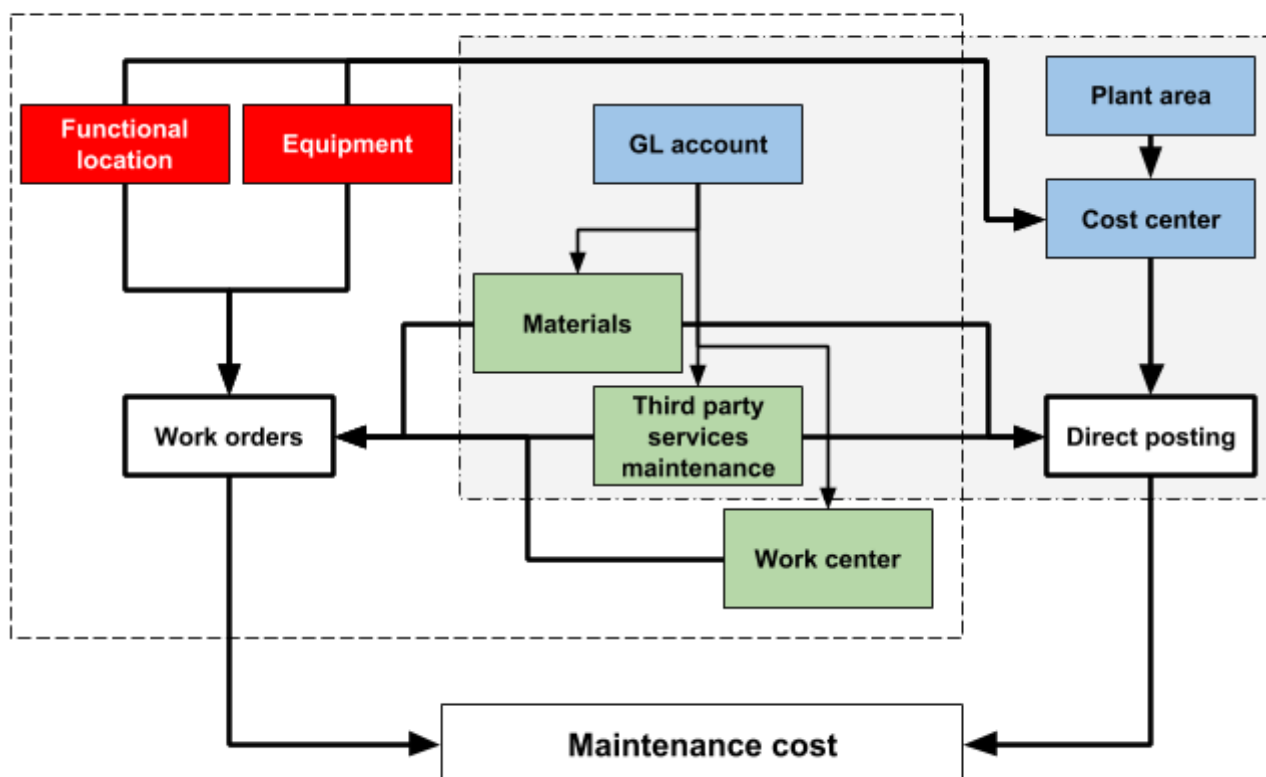


Fig. 2. Elements of the maintenance cost grouped by cost posting pattern - Work orders or Direct posting.

For an easy access and reliable maintenance cost analysis, automatic data extraction and processing must be implemented. QlikView web based application linked with SAP Business warehouse (BW) information cubes developed at regional Information Technology Service Center (ITSC) level must roll-out as soon as the level of data accuracy on maintenance cost posting enable a relevant results.

A correct cost posting is essential for accurate cost analysis. Posting maintenance related costs direct at the level of cost centers, bypassing the work order system, will cause the link with the equipment and the reason of the expenses to be lost.

**Maintenance forecasting** process has as scope to update the annual maintenance plan and increase the accuracy for the cost estimations for the remaining months till the year end, to assure that the plant reaches the required reliability within the limits of plant approved targets.

As shown in the fig.3 this process uses as inputs:

- updated annual maintenance plan done previous month,
- results of YTD maintenance performed activities,
- maintenance cost analysis up to date,
- updated production planning for the following months,
- significant changes on the condition of plant equipment,
- adjusted financial targets for year end.

If the maintenance forecast is above the (maybe revised) target, a more in-depth analysis of the remaining tasks must be carried out to bring the forecast back down to the target. The activities have to be analyzed according to their priorities and alternatives have to be evaluated once more.

The result of the forecast process is an updated annual maintenance plan and an estimation about the cost to execute the planned activities during remaining months till the end of the year.

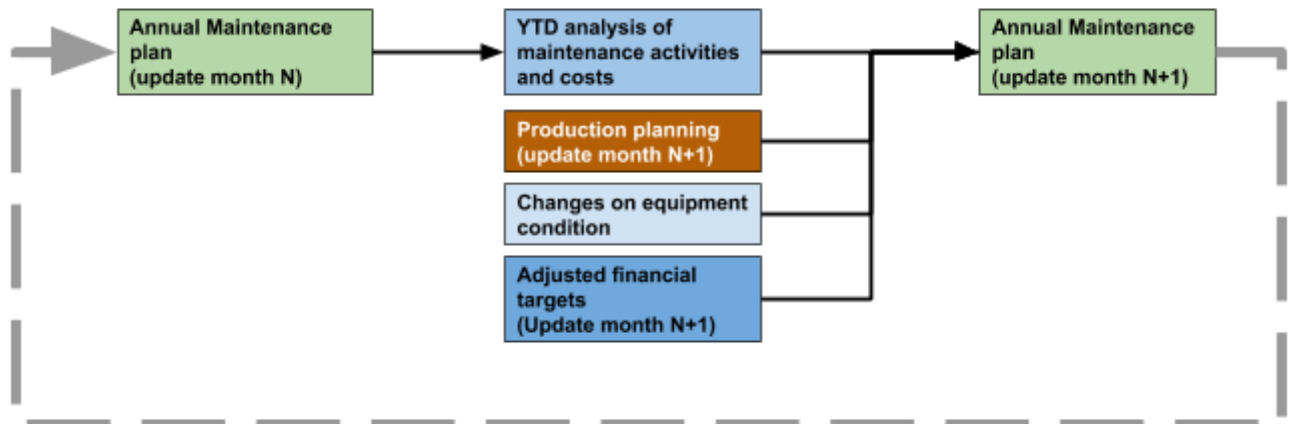


Fig. 3. Maintenance forecast process loop

## 5. Maturity Elements

Element	Emerging level	Requirements for Basic level	Requirements for Advanced level	Requirements for Excellent level	Measured by
<b>Maintenance budgeting</b>	Not all the requirements described for basic level are fully implemented or some of them are missing	<ul style="list-style-type: none"> <li>Plant has a maintenance budget approved, part of plant budget, split by cost elements</li> <li>Plant actively use the major equipment condition analysis for budget development</li> <li>Budget includes cost details of major activities planned for shutdown, aligned with PDP</li> <li>Budget development considers all postponed maintenance activities</li> <li>Plant has a transparent cost overview of all ongoing and new maintenance service contracts</li> </ul>	<ul style="list-style-type: none"> <li>The budgeting process uses the records from the previous 3 years performed activities</li> <li>Budget development is fully aligned with the equipment replacement strategy</li> <li>The budget is detailed at level of activities for shutdown and groups of activities (preventive maintenance, routine corrective works) for base load are clearly identifiable and, split by cost elements, distributed during year based on occurrence period of pattern</li> <li>Planned activities are prioritized based on risk assessments results and their individual impact on plant reliability</li> <li>Decisions on risk taking are documented and communicated to plant management</li> </ul>	<ul style="list-style-type: none"> <li>Utilization of third party services maintenance is budgeted based on analysis of own personnel capabilities and their workload for budgeted period</li> <li>Projects for equipment reliability improvements and cost optimization are underlined in the budget</li> <li>Plant team can support other plants on the process to develop a maintenance budget</li> </ul>	<ul style="list-style-type: none"> <li>Actual cost vs budget</li> <li>Shutdown cost vs Shutdown budget</li> <li>Actual specific maintenance cost vs RV</li> <li>Forecast accuracy</li> </ul>



<b>Maintenance cost tracking</b>		<ul style="list-style-type: none"> <li>• Plant team use the 15A report for cost analysis on monthly basis</li> <li>• Identified deviations are analyzed with support and involvement of plant controller</li> <li>• Plant identified, track and act to correct deviations at least the top 10 spendings</li> <li>• Actions with clear deadlines and responsibilities are put in place and follow-up to mitigate deviations</li> </ul>	<ul style="list-style-type: none"> <li>• Maintenance team has under their control all related maintenance costs</li> <li>• Plant team performs detailed analysis of the maintenance costs per main cost centers, cost elements, equipment group, types and individual equipment, materials, material type and groups, third party services maintenance, Shutdown on monthly basis or weekly basis if plant status requires higher frequency for reviews</li> <li>• Plant team identified the high spent items, track and act to correct deviations on spendings considering works, equipment, materials and third party services for minimum 80% of total maintenance cost</li> </ul>	<ul style="list-style-type: none"> <li>• Plant use regional / global accessible applications as QlikView for detail cost analysis based on predefined and customized reports</li> </ul>	
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Maintenance forecast		<ul style="list-style-type: none"> <li>• Plant use the previous month updated annual maintenance plan, cost analysis results and plant condition to develop the forecast for following months</li> <li>• Plant team understand and use the tracking tool to follow-up cost and forecasted results, providing information about deviations and mitigating actions put in place</li> </ul>	<ul style="list-style-type: none"> <li>• Update of the annual maintenance plan for remaining months considers:             <ul style="list-style-type: none"> <li>• Updated annual maintenance plan done previous month,</li> <li>• Results of YTD maintenance performed activities and cost analysis</li> <li>• Updated production planning for the following months,</li> <li>• Significant changes on the condition of plant equipment</li> </ul> </li> <li>• Deviations from the maintenance plan and allocated costs are analyzed and conclusions are used to update the annual plan in order to fulfill the plant targeted reliability and cost</li> </ul>	<ul style="list-style-type: none"> <li>• Plant team is prepared to react fast considering different cases for business evolution and/or equipment condition changes</li> <li>• Plant team can provide expertise on maintenance forecast development for other plant in the region/cluster</li> </ul>	
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## 6. Support for implementation

The implementation of the key topics is done using a standard methodology described by the CIF roll-out methodology. The following information gives specific guidance for the implementation:

Implementation activity	Reference Timeline	Resources (people, training, equipment)	Reference documents and tools to be used Implementation step
<b>Establish the list with major activities to be carried out during the shutdown during next year</b> based on equipment condition, considering costs, duration and timing for execution  <i>Prerequisite: Basic level of Equipment replacement strategy and for Preventive maintenance in place</i>	3 months At least with 9 month in advance before next shutdown	Maintenance manager Preventive maintenance manager Mechanical and Electrical Coordinator Planners Shutdown project manager	Annual maintenance plan
<b>Develop the maintenance activities backlog</b> with postponed activities for next year	1 week	Maintenance manager Preventive maintenance manager Mechanical and Electrical Coordinator Planners	Annual Maintenance plan
Implement a contracts mapping process covering all ongoing maintenance service contracts.	1 month	Maintenance manager Planners Procurement	
Implement Maintenance Budget development process	1 month	Maintenance manager Preventive maintenance manager Mechanical and Electrical Coordinator Planners	Annual Maintenance plan
Implementation of 15A report based monthly maintenance cost analysis with support of controlling	1 month	Preventive maintenance Plant Controller  Cost calculation, 15A	Monthly cost analysis report
Implement one Actions tracking tool and roles and responsibilities for follow-up  <i>Actions tracking tool is one tool for all plant topics and its development is linked with other plant processes</i>	1 week	Maintenance manager Preventive maintenance manager	Google spreadsheet
Implement monthly forecast process	1 week	Maintenance manager Preventive maintenance manager Planners	Annual Maintenance plan
Implementation of tracking tool for cost follow-up and forecast	1 week	Maintenance manager	Google tracking tool
Introduce the high detail annual maintenance plan, prioritized based on risk assessment regarding impact on plant	2 months	Maintenance manager Preventive maintenance manager	Annual Maintenance plan (budget list)

reliability, based on equipment condition and equipment replacement strategy  <b>Prerequisite:</b> <i>Preventive maintenance and Equipment replacement strategy implementation at advance level</i>		Planners	
Implementation of high level maintenance cost analysis based on cost posting controlling records, work orders data, spare parts and third party service maintenance provider identification  <b>Prerequisite:</b> <i>Fully integrated ERP solution implemented and in use</i>	1 week	Maintenance manager Preventive maintenance manager Planners  SAP PM module data extraction or equivalent, Cost management	MANi analysis model
Increase the monthly forecast accuracy through deeper cost analysis and more accurate equipment information  <b>Prerequisite:</b> <i>Preventive maintenance implementation at advance level</i>	1 month	Maintenance manager Preventive maintenance manager Mechanical and Electrical Coordinator Planners	
Introduce the workload balance on annual maintenance plan at budget phase	2 months	Workload balance (part of PMR development training session)	Workload balancing tool
Roll-out the Qlikview application and predefined reports for maintenance cost analysis  <i>Considers one time implementation for region/ITSC where SAP is implemented</i>	3 months	Qlikview training	Qlikview application dashboard

## 7. Document Management

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