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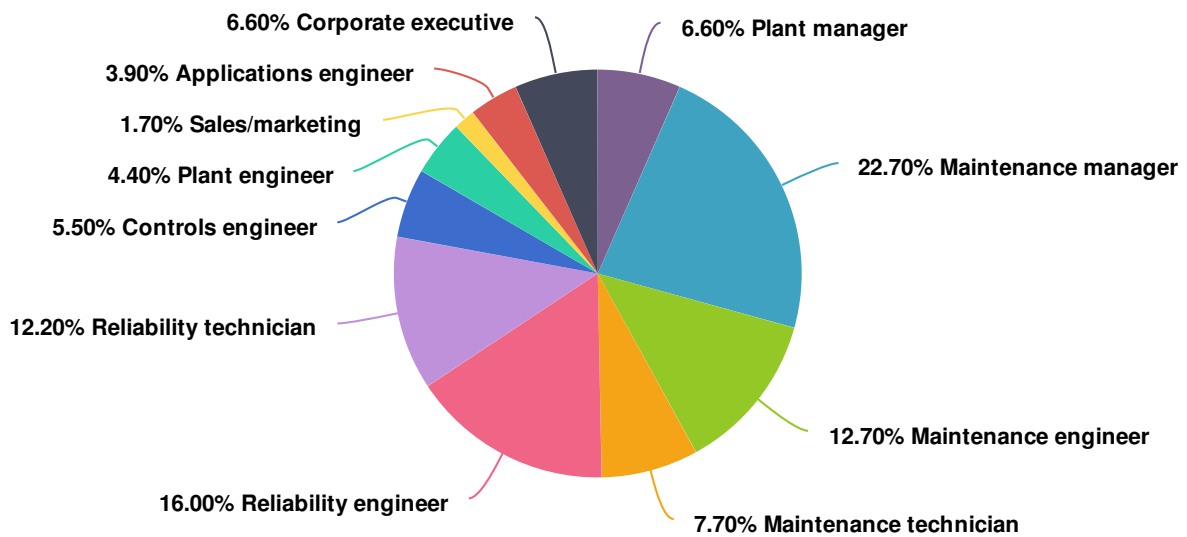





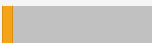







PdM Balance

Our 2017 predictive maintenance survey reveals how plant teams are tying fresh approaches into their PdM programs.

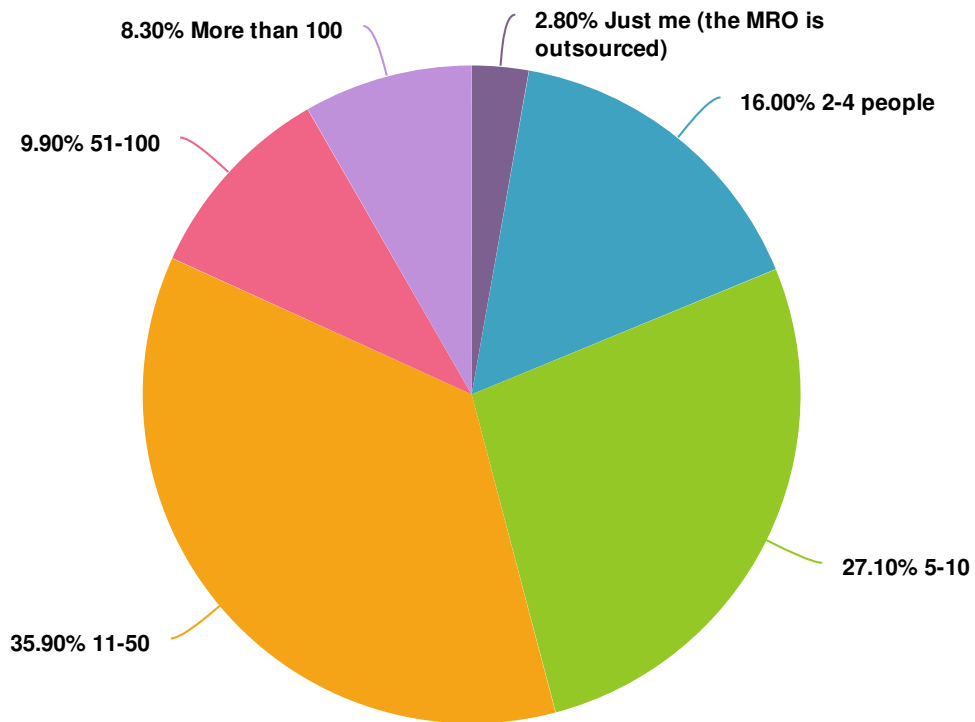
PS PdM Survey 2017 - FINAL - 4/18/17

1. What is your primary job function?



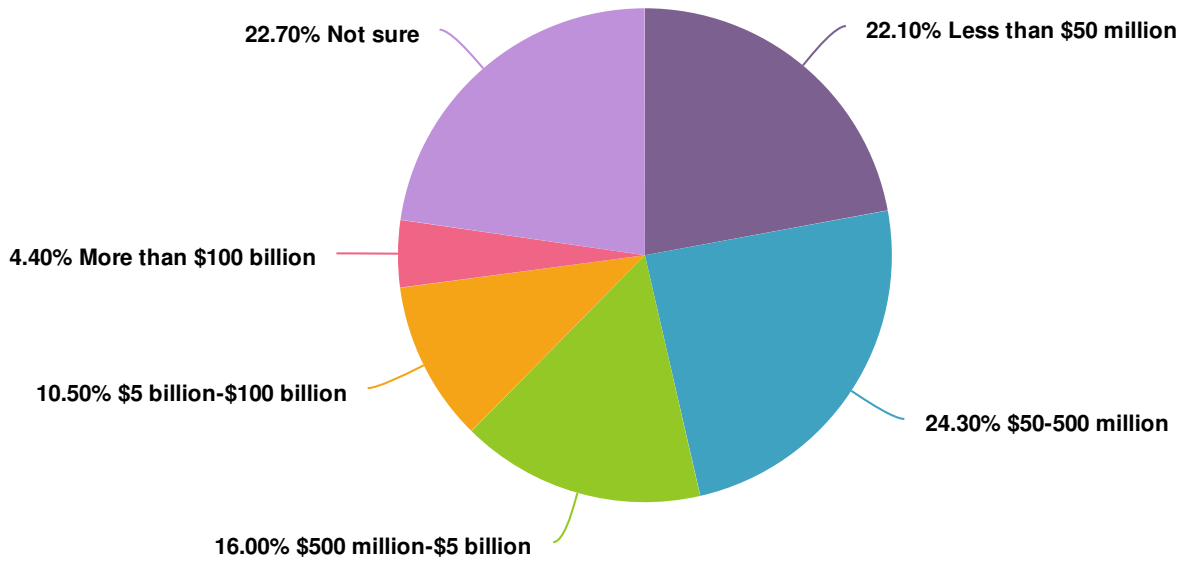
Value		Percent
Plant manager		6.6%
Maintenance manager		22.7%
Maintenance engineer		12.7%
Maintenance technician		7.7%
Reliability engineer		16.0%
Reliability technician		12.2%
Controls engineer		5.5%
Plant engineer		4.4%
Sales/marketing		1.7%
Applications engineer		3.9%
Corporate executive		6.6%

2. How big is the maintenance/reliability staff at your plant?



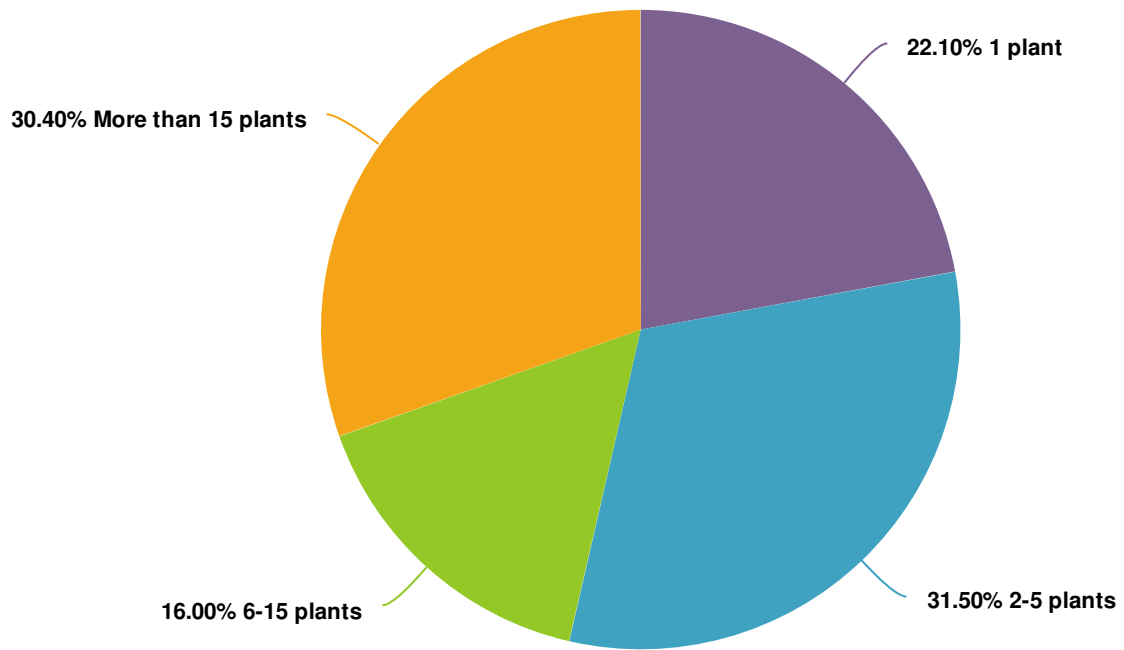
Value	Percent
Just me (the MRO is outsourced)	2.8%
2-4 people	16.0%
5-10	27.1%
11-50	35.9%
51-100	9.9%
More than 100	8.3%

3. What is the annual revenue of your organization?



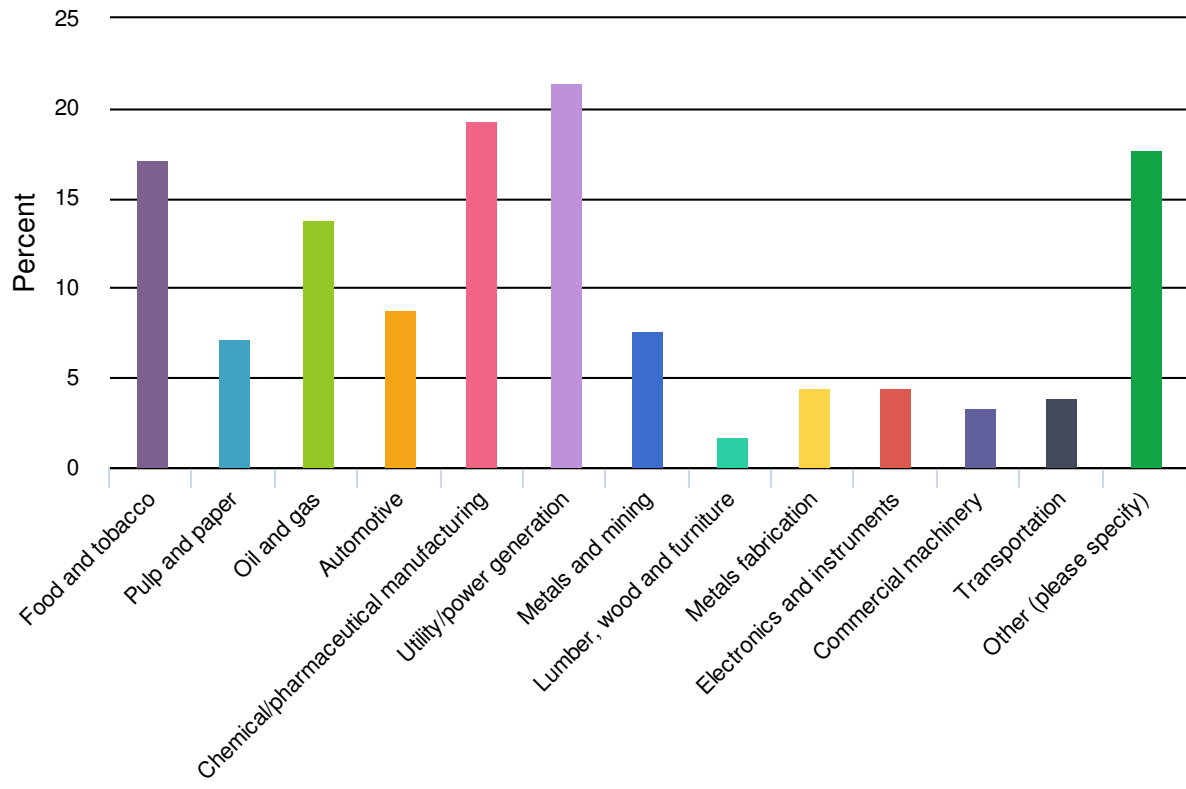
Value	Percent
Less than \$50 million	22.1%
\$50-500 million	24.3%
\$500 million-\$5 billion	16.0%
\$5 billion-\$100 billion	10.5%
More than \$100 billion	4.4%
Not sure	22.7%




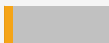









4. How many total plants does your organization manage?



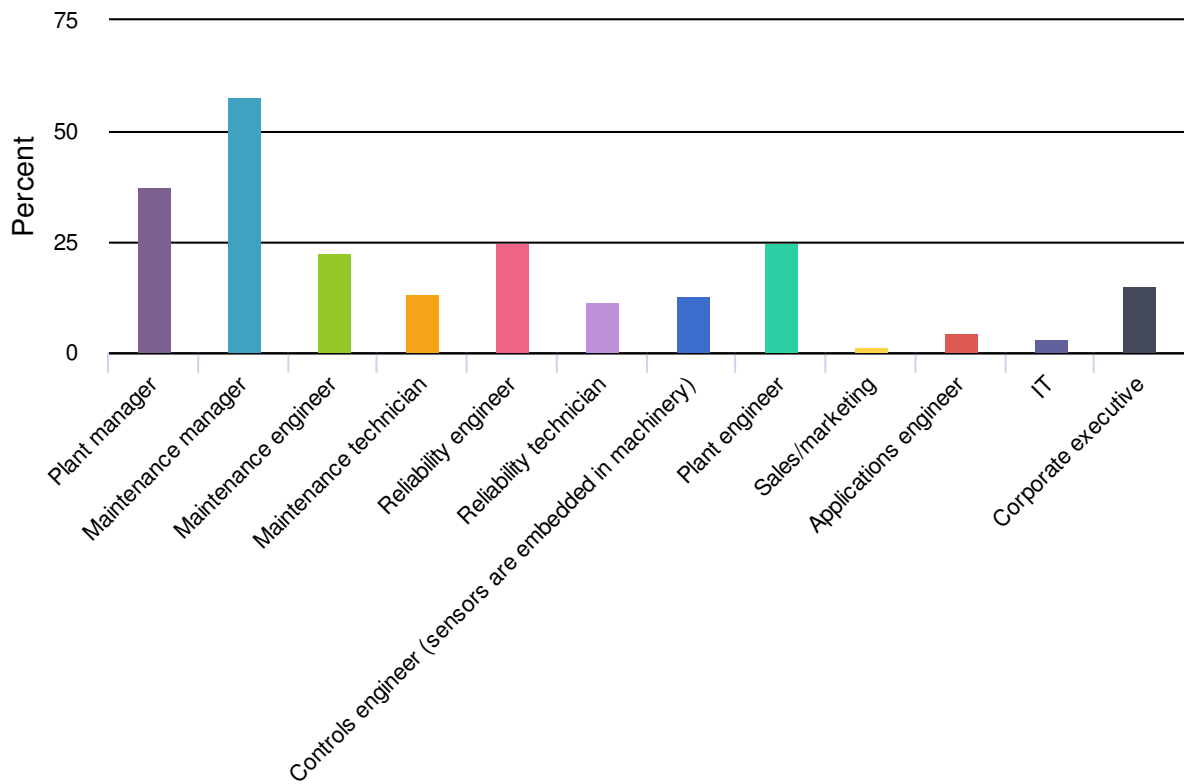
Value		Percent
1 plant		22.1%
2-5 plants		31.5%
6-15 plants		16.0%
More than 15 plants		30.4%

5. What vertical does your plant most closely align with? (Please check all that apply.)















Value		Percent
Food and tobacco		17.1%
Pulp and paper		7.2%
Oil and gas		13.8%
Automotive		8.8%
Chemical/pharmaceutical manufacturing		19.3%
Utility/power generation		21.5%
Metals and mining		7.7%
Lumber, wood and furniture		1.7%
Metals fabrication		4.4%
Electronics and instruments		4.4%
Commercial machinery		3.3%
Transportation		3.9%
Other (please specify)		17.7%

6. Who in your plant makes decisions on asset monitoring tools and configurations? (Please check all that apply.)



Value

Percent

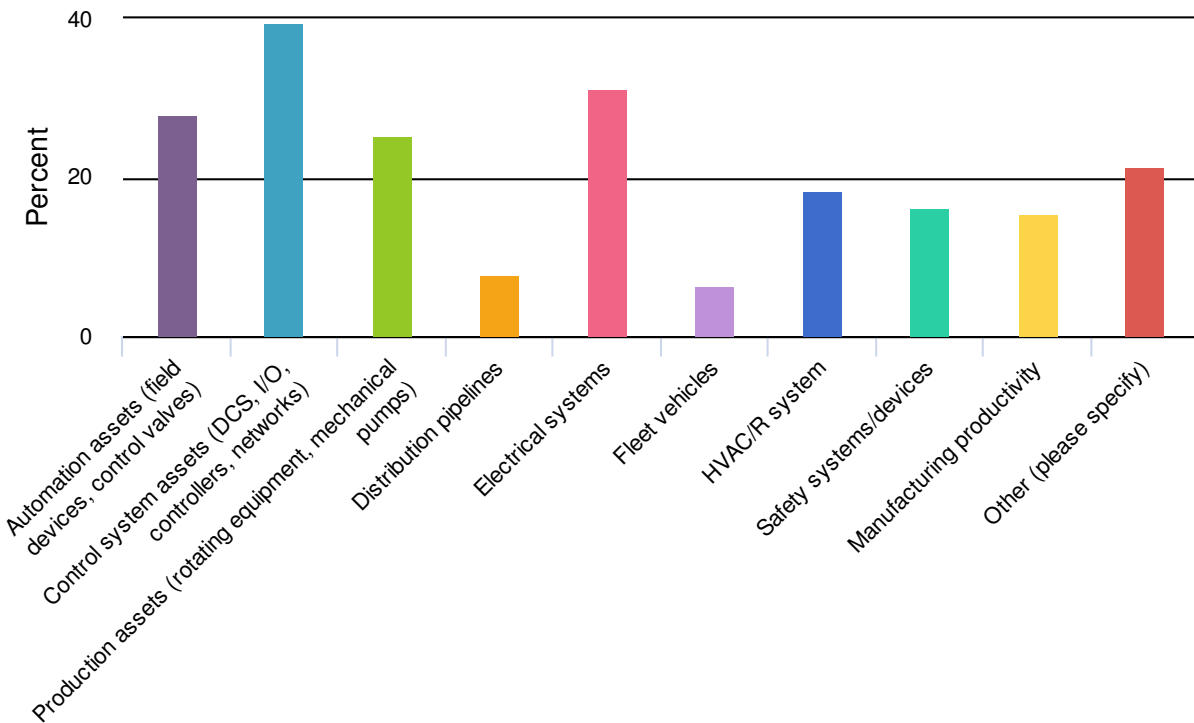
Plant manager		37.4%
Maintenance manager		58.1%
Maintenance engineer		22.6%
Maintenance technician		13.5%
Reliability engineer		25.2%
Reliability technician		11.6%
Controls engineer (sensors are embedded in machinery)		12.9%
Plant engineer		25.2%
Sales/marketing		1.3%
Applications engineer		4.5%
IT		3.2%
Corporate executive		15.5%











7. Which of these technologies are you using to monitor assets?

	Using now	In 2017 budget	Within 3 years	No plans	Responses
Controls equipment (controllers, networks, software) Row %	75.7%	5.3%	7.9%	11.2%	11.1%
Self-diagnostic (smart) instrumentation and final control elements (drives, valves) Row %	55.0%	5.3%	17.2%	22.5%	11.1%
Specialized system control systems (combustion controls, steam trap monitors, water/wastewater, cooling systems, compressed air) Row %	58.3%	2.6%	11.3%	27.8%	11.1%
Predictive maintenance (PdM) technologies for condition-monitoring (thermography, oil analysis, vibration, ultrasound, motor testing) Row %	74.5%	9.2%	9.8%	6.5%	11.2%
Instrumentation (valve analysis, signal processing and alarm management software) Row %	58.7%	4.0%	15.3%	22.0%	11.0%
Automation, data archiving, and reporting software Row %	63.4%	5.2%	9.2%	22.2%	11.2%
Automation of work order generation (including repair history, diagnostics, procedure and parts information) Row %	54.6%	11.2%	17.8%	16.4%	11.1%

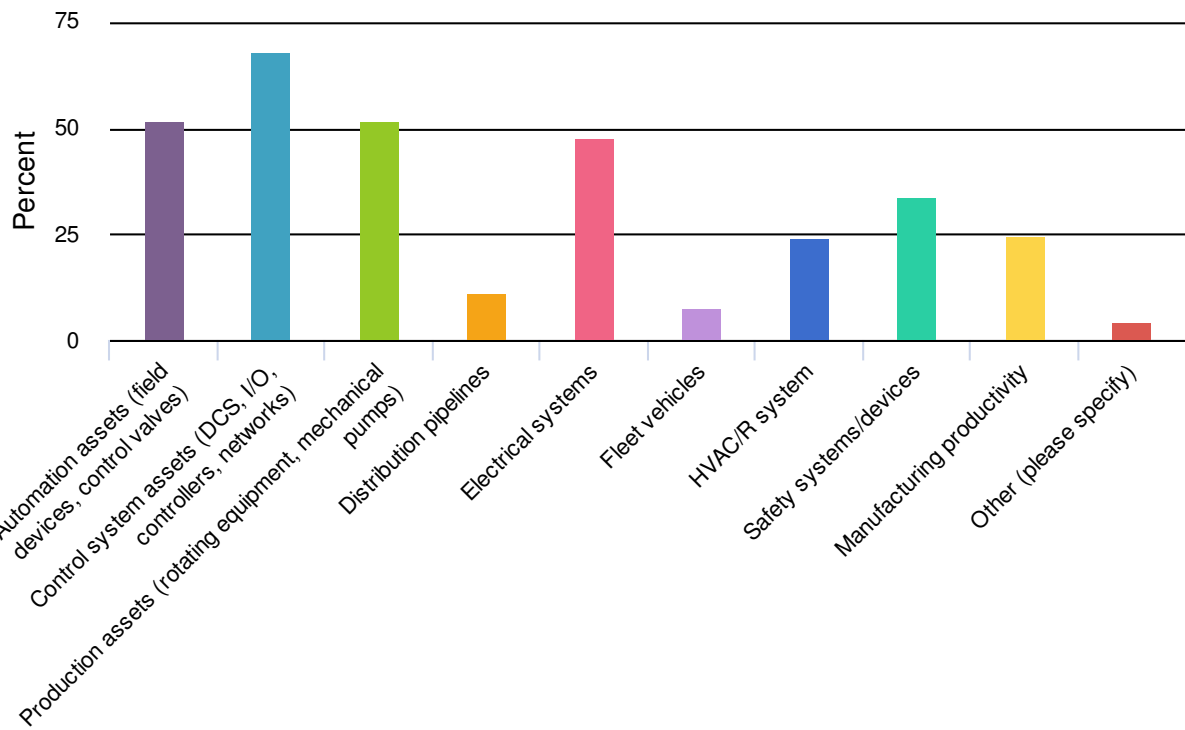
	Using now	In 2017 budget	Within 3 years	No plans	Responses
Embedded remote monitoring devices Row %	39.1%	8.6%	21.2%	31.1%	11.1%
Energy monitoring and control devices (drives, valve actuators) Row %	51.6%	6.5%	16.3%	25.5%	11.2%
Total					100.0%

8. Which of these systems/functions are you using Internet-enabled systems and sensors (i.e., IIoT technologies) to monitor? (Please check all that apply.)













Value		Percent
Automation assets (field devices, control valves)		27.9%
Control system assets (DCS, I/O, controllers, networks)		39.6%
Production assets (rotating equipment, mechanical pumps)		25.3%
Distribution pipelines		7.8%
Electrical systems		31.2%
Fleet vehicles		6.5%
HVAC/R system		18.2%
Safety systems/devices		16.2%
Manufacturing productivity		15.6%
Other (please specify)		21.4%

9. Which of these systems/functions are you using your control system and connected sensors to monitor? (Please check all that apply.)

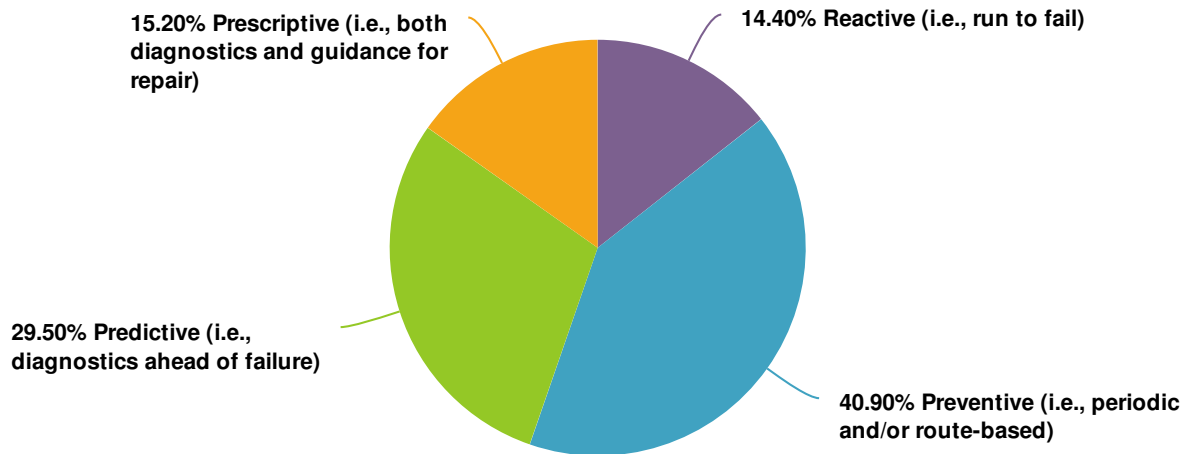


Value

Percent

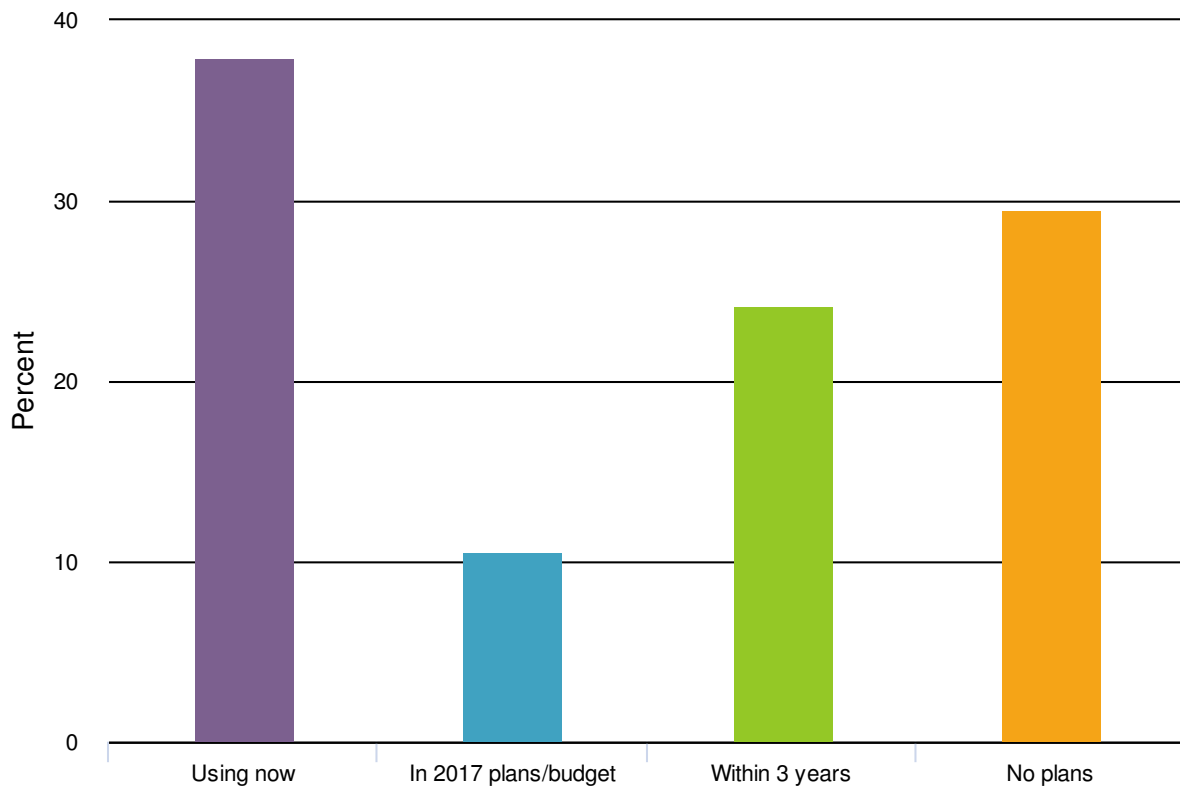
Automation assets (field devices, control valves)		51.9%
Control system assets (DCS, I/O, controllers, networks)		68.2%
Production assets (rotating equipment, mechanical pumps)		51.9%
Distribution pipelines		11.0%
Electrical systems		48.1%
Fleet vehicles		7.8%
HVAC/R system		24.0%
Safety systems/devices		33.8%
Manufacturing productivity		24.7%
Other (please specify)		4.5%

10. Which types of maintenance approaches are currently employed by your plant? (Please check all that apply.)



Value	Percent
Reactive (i.e., run to fail)	14.4%
Preventive (i.e., periodic and/or route-based)	40.9%
Predictive (i.e., diagnostics ahead of failure)	29.5%
Prescriptive (i.e., both diagnostics and guidance for repair)	15.2%

11. To what degree does your team or organization currently engage in prescriptive maintenance?



Value	Percent
Using now	37.9%
In 2017 plans/budget	10.6%
Within 3 years	24.2%
No plans	29.5%

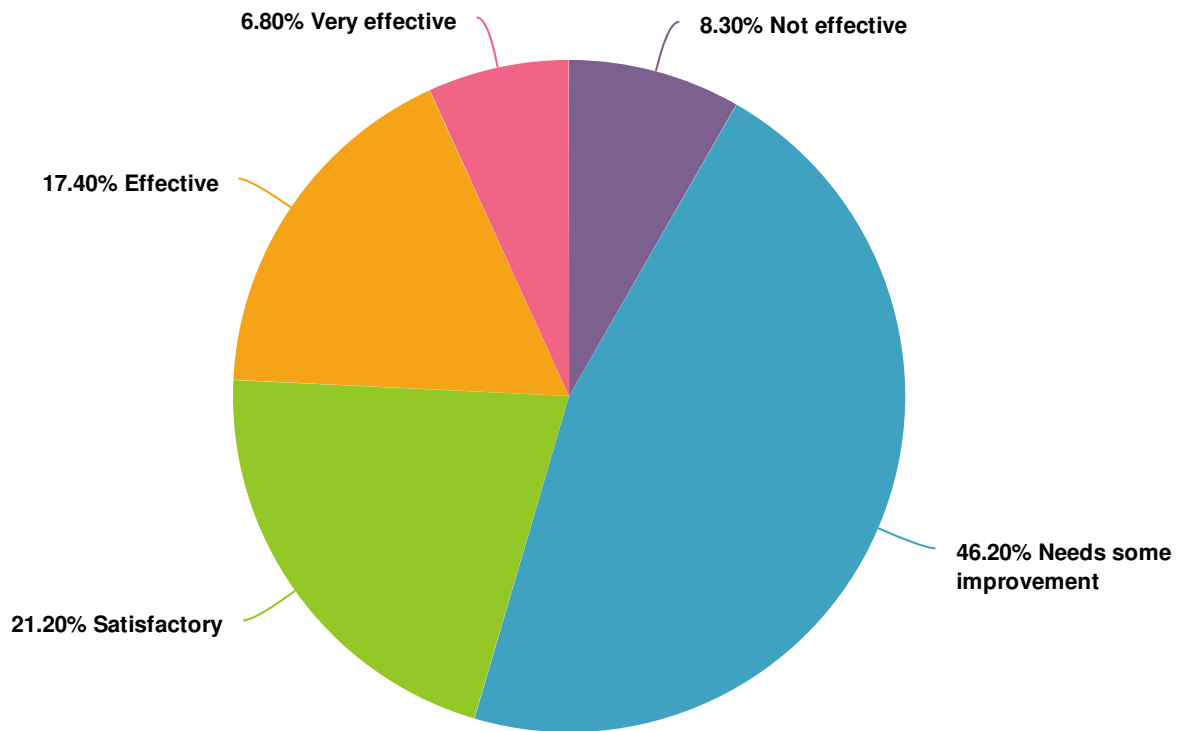
12. Which predictive maintenance (PdM) technologies have you deployed or are you planning to deploy?

	Using now	In 2017 budget	Within 3 years	No plans	Responses
Vibration Count Row %	93 70.5%	13 9.8%	10 7.6%	16 12.1%	12.5%
Ultrasonic Count Row %	78 59.1%	16 12.1%	10 7.6%	28 21.2%	12.5%
Acoustic Count Row %	45 34.4%	7 5.3%	21 16.0%	58 44.3%	12.5%
Corrosion Count Row %	59 45.0%	4 3.1%	14 10.7%	54 41.2%	12.5%
Infrared Count Row %	98 74.8%	4 3.1%	10 7.6%	19 14.5%	12.5%
Oil analysis Count Row %	97 73.5%	7 5.3%	8 6.1%	20 15.2%	12.5%
Predictive modeling software Count Row %	27 20.6%	14 10.7%	26 19.8%	64 48.9%	12.5%
Electric motor testing Count Row %	62 47.0%	13 9.8%	28 21.2%	29 22.0%	12.5%
Total					100.0%

13. Please rate the drivers for deploying your PdM solutions.

	Not a factor	Low	Medium	High	Responses
Reduce maintenance costs Row %	3.8%	13.6%	31.1%	51.5%	11.1%
Reduce operational costs Row %	3.8%	9.8%	32.6%	53.8%	11.1%
Improve uptime Row %	2.3%	7.6%	15.9%	74.2%	11.1%
Knowledge capture Row %	6.1%	22.0%	42.4%	29.5%	11.1%
Increase visibility into troubled assets Row %	6.1%	15.9%	41.7%	36.4%	11.1%
Environmental, health, and safety issues Row %	6.8%	22.0%	35.6%	35.6%	11.1%
Regulatory compliance Row %	9.1%	29.5%	30.3%	31.1%	11.1%
Energy management Row %	9.8%	34.1%	28.8%	27.3%	11.1%
Reduce risk Row %	3.8%	15.2%	31.8%	49.2%	11.1%
Total					100.0%

14. Please rate the performance of your PdM program over the past 12 months.



Value	Percent
Not effective	8.3%
Needs some improvement	46.2%
Satisfactory	21.2%
Effective	17.4%
Very effective	6.8%

15. Please rate the performance of PdM in relation to other investments.

	1 - Least important	2	3 - Moderately important	4	5 - Most important	Responses
PdM technologies Row %	8.3%	9.1%	37.1%	28.8%	16.7%	11.2%
Reliability solutions Row %	5.3%	7.6%	33.3%	31.8%	22.0%	11.2%
EAM/CMMS Row %	8.3%	11.4%	42.4%	25.0%	12.9%	11.2%
Safety systems Row %	3.8%	9.1%	17.4%	29.5%	40.2%	11.2%
DCS Row %	13.6%	18.2%	29.5%	18.2%	20.5%	11.2%
Field devices Row %	9.2%	18.3%	30.5%	28.2%	13.7%	11.1%
Plant process networks Row %	8.4%	18.3%	30.5%	25.2%	17.6%	11.1%
EH&S solutions Row %	11.5%	18.5%	29.2%	26.2%	14.6%	11.0%
Sustainable & energy management Row %	8.5%	16.2%	35.4%	20.8%	19.2%	11.0%
Total						100.0%

16. Please rate the obstacles limiting the success of your PdM initiatives.

	Not a factor	Low	Medium	High	Responses
No improvements needed Row %	39.4%	30.3%	23.5%	6.8%	11.1%
Budget constraints Row %	6.8%	18.2%	40.9%	34.1%	11.1%
Undefined financial benefits Row %	10.6%	27.3%	39.4%	22.7%	11.1%
Limited IT resources Row %	15.2%	27.3%	38.6%	18.9%	11.1%
Lack of executive support Row %	16.7%	25.0%	35.6%	22.7%	11.1%
Limited engineering resources Row %	10.6%	22.0%	39.4%	28.0%	11.1%
Undefined operational benefit Row %	9.1%	33.3%	45.5%	12.1%	11.1%
Lack of EAM integration Row %	10.6%	31.8%	39.4%	18.2%	11.1%
Poor program execution Row %	16.7%	25.8%	40.9%	16.7%	11.1%
Total					100.0%

17. What types of assets are managed by your PdM solutions?

	Using now	In 2017 budget	Within 3 years	No plans	Asset type not installed	Responses
Automation assets (field devices, control valves) Row %	48.2%	2.6%	14.0%	22.8%	12.3%	14.3%
Control system assets (DCS, I/O, controllers, networks) Row %	50.4%	5.3%	10.6%	23.9%	9.7%	14.2%
Production assets (rotating equipment, mechanical pumps) Row %	67.5%	5.3%	7.9%	11.4%	7.9%	14.3%
Distribution pipelines Row %	23.7%	1.8%	10.5%	28.9%	35.1%	14.3%
Electrical systems Row %	60.5%	0.9%	14.0%	21.1%	3.5%	14.3%
Fleet vehicles Row %	10.5%	2.6%	10.5%	38.6%	37.7%	14.3%
HVAC/R system Row %	34.2%	5.3%	13.2%	34.2%	13.2%	14.3%
Total						100.0%

18. Which types of assets are you using Internet-enabled / IIoT technologies to manage?

	Using now	In 2017 budget	Within 3 years	No plans	Asset type not installed	Responses
Automation assets (field devices, control valves) Row %	25.7%	4.4%	13.3%	38.1%	18.6%	14.2%
Control system assets (DCS, I/O, controllers, networks) Row %	23.7%	4.4%	19.3%	34.2%	18.4%	14.3%
Production assets (rotating equipment, mechanical pumps) Row %	23.7%	4.4%	18.4%	36.0%	17.5%	14.3%
Distribution pipelines Row %	9.6%	3.5%	9.6%	46.5%	30.7%	14.3%
Electrical systems Row %	22.8%	3.5%	13.2%	44.7%	15.8%	14.3%
Fleet vehicles Row %	5.3%	1.8%	9.6%	50.0%	33.3%	14.3%
HVAC/R system Row %	14.0%	6.1%	14.0%	45.6%	20.2%	14.3%
Total						100.0%

19. Is your PdM system integrated with any of the following higher-level systems?

	Using now	In 2017 budget	Within 3 years	No plans	Responses
Reliability solutions Row %	21.1%	7.0%	24.6%	47.4%	16.7%
Historian Row %	29.8%	5.3%	16.7%	48.2%	16.7%
EAM/CMMS system Row %	38.6%	7.0%	17.5%	36.8%	16.7%
EH+S solution Row %	9.6%	10.5%	14.9%	64.9%	16.7%
ERP system Row %	11.4%	7.9%	20.2%	60.5%	16.7%
Cloud-based analytics Row %	5.3%	4.4%	21.1%	69.3%	16.7%
Total					100.0%

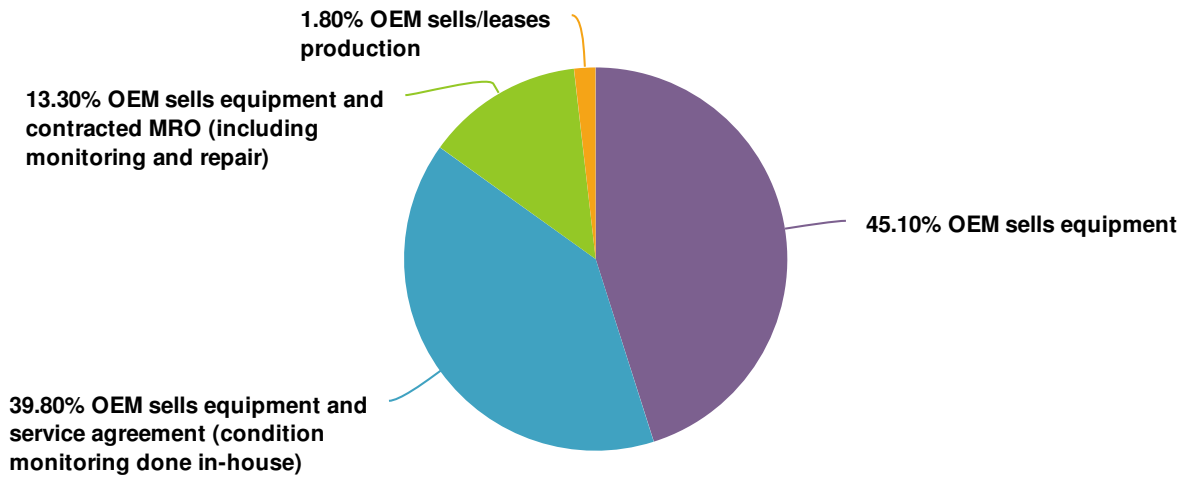
20. What data collection methods do you use with your PdM system?

	Using now	In 2017 budget	Within 3 years	No plans	Responses
Paper-based system Row %	62.8%	2.7%	3.5%	31.0%	9.1%
Handheld data collector Row %	59.3%	7.1%	15.0%	18.6%	9.1%
Embedded sensors/monitoring devices Row %	46.9%	6.2%	22.1%	24.8%	9.1%
Wireless sensors/transmitters Row %	29.2%	10.6%	26.5%	33.6%	9.1%
Internet-enabled sensors Row %	12.4%	5.3%	25.7%	56.6%	9.1%
Industrial-grade smartphone Row %	7.1%	6.2%	20.4%	66.4%	9.1%
Consumer-grade smartphone Row %	18.6%	5.3%	15.9%	60.2%	9.1%
Industrial-grade tablet Row %	15.0%	11.5%	30.1%	43.4%	9.1%
Consumer-grade tablet Row %	13.3%	8.0%	19.5%	59.3%	9.1%
Industrial-grade PC Row %	39.8%	5.3%	16.8%	38.1%	9.1%
Consumer-grade PC Row %	35.4%	3.5%	13.3%	47.8%	9.1%
Total					100.0%

21. Who uses the information provided by your PdM systems and with what frequency?

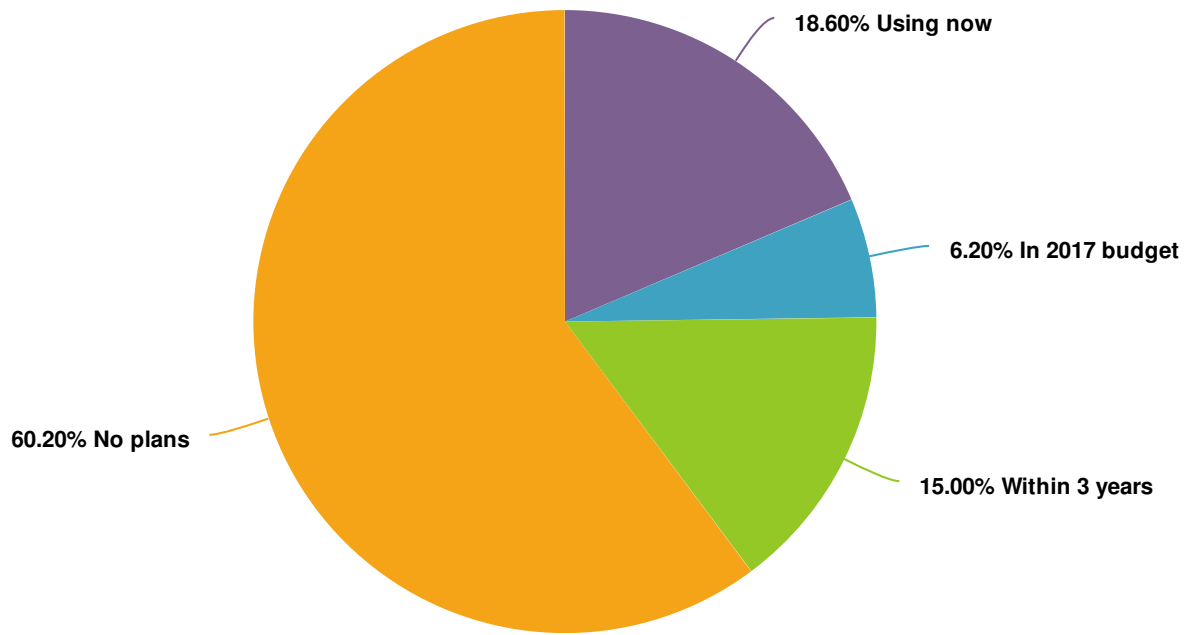
	Never	Weekly	Monthly	Quarterly	Responses
In-house maintenance Row %	6.2%	48.7%	33.6%	11.5%	16.7%
In-house operations Row %	32.7%	34.5%	16.8%	15.9%	16.7%
In-house reliability engineers Row %	21.2%	44.2%	27.4%	7.1%	16.7%
Totally outsourced to third-party maintenance and repair Row %	76.1%	6.2%	10.6%	7.1%	16.7%
Third-party remote monitoring Row %	76.1%	11.5%	8.8%	3.5%	16.7%
OEM supplier Row %	69.0%	6.2%	12.4%	12.4%	16.7%
Total					100.0%

22. What is your relationship with OEMs whose physical assets you use?



Value	Percent
OEM sells equipment	45.1%
OEM sells equipment and service agreement (condition monitoring done in-house)	39.8%
OEM sells equipment and contracted MRO (including monitoring and repair)	13.3%
OEM sells/leases production	1.8%

23. Are you using OEM-enabled remote monitoring technologies and/or services?



Value	Percent
Using now	18.6%
In 2017 budget	6.2%
Within 3 years	15.0%
No plans	60.2%

24. Which advanced PdM features have you deployed?

	Using now	In 2017 budget	Within 3 years	No plans	Responses
Internet-enabled / IIoT technologies Row %	15.7%	3.7%	25.0%	55.6%	16.7%
Troubleshooting decision tree Row %	31.5%	5.6%	14.8%	48.1%	16.7%
HMI with color-coded alerts Row %	35.2%	6.5%	13.9%	44.4%	16.7%
Optimized PdM work processes Row %	26.9%	9.3%	23.1%	40.7%	16.7%
Route optimization for mechanics and operators Row %	28.7%	7.4%	21.3%	42.6%	16.7%
Energy consumption of assets Row %	25.0%	10.2%	21.3%	43.5%	16.7%
Total					100.0%

25. Which emerging technologies are you considering for inclusion in your PdM initiative?

	Using now	In 2017 budget	Within 3 years	No plans	Responses
Embedded PdM intelligence from equipment suppliers Row %	16.7%	5.6%	27.8%	50.0%	11.1%
Wireless connectivity to field workforce (work history info and manuals) Row %	15.7%	5.6%	33.3%	45.4%	11.1%
Cloud web-based PdM deployment Row %	2.8%	7.4%	27.8%	62.0%	11.1%
Smartphones Row %	17.6%	7.4%	29.6%	45.4%	11.1%
Tablets Row %	23.1%	10.2%	30.6%	36.1%	11.1%
RFID for asset identification Row %	13.0%	6.5%	30.6%	50.0%	11.1%
GIS for asset location Row %	6.5%	5.6%	20.4%	67.6%	11.1%
Remote monitoring and analysis Row %	33.3%	9.3%	25.0%	32.4%	11.1%
Analytics software Row %	22.2%	10.2%	31.5%	36.1%	11.1%
Total					100.0%

26. What changes, if any, are planned in your PdM investments for the following?

	Declining	No change	Increase 0 - 5%	Increase > 5%	Responses
Control systems (DCS, PLC) Count Row %	4 3.7%	60 55.6%	33 30.6%	11 10.2%	16.7%
Production assets (rotating equipment, compressors) Count Row %	5 4.6%	46 42.6%	38 35.2%	19 17.6%	16.7%
Instrumentation Count Row %	4 3.7%	45 41.7%	43 39.8%	16 14.8%	16.7%
EAM/CMMS Count Row %	8 7.5%	59 55.1%	26 24.3%	14 13.1%	16.5%
Data historian Count Row %	7 6.5%	61 56.5%	30 27.8%	10 9.3%	16.7%
Predictive analytic software Count Row %	5 4.6%	49 45.4%	38 35.2%	16 14.8%	16.7%
Total					100.0%