Maintenance Study

February 2014
Introduction and methodology

Objective
Plant Engineering performed this research to better understand maintenance practices and strategies currently in place in North American manufacturing facilities and the effects of maintenance on productivity and profitability.

Sample
The sample was selected from recipients of Plant Engineering for whom email addresses were available.

Method
Subscribers were sent an email asking them to participate in this study. The email included a URL linked to the questionnaire.

- Respondents were asked if they are responsible for maintenance of all or part of their facilities. Those responding positively were asked about maintenance strategies, outsourcing maintenance, training, technologies, and unscheduled downtime.
- Number of respondents: 317
  - Margin of error: +/- 5.5% at a 95% confidence level
- Incentive: Survey participants were offered the opportunity to enter a drawing for a $150 VISA gift card.
Respondent profile
Job title and industry experience

Half of respondents indicated their job title as an engineer, while 26% are in a management position. Sixty-two percent have 20 or more years of industry experience.

Q: Which of the following best describes your job title? (n=316)

- Engineer: 50%
- Manager: 22%
- Foreman: 7%
- General manager: 4%
- Superintendent: 3%
- Vice president: 1%
- Other: 13%

Q: For approximately how long have you worked in a plant or engineering-related position? (n=317)

- Less than 5 years: 8%
- 5 to 9 years: 11%
- 10 to 19 years: 20%
- 20 to 29 years: 29%
- 30 to 39 years: 27%
- 40 or more years: 6%
Company size and location

Sixty-nine percent of respondents have less than 500 employees at their respective locations, and 30% of respondents are based in the North Central region of the United States.

**No. of employees**

- Less than 100, 29%
- 100 to 249, 20%
- 250 to 499, 20%
- 500 to 999, 13%
- 1,000 or more, 18%

**Location**

- East North Central 22%
- Middle Atlantic 14%
- Based outside the U.S. 13%
- South Atlantic 12%
- Pacific 7%
- New England 5%
- East South Central 7%
- West South Central 8%
- West North Central 8%
- Mountain 4%

Q: Approximately how many people work at your location? (n=316)
Q: In what region of the country are you based? (n=317)
The top three industries represented by respondents are food, beverage, or tobacco (11%); chemicals or pharmaceuticals (11%); and wood, paper, printing, or related products (9%).

<table>
<thead>
<tr>
<th>Industry</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food, beverage, tobacco</td>
<td>11%</td>
</tr>
<tr>
<td>Chemicals, pharmaceuticals</td>
<td>11%</td>
</tr>
<tr>
<td>Wood, paper, printing</td>
<td>9%</td>
</tr>
<tr>
<td>Plastics, rubber</td>
<td>7%</td>
</tr>
<tr>
<td>Transportation</td>
<td>7%</td>
</tr>
<tr>
<td>Primary metals, non-metallic mineral products</td>
<td>7%</td>
</tr>
<tr>
<td>Fabricated metals</td>
<td>6%</td>
</tr>
<tr>
<td>Oil, gas, petroleum refining</td>
<td>5%</td>
</tr>
<tr>
<td>Utilities</td>
<td>5%</td>
</tr>
<tr>
<td>Aircraft, aerospace, defense</td>
<td>3%</td>
</tr>
<tr>
<td>Industrial, commercial, agricultural machinery</td>
<td>3%</td>
</tr>
<tr>
<td>Plant, facilities maintenance</td>
<td>3%</td>
</tr>
<tr>
<td>Computers, electronics</td>
<td>3%</td>
</tr>
<tr>
<td>Distribution centers, warehousing</td>
<td>2%</td>
</tr>
<tr>
<td>Textiles, apparel, leather</td>
<td>2%</td>
</tr>
<tr>
<td>Government, military</td>
<td>2%</td>
</tr>
<tr>
<td>Electrical equipment, appliances</td>
<td>1%</td>
</tr>
<tr>
<td>Hospitals, health care</td>
<td>1%</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>4%</td>
</tr>
<tr>
<td>Other</td>
<td>8%</td>
</tr>
</tbody>
</table>

Q: What is the primary business or product manufactured at your location? (n=317)
Facility maintenance
**Time spent on maintenance each week**

Fifty-nine percent of respondents indicated that their plants spend 20 hours or more each week on scheduled maintenance, while 20% spend less than 10 hours per week.

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10 hours</td>
<td>20%</td>
</tr>
<tr>
<td>10 to 19 hours</td>
<td>22%</td>
</tr>
<tr>
<td>20 to 29 hours</td>
<td>17%</td>
</tr>
<tr>
<td>30 hours or more</td>
<td>42%</td>
</tr>
</tbody>
</table>

Q: Approximately how many hours per week does your plant spend on scheduled maintenance? (n=317)
Twenty-eight percent of respondents indicated that their plants shutdown specialized production machinery only once each year for scheduled maintenance, while 25% say their material handling equipment is shutdown every other month.

Q: How often are the following areas of your plant shutdown for scheduled maintenance? (n=317)
Attention to systems maintenance

Half of respondents said that their internal electrical distribution systems receive “some” maintenance support, while rotating equipment receives “a lot” (45%) or “a great deal” (20%).

Q: On a scale of 1 to 4, where 1 means “none at all” and 4 means “a great deal,” rank the following areas of your plant based on the amount of maintenance support they receive: (n=311)
Outsourcing maintenance

Almost three-quarters of respondents indicated that less than 25% of their maintenance operations are outsourced, and the top reasons for outsourcing are the lack of skills among current staff (47%) and the impractical amount of skills necessary (46%).

Q: How much of your plant's maintenance operation is outsourced? (n=317)

- 0%, 11%
- 1% to 25%, 63%
- 26% to 50%, 16%
- 51% to 75%, 5%
- 76% to 100%, 4%

Q: What factors led to the outsourcing of maintenance operation at your plant? (n=281)

- Lack of skills among current staff: 47%
- Too many specialized skills required to be practical: 46%
- Insufficient budget to hire/retain skilled individuals: 35%
- Skilled individuals simply not available: 26%
- Union considerations: 10%
- Other: 13%
Maintenance training

More than half of respondents’ maintenance personnel receive training in basic electrical and mechanical skills; motor, gearboxes, and bearings; lubrication; and predictive maintenance.

<table>
<thead>
<tr>
<th>Training Area</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic electrical skills</td>
<td>81%</td>
</tr>
<tr>
<td>Basic mechanical skills</td>
<td>79%</td>
</tr>
<tr>
<td>Motors, gearboxes, bearings</td>
<td>54%</td>
</tr>
<tr>
<td>Lubrication</td>
<td>53%</td>
</tr>
<tr>
<td>Predictive maintenance</td>
<td>52%</td>
</tr>
<tr>
<td>Basic plumbing/pipe fitting</td>
<td>50%</td>
</tr>
<tr>
<td>Process operations</td>
<td>42%</td>
</tr>
<tr>
<td>Welding and fabricating</td>
<td>42%</td>
</tr>
<tr>
<td>Fluid power systems</td>
<td>40%</td>
</tr>
<tr>
<td>Blueprint reading</td>
<td>36%</td>
</tr>
<tr>
<td>Machine stop technology</td>
<td>29%</td>
</tr>
<tr>
<td>Other</td>
<td>13%</td>
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</tbody>
</table>

Q: What kind of training does your maintenance personnel receive? (n=317)
Maintenance technologies

Nearly two-thirds of respondents’ facilities use a computerized maintenance management system to monitor or manage maintenance, while only 33% use a standard automated maintenance schedule.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Computerized maintenance management system</td>
<td>65%</td>
</tr>
<tr>
<td>In-house created spreadsheets, schedules</td>
<td>47%</td>
</tr>
<tr>
<td>Clipboards, paper records of maintenance rounds</td>
<td>36%</td>
</tr>
<tr>
<td>Automated maintenance schedule</td>
<td>33%</td>
</tr>
<tr>
<td>General computerized calendar</td>
<td>20%</td>
</tr>
<tr>
<td>Enterprise asset management</td>
<td>17%</td>
</tr>
<tr>
<td>Other</td>
<td>4%</td>
</tr>
</tbody>
</table>

Q: What technologies are used to monitor or manage maintenance within your plant? (n=317)
Unscheduled downtime

Aging equipment (45%) and operator errors (21%) are the leading causes of unscheduled downtime, according to respondents. Thirty-one percent of respondents mentioned implementing better preventive maintenance in order to decrease future unscheduled downtime.

Q: What is the leading cause of unscheduled downtime in your plant? (n=317)

Q: How do you plan to decrease unscheduled downtime in your plant? (n=278)

Planned maintenance

<table>
<thead>
<tr>
<th>Plan</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Preventive maintenance</td>
<td>31%</td>
</tr>
<tr>
<td>Equipment upgrades</td>
<td>20%</td>
</tr>
<tr>
<td>Better/more training</td>
<td>14%</td>
</tr>
<tr>
<td>Better/more monitoring</td>
<td>8%</td>
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</table>
Attitude towards maintenance

More than half of respondents see maintenance as a cost center, but 41% see it as a profit center because they are improving production within their plants.

Q: Which of the following statements best describes your attitude toward maintenance? (n=317)

- It's a profit center where we can deliver greater capacity to our plant.  
  41%

- It's a cost center, but we need to spend in order to keep equipment running.  
  39%

- It's a cost center, and we need to carefully control costs.  
  13%

- It's a necessary evil.  
  7%
The key challenges respondents indicated for improving maintenance in their facilities are the lack of resources or staff (53%), the lack of understanding of new maintenance options and technologies (40%), and the lack of available funding (37%).

Q: What are the key challenges for improving maintenance at your facility? (n=317)

- Lack of resources or staff: 53%
- Lack of understanding of new maintenance options, technologies: 40%
- Lack of available funding: 37%
- Lack of training: 35%
- Outdated technology: 31%
- Lack of support from management: 28%
- Poor scheduling, rarely followed through: 22%
- Safety issues: 7%
- Security issues: 2%
- Other: 5%
Maintenance strategies
Maintenance strategies

Most respondents indicated that their facilities use a planned maintenance strategy, while over half follow reactive maintenance, and 49% use predictive maintenance.

Q: Which of the following maintenance strategies are used in your plant? (n=316)

- Planned maintenance: 87%
- Reactive maintenance: 57%
- Predictive maintenance (PdM): 49%
- Condition-based maintenance: 35%
- Reliability-centered maintenance (RCM): 23%
- Other: 2%

Q: Which of the following maintenance strategies are used in your plant? (n=316)
Advantages of maintenance strategies (Part 1 of 2)

PdM (76%) and planned maintenance (72%) both excel at decreasing downtime, while RCM and planned maintenance are cost effective overall, according to more than half of respondents.

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=283)

- Better product quality: 51%, 48%, 51%, 53%
- Cost effective overall: 57%, 55%, 52%, 58%
- Decreases downtime: 72%, 76%
- Energy savings: 41%, 47%, 48%, 38%
- Flexibility: 52%, 40%, 35%, 32%

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=283)
Advantages of maintenance strategies (Part 2 of 2)

Reactive maintenance was rated very low, except when evaluating initial cost. Compared to the other four maintenance strategies, this is reactive maintenance's best advantage, according to 51% of respondents.

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=283)

- Improved safety: 63%
  - Planned maintenance: 7%
  - Reactive maintenance: 53%
  - Condition-based maintenance: 55%
  - Predictive maintenance (PdM): 55%

- Increased component life: 64%
  - Planned maintenance: 18%
  - Reactive maintenance: 55%
  - Condition-based maintenance: 18%
  - Predictive maintenance (PdM): 13%

- Low initial cost: 64%
  - Planned maintenance: 58%
  - Reactive maintenance: 54%
  - Condition-based maintenance: 17%
  - Predictive maintenance (PdM): 15%

- Minimize overhaul frequency: 64%
  - Planned maintenance: 43%
  - Reactive maintenance: 56%
  - Condition-based maintenance: 43%
  - Predictive maintenance (PdM): 24%

- Reduced probability of failure: 61%
  - Planned maintenance: 3%
  - Reactive maintenance: 70%
  - Condition-based maintenance: 61%
  - Predictive maintenance (PdM): 57%
Advantages of planned maintenance

The top advantages of a planned maintenance strategy, according to respondents are decreased downtime (72%), reduced probability of failure (64%), and improved safety (63%).

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=274)
Advantages of reactive maintenance

Despite having a low initial cost, only 27% of respondents said that reactive maintenance is cost effective overall, and very few said it actually improves safety (7%) and product quality (6%).

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=181)
### Advantages of predictive maintenance

Decreased downtime (76%) and reduced probability of failure (70%) are the top two advantages of predictive maintenance, according to respondents.

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Decreased downtime</td>
<td>76%</td>
</tr>
<tr>
<td>Reduced probability of failure</td>
<td>70%</td>
</tr>
<tr>
<td>Increased component life</td>
<td>64%</td>
</tr>
<tr>
<td>Minimize overhaul frequency</td>
<td>56%</td>
</tr>
<tr>
<td>Cost effective overall</td>
<td>55%</td>
</tr>
<tr>
<td>Improved safety</td>
<td>53%</td>
</tr>
<tr>
<td>Better product quality</td>
<td>48%</td>
</tr>
<tr>
<td>Energy savings</td>
<td>47%</td>
</tr>
<tr>
<td>Flexibility</td>
<td>40%</td>
</tr>
<tr>
<td>Low initial cost</td>
<td>17%</td>
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</tbody>
</table>

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=154)
Advantages of condition-based maintenance

A major advantage to condition-based maintenance over the other strategies mentioned is energy savings, according to 48% of respondents.

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=109)

- Decreases downtime: 61%
- Reduced probability of failure: 61%
- Increased component life: 58%
- Improved safety: 55%
- Cost effective overall: 52%
- Minimize overhaul frequency: 52%
- Better product quality: 51%
- Energy savings: 48%
- Flexibility: 35%
- Low initial cost: 13%
Advantages of reliability-centered maintenance

Respondents cited reliability-centered maintenance as the most cost effective overall, compared to the other maintenance strategies mentioned.

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=72)

- Decreases downtime: 64%
- Cost effective overall: 58%
- Reduced probability of failure: 57%
- Increased component life: 54%
- Better product quality: 53%
- Minimize overhaul frequency: 51%
- Improved safety: 44%
- Energy savings: 38%
- Flexibility: 32%
- Low initial cost: 15%