Maintenance Report

March 2017

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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 e-mail addresses were available. Only respondents responsible for maintenance for all or part of their facilities were asked about maintenance strategies, outsourcing maintenance, training, technologies, and unscheduled downtime.

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

- **Data collected:** Jan. 4, 2017, through Jan. 22, 2017
- **Number of respondents:** 322
  - Margin of error: +/- 5.5% at a 95% confidence level
- **Incentive:** Survey participants were offered the opportunity to enter a drawing for one Visa gift card valued at $50.00.
Respondents to the *Plant Engineering* 2017 Maintenance Study identified six important, high-level findings impacting the manufacturing industries today:

1. **Maintenance strategies:** Seventy-eight percent of manufacturing facilities follow a preventive maintenance strategy; 61% use a run-to-failure method and 59% use a computerized maintenance management system (CMMS).

2. **Shutdown schedule:** Standard and specialized production machinery are generally shutdown only once or twice each year for scheduled maintenance, while material handling equipment is typically shutdown on a quarterly or monthly basis.

3. **Unscheduled downtime:** The leading cause of unscheduled downtime within respondents’ facilities remains aging equipment (42%), followed by operator error (19%) and lack of time (13%). Some facilities plan to upgrade their equipment and improve/increase training in an effort to decrease downtime.

4. **Training:** Maintenance teams are mostly trained on safety (81%) and basic electrical (70%) and mechanicals skills (66%). Other types of training include motors, gearboxes, bearings (58%) and lubrication (56%).

5. **Technologies:** The most common technologies facilities use to monitor/manage maintenance are CMMS (53%), in-house spreadsheets/schedules (52%), and paper records of maintenance reports (39%).

6. **Outsourcing:** The average facility outsources 19% of their maintenance operations, and the leading factors are lack of time/manpower and lack of skills among current staff.
Respondent profile
Seventy-seven percent of respondents have engineering, maintenance, and/or supervisory responsibilities at their facilities, more than half of whom have engineering job titles.

Q: Which of the following best describes your job title? (n=322)
Respondents have worked in a plant or engineering-related position for an average of 22 years, with 32% having been in the industry for 30 years or longer. The average facility employs 406 people.

**Industry experience**
- Less than 5 years: 9%
- 5 to 9 years: 11%
- 10 to 19 years: 21%
- 20 to 29 years: 27%
- 30 to 39 years: 23%
- 40 years or longer: 9%

**Facility size**
- 1,000 or more: 14%
- 500 to 999: 11%
- 250 to 499: 17%
- 100 to 249: 19%
- 20 to 49: 9%
- 50 to 99: 15%
- 1 to 19: 15%

**Average**
- 22 years
- 406 employees

Q: For approximately how long have you worked in a plant or engineering-related position? (n=322); Q: How many people work at your location? (n=322)
Twenty-seven percent of respondents are located in the North Central region of the U.S., and another 26% are based outside of the U.S. Other countries represented include India, Canada, Mexico, and Romania.

Q: In what region of the United States are you based? (n=322)
Businesses or products manufactured

The top three industries represented by respondents are plant/facilities engineering or maintenance services (17%); utilities, including electric, gas, water, waste, and telecommunications (16%); and fabricated metal manufacturing (15%).

Q: What are the businesses at your location? (n=321)
Facility maintenance
Scheduled maintenance: hours/week

Thirty-four percent of respondents’ facilities spend 30 hours or more each week on scheduled maintenance, up from 26% in the 2016 survey. The average facility spends about 19 hours per week on maintenance tasks.

Q: Approximately how many hours per week does your plant spend on scheduled maintenance? (n=322)
Scheduled maintenance shutdown frequency

Twenty-four percent of facilities shutdown their automated specialized production machinery only once each year for scheduled maintenance, while 17% shutdown these systems twice a year.

Q: How often are the following areas of your plant shutdown for scheduled maintenance? (n=313;314;310;309;311;304)
Six in 10 facilities dedicate a significant amount of maintenance support to their rotating equipment (motors, power transmission, etc.), while 53% grant an equal amount of support to their plant automation systems.

Q: How much maintenance support do the following areas of your facility receive? (n=310;314;308;316;310)

- Plant automation systems
  - A great deal: 18%
  - A lot: 35%
  - Some (little): 35%
  - None at all (N/A): 12%

- Internal electrical distribution systems
  - A great deal: 10%
  - A lot: 28%
  - Some (little): 52%
  - None at all (N/A): 10%

- Fluid power systems (air, hydraulic, etc.)
  - A great deal: 13%
  - A lot: 38%
  - Some (little): 42%
  - None at all (N/A): 7%

- Rotating equipment (motors, power transmission, etc.)
  - A great deal: 19%
  - A lot: 44%
  - Some (little): 32%
  - None at all (N/A): 4%

- Material handling equipment
  - A great deal: 10%
  - A lot: 36%
  - Some (little): 38%
  - None at all (N/A): 16%

Q: How much maintenance support do the following areas of your facility receive? (n=310;314;308;316;310)
Aging equipment (42%) and operator errors (19%) remain the leading causes of unscheduled downtime. In an effort to decrease downtime, half of respondents plan to upgrade equipment, improve/increase training efforts, and/or introduce/implement preventive strategies.

Q: What is the leading cause of unscheduled downtime in your plant? (n=322); Q: How do you plan to decrease unscheduled downtime in your plant? (n=322)

- Aging equipment: 42%
- Operator error: 19%
- Lack of maintenance: 11%
- Lack of time to perform maintenance: 13%
- Poor equipment design/engineering: 9%
- Other: 4%
- Don't know: 2%

Plans to decrease downtime:
- Upgrade equipment
- Improve training, increase frequency
- Introduce preventive maintenance strategies
- Expand monitoring capabilities
- Other
- Don't know
- None
More than half of respondents’ maintenance personnel receives training in safety (81%); basic electrical skills (70%); basic mechanical skills (66%); motors, gearboxes, bearings (58%); lubrication (56%), and predictive maintenance (56%).

Q: What kind of training does your maintenance personnel receive? (n=268)
Half of respondents’ facilities use a computerized maintenance management system (CMMS) or in-house created spreadsheets/schedules to monitor or manage maintenance. Only 7% take advantage of IIoT.

**Q: What technologies are used to monitor or manage maintenance within your plant? (n=322)**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Response Percentage</th>
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<tbody>
<tr>
<td>Computerized maintenance management system (CMMS)</td>
<td>60%</td>
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<tr>
<td>In-house created spreadsheets and schedules (e.g., Microsoft Excel)</td>
<td>50%</td>
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<tr>
<td>Clipboards and paper records of maintenance rounds</td>
<td>40%</td>
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<tr>
<td>General computerized calendar (e.g., Microsoft Outlook)</td>
<td>30%</td>
</tr>
<tr>
<td>Automated maintenance schedule generated by manufacturing scheduling system</td>
<td>20%</td>
</tr>
<tr>
<td>Enterprise asset management (EAM)</td>
<td>10%</td>
</tr>
<tr>
<td>Industrial Internet of Things (IIoT)</td>
<td>10%</td>
</tr>
<tr>
<td>Other</td>
<td>5%</td>
</tr>
<tr>
<td>None</td>
<td>0%</td>
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Outsourcing maintenance

The average facility outsources 19% of their maintenance operations, down from 22% in 2016. The top reasons for outsourcing include lack of time/manpower (45%), too many specialized skills are required (44%), and current personnel lack the skills required (42%).

Q: How much of your plant's maintenance operation is outsourced? (n=322); Q: Which factors led to the outsourcing of maintenance operation at your plant? (n=268)
Fifty-seven percent of respondents see maintenance as a cost center, most of whom understand that they need to spend in order to keep their equipment running. Another 37% see maintenance as a profit center that delivers greater capacity to their facility.

Q: Which of the following statements best describes your attitude toward maintenance? (n=322)

- It's a cost center, and we need to carefully control costs. 16%
- It's a profit center where we can deliver greater capacity to our plant. 37%
- It's a cost center, but we need to spend in order to keep equipment running. 41%
- It's a necessary evil. 6%
Challenges to improving maintenance

Key challenges to improving maintenance at respondents’ facilities include a lack of resources or staff (52%), outdated technology (37%), a lack of understanding of new options/technologies (36%), and a lack of funding (33%).

Q: What are the key challenges for improving maintenance at your facility? (n=322)
More than half of facilities are not using handheld or mobile devices for plant maintenance, but 27% are looking into it. Only 9% have full integrated handheld/mobile devices into a plant-wide CMMS or IIoT system.

Q: To what extent is your plant using handheld/mobile devices for plant maintenance? (n=322)

- Do not use, and have no plans to use: 29%
- Use for communications between maintenance personnel and schedulers: 16%
- Use for scheduling, to provide information about the machine and its work history at the repair site: 12%
- Devices are fully integrated into a plant-wide CMMS/IIoT system: 9%
- Don't know: 7%
Impact of the Industrial Internet of Things

Thirty-two percent of respondents believe that adopting IIoT will help them to better understand machine health, and therefore keep up with planned routine maintenance. Twenty-four percent are unsure how or if IIoT would impact their plant’s maintenance operations.

Q: How will the Industrial Internet of Things (IIoT) impact plant maintenance operations? (n=322)
Maintenance strategies
Maintenance strategies used

Manufacturers use multiple maintenance strategies on the plant floor, depending on the equipment. Seventy-eight percent use preventive maintenance, while 61% employ a "run-to-failure" strategy and 59% opt to use a CMMS.

Q: Which of the following maintenance strategies are present within your plant? (n=322)
Advantages of maintenance strategies

Preventive, predictive (PdM), and reliability-centered maintenance (RCM) strategies have the most advantages compared to others, according to respondents. A top advantage for all three strategies is decreased downtime.

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=250;196;190;152;92)
Advantages of preventive maintenance

Six in 10 respondents who use preventive maintenance techniques within their facilities have witnessed decreased downtime (69%), a reduced probability of failure (66%), overall equipment effectiveness (63%), and an improvement in safety (62%).

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=250)

- Decreases downtime
- Reduced probability of failure
- Overall equipment effectiveness
- Improved safety
- Overall efficiency
- Increased component safety
- Cost effective overall
- Better productivity
- Minimize overhaul frequency
- Energy savings
- Flexibility
- Low initial cost

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=250)
Advantages of reactive maintenance

Reactive maintenance strategies boast the lowest initial cost (61%), but continue to lack other key benefits, such as improved safety (9%), increase component safety (7%), and reduced probability of failure (7%).

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=196)

- Low initial cost (61%)
- Cost effective overall (30%)
- Flexibility (20%)
- Minimize overhaul frequency (15%)
- Better productivity (10%)
- Overall equipment effectiveness (10%)
- Decreases downtime (5%)
- Overall efficiency (5%)
- Energy savings (5%)
- Improved safety (5%)
- Increased component safety (5%)
- Reduced probability of failure (5%)
Advantages of CMMS

According to respondents, a computerized maintenance management system improves overall efficiency (65%), boasts overall equipment effectiveness (59%), and decreases downtime (58%).

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=190)

- Overall efficiency
- Overall equipment effectiveness
- Decreases downtime
- Better productivity
- Cost effective overall
- Improved safety
- Flexibility
- Reduced probability of failure
- Increased component safety
- Energy savings
- Minimize overhaul frequency
- Low initial cost

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=190)
Advantages of predictive maintenance

Looking past a higher initial cost, predictive maintenance strategies have shown to substantially decrease downtime (73%) and reduce probability of failure (73%), along with overall equipment effectiveness (63%).

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Decreases downtime</td>
<td>73%</td>
</tr>
<tr>
<td>Reduced probability of failure</td>
<td>73%</td>
</tr>
<tr>
<td>Overall equipment effectiveness</td>
<td>63%</td>
</tr>
<tr>
<td>Minimize overhaul frequency</td>
<td>55%</td>
</tr>
<tr>
<td>Overall efficiency</td>
<td>50%</td>
</tr>
<tr>
<td>Better productivity</td>
<td>46%</td>
</tr>
<tr>
<td>Cost effective overall</td>
<td>43%</td>
</tr>
<tr>
<td>Improved safety</td>
<td>37%</td>
</tr>
<tr>
<td>Increased component safety</td>
<td>32%</td>
</tr>
<tr>
<td>Energy savings</td>
<td>27%</td>
</tr>
<tr>
<td>Flexibility</td>
<td>21%</td>
</tr>
<tr>
<td>Low initial cost</td>
<td>10%</td>
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Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=152)
Advantages of reliability-centered maintenance

Of the respondents whose facilities use a reliability-centered maintenance strategy, six in 10 have observed a reduced probability of failure (60%), increased productivity (60%), decreased downtime (64%), and overall equipment effectiveness (67%) as a result.

Q: What are the advantages to the maintenance strategy/strategies in place at your plant? (n=92)
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