Digital Industrial Revolution with Predictive Maintenance

Are European businesses ready to streamline their operations and reach higher levels of efficiency?

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Preface

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Digitalization is affecting every industry, disrupting current leaders and creating new business opportunities. To survive disruption, manufacturers must rethink every aspect of their business and become a digital enterprise. This means leveraging cutting edge technology drivers across each phase of operations to reduce cycle times, increase yields, and create new business opportunities.

The PAC study found 93% of companies describe their maintenance processes as not very efficient, which means there is plenty of room for improvement. Major challenges that companies currently face are unplanned downtime and sudden failures, as well as aging infrastructure which brings innovation to a halt. The survey also found that 49% of companies have already invested in predictive maintenance initiatives and plan to further invest in the next two years. The results of the survey also reflect determination to address these issues as more than 90% of the companies plan to invest into technology solutions that enable predictive maintenance such as: data and predictive maintenance platforms, networking infrastructure, Internet of Things (IoT) and edge analytics.

IoT and advanced analytics provide the foundation for creating a digital twin of performance. Predictive maintenance enables companies to identify precursors for poor performance, such as sudden spikes within a normal operating range and specific test results, and correlate them with equipment maintenance records to predict which equipment may suddenly require unscheduled maintenance or downtime. Identifying patterns within normal operations that may otherwise go unnoticed enables companies to schedule preventive maintenance and avoid unscheduled equipment downtime.

Combining predictive technology with IoT, service, field and other customer data streams enables companies to create a deeper impact on the customer experience. Leveraging as-used data to identify patterns and sequences of events enables companies to engage with customers before problems arise and to resolve potential issues. Companies can proactively identify problems and push fixes (parts, software, hardware or firmware) to eliminate possible points of failure or degraded performance that end-users could experience – ultimately increasing customer satisfaction and improving net promoter scores. Siemens MindSphere, the cloud-based open IoT operating system, enables companies to transform data into productive business results which will drive up operational efficiencies and drive down costs.

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INTRODUCTION

As two of the most asset-heavy industries in Europe, manufacturing and transport are facing strong headwinds thanks to growing operational costs and competitive pressures coming from within the European continent and beyond. Additionally, dated legacy systems and operational technology add to the pressure as companies can struggle to integrate innovative digital solutions into these, thus slowing down innovation and limiting their growth. In such markets, improving operational efficiencies and cutting costs wherever possible becomes imperative for most businesses in these sectors.

Since major investments go into new industrial machinery and fleets of vehicles, maintenance is of critical importance in order to enable greater utilization and longer lifetime and thus maximizing the return on investment. However, existing maintenance processes are far from efficient which leaves plenty of room for improvement. As a result, companies are turning to digital technologies such as the internet of things (IoT) and predictive analytics to unlock the streams of data coming from the industrial machinery and vehicles and turn this data into value. This can be achieved by processing the data with predictive algorithms which can make the companies aware of when their assets might fail. On the back of these insights, maintenance processes can be optimized in order to reduce equipment downtime, but also of the products these companies make or services they provide. This provides an opportunity to boost utilization and productivity, while at the same time improving customer experience.

However, are manufacturers and transport operators aware of these opportunities, and do they have necessary capabilities in place? How far away are they from having all the maintenance processes based on predictive insights? This study sets out to explore how European manufacturers and transport operators are approaching predictive maintenance initiatives from an investment, infrastructure implementation, and strategy perspective. Based on interviews with more than 230 senior business and technology decision-makers, this report explores the impact that digital transformation has on maintenance processes and achieving cost savings. The study discusses specific predictive maintenance use cases from the industry that companies have recently undertaken and, as such, presents relevant and interesting reading for senior decision-makers at European manufacturing and transport companies who are looking to better understand the benefits of predictive maintenance solutions and peek into the progress their peers are making in this field.

> More than 90% of the companies describe their existing maintenance processes as not very efficient, but are they ready to streamline them?

KEY FINDINGS

✓ 93% of companies describe their maintenance processes as not very efficient which means there is plenty of room for improvement.
Major challenges that companies currently face are unplanned downtime and sudden failures, as well as aging infrastructure which acts as a break for innovation.

✓ 55% of the companies are at least piloting predictive maintenance initiatives while 23% are generating a tangible business impact.
This shows a degree of maturity of adoption in the sectors and show that almost quarter of the companies are already bearing fruit and recognize its importance on the long-term.

✓ 49% of companies have already invested in predictive maintenance initiatives and plan to further invest in the next two years.
Furthermore, 34% haven't yet but plan to invest in the next two years, which means that in total 83% will invest over this timeframe.

✓ Within majority of the companies, the departments that are most involved in predictive maintenance decision making sit within the lines of business.
These include after sales departments for 83% of the companies, operational technology departments for 71%, production departments for 67% and product development departments for 63% of the companies.

✓ Unsurprisingly, data security and privacy concerns are at the top of the list of inhibitors of predictive maintenance developments for 89% of the companies, but there is a significant lack of internal capabilities as well.
The major challenges that directly affect the adoption of predictive maintenance and its success relate to an inability to handle growing volumes of available data, to process these, obtain valuable insight and then redesign maintenance processes based on this insight. Inappropriate available technology and infrastructure is another major inhibitor which is a prerequisite to make the predictive maintenance reality.

✓ In order to address these challenges, companies turn to vendors for support along this road to improved operational efficiency.
This means that the major collaborations between the companies and vendors are currently happening in the infrastructure domain such as the deployment of new networks, the cloud, as well as provision of analytics services.

KEY TRENDS

Automotive and discrete manufacturing	91% of companies see reduction of repair time and unplanned downtime as the major goal of their predictive maintenance initiatives. They are frontrunners in generating business impact with predictive maintenance at the moment as 27% of the companies are already doing so. In only 43% of the companies, IT departments are involved in predictive maintenance decision making, which is smaller than in other companies.
Process manufacturing	93% of companies see improvement of aging industrial infrastructure as the major goal of their predictive maintenance initiatives. More than half of the companies are only at the planning and evaluation stage of such initiatives. They also seem to have a bigger problem with the redesigning of maintenance processes based on predictive insights as 74% of the companies see it as the major challenge.
Transport	Transport operators are frontrunners when it comes to deploying predictive maintenance initiatives as 72% already have pilot projects underway, whereas 25% are also generating business impact. They are also leaders when it comes to current investments, as 63% have already invested and plan further investments.

Summary of key trends by geographies

|	
France	In 93% of the companies, the predictive maintenance decision making involves after sales service departments. 52% are beyond the planning and evaluation phase of predictive maintenance adoption.
Germany	80% will invest in predictive maintenance in the next two years, while 54% have already invested. Only 30% need help with solution management which indicates strong internal capabilities.
Nordics	85% of the companies plan investments in predictive maintenance initiatives while 44% have already invested. 52% of the companies see purchase cost as a challenge in adopting predictive maintenance.
UK & Ireland	85% see redesigning of maintenance processes based on predictive insights as the major challenge for predictive maintenance adoption, while 28% generate business impact based on them.
Benelux	92% of the companies see their internal analytics capability as the major obstacle in adopting predictive maintenance solutions.
Italy	52% of the companies have current maintenance processes based on real-time monitoring using pre-established rules or critical levels, which is higher than in other countries.
Spain	60% have already invested and plan further investments in predictive maintenance, which puts them ahead of companies from other countries.

TRANSFORMING MAINTENANCE PROCESSES WITH PREDICTIVE ANALYTICS

Companies in asset heavy industries such as manufacturers and transport operators rely on numerous industrial assets such as machines and equipment, and/or vehicles such as trains, planes or road vehicles. Apart from major investments for buying them, significant costs also go into their maintenance which also directly reflects on their utilization rate and lifetime. Thus, companies need to make sure that all processes run smoothly to provide maximum availability of fleets, production lines and products. Current maintenance processes are usually based on a regular service schedule which includes check-ups and the replacement of some parts. Such an approach means that these activities might be done when it's not necessary and, for example, parts will be replaced that still have a solid lifetime ahead of them. On the other hand, things can go south, and parts can fail between these regular maintenance checks, causing sudden failures. As a result, companies can experience unexpected downtimes resulting in production or transport delays, as well as product outages which all negatively affect customer experience, and can possibly earn penalties from public authorities especially in the transport sector.

On top of these challenges, both industries are very competitive in Europe. Manufacturers are fighting with foreign rivals whereas transport operators bet on low cost tickets as passengers show very little loyalty. For transport operators, this brings wafer-thin margins, which is why customer experience is now a boardroom topic.

One of the first key questions to set the scene for the rest of this report was to find out how European organizations feel about their existing maintenance practices and processes.
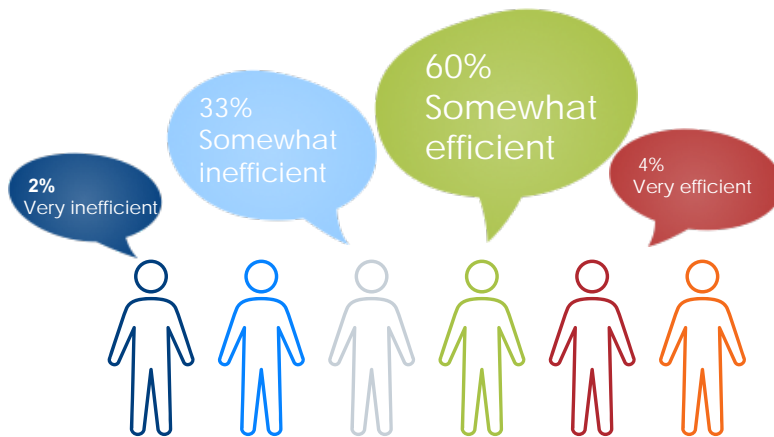
Fig. 1: How would you describe your current maintenance processes for industrial equipment or vehicles within your internal operations?

Answers to this question reflect that companies are not too confident about their existing maintenance set-up, as more than 90% of them do not see it as very efficient. This is a great indicator that room for improvement exists, especially as around a third of these companies see these processes as inefficient to a certain extent. This is a pan-European trend as there are no major differences in this perception of the companies in different countries, or even the sectors they operate in or the size of each company. PAC expects that companies will invest in digital technologies to streamline their processes and, in a few years' time, describe them as very efficient. Some of the companies, however, are already leading the way in this direction and showing a good example of how predictive maintenance can be done and what to expect.

The latest developments in the technology domain allow companies to reach higher levels of operational efficiency which not only benefits cost reduction but customer experience as well. Technology game changers for these challenges are definitely the internet of things (IoT) and a range of predictive analytics tools and techniques. When used together they can boost efficiencies by allowing companies to predict asset, vehicle, and product failures. IoT solutions are used to integrate the data coming from assets and products into IoT platforms. Once the data is available, processing it with predictive algorithms provides insight into the future and enables the companies to anticipate asset failures and leave plenty of preparation time to minimize the impact. This also puts companies in the position to completely redefine their current maintenance processes and practices and completely revolutionize operational efficiency. Thus, the servicing of assets in a pre-defined/prescriptive way might become a thing of the past, while servicing in the predictive way is becoming a thing of the future. Finally, improving the maintenance processes also enables product-oriented companies to improve the servicing of their products and develop new business models. This means that instead of selling, product companies can offer the service of using the product to customers as they have real

Predictive maintenance in action: Vestas

Danish wind turbine manufacturer wants to provide global availability of predictive insights into the operational data of its turbines to enable its customers to optimize their maintenance services.

time insight into the utilization which enables customers to pay only for what they use.

This study delves deeper into European markets and evaluates the current maintenance practices in companies, explores their major pain points and motivation for revamping them with digital technologies.

The findings in this study are based on the survey of more than 230 senior business and IT decision-makers from large companies in the manufacturing and transport sectors. A more detailed breakdown of the sample is available at the end of this document.

Current developments in European markets reveal that many of the companies are investing in IoT solutions to enable predictive maintenance and improve their operational efficiency. 94% of the companies plan to invest in the next two years, while 52% have already invested. For example, the largest Italian train operator Trenitalia is analyzing operational data provided by IoT solutions and aims to reduce the maintenance cost of its rolling stock by 8-10%. Another player betting on predictive maintenance is Danish wind turbine manufacturer Vestas. It is working with technology partners to enable predictive insights into the operational data of its turbines worldwide and enable its customers to optimize maintenance servicing work based on these predictive insights.

Transport for London (TfL) is one such company that is increasingly experimenting with data analytics to try to predict the maintenance needs of its trains and ultimately provide Londoners with a reliable service. In its recent project, the transport operator analyzed train operational data to predict when the motors on the train would fail aiming to save approximately GBP 3 million a year.

What are the major pain points in existing maintenance processes of European organizations?

Unplanned downtime and emergency maintenance together with aging IT infrastructure and technology is the major challenge for almost 90% of the companies

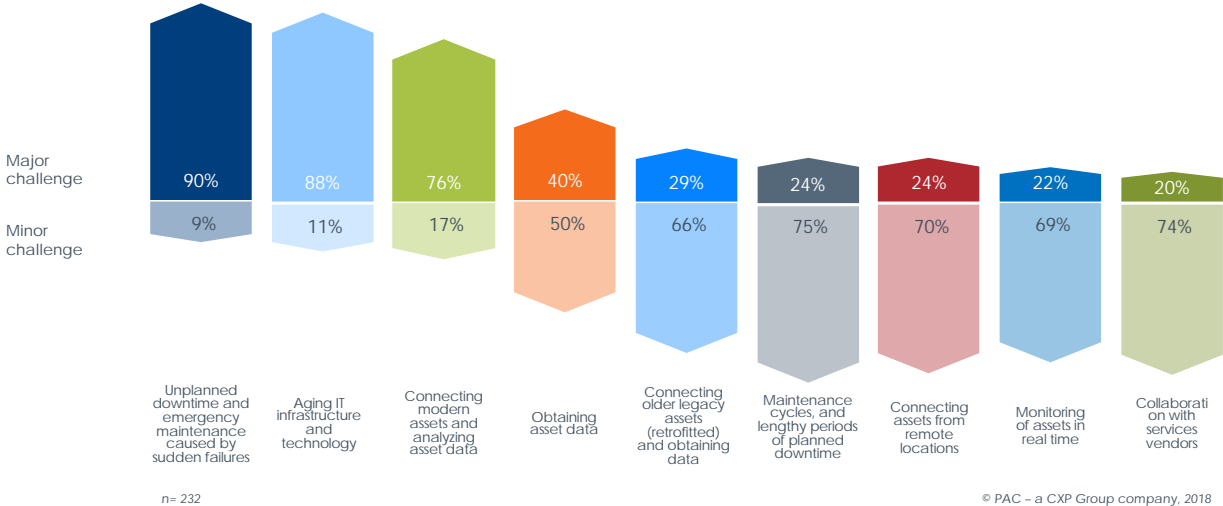|	Major challenge	Minor challenge	Label
Unplanned downtime and emergency maintenance caused by sudden failures	90%	9%	
Aging IT infrastructure and technology	88%	11%	
Connecting modern assets and analyzing asset data	76%	17%	
Obtaining asset data	40%	50%	
Connecting older legacy assets (retrofitted) and obtaining data	29%	66%	
Maintenance cycles, and lengthy periods of planned downtime	24%	75%	
Connecting assets from remote locations	24%	70%	
Monitoring of assets in real time	22%	69%	
Collaboration with services vendors	20%	74%	

n= 232

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Fig. 2: Which of the following are a major, minor, or not a challenge for your company when it comes to existing maintenance and servicing processes for your assets?

When it comes to existing maintenance practices of European companies, they face many operational challenges but some of them particularly stand out, and actually provide fertile ground for improvements. The major obstacle on the road for most of them is unplanned downtime and emergency maintenance required when equipment suddenly fails. In manufacturing industries, these could put entire production lines on hold resulting in production and capacity delays, as well as product unavailability for customers. Moreover, sudden product failures also test customer loyalty. On the other hand, sudden failures in the transport industry cause delays and disruption in service, which can also come with a price tag for transport operators as they may even be penalized by public authorities or face customer refund claims.

As many of the companies in these sectors rely on dated, old core IT systems, it is not surprising that another major challenge is legacy IT infrastructure which is aged and cannot support quick development, deployment, and scaling of new services, and the integration of new equipment.

With obvious room for the improvement of maintenance processes, what is the current state deployment of predictive maintenance approaches among European organizations?
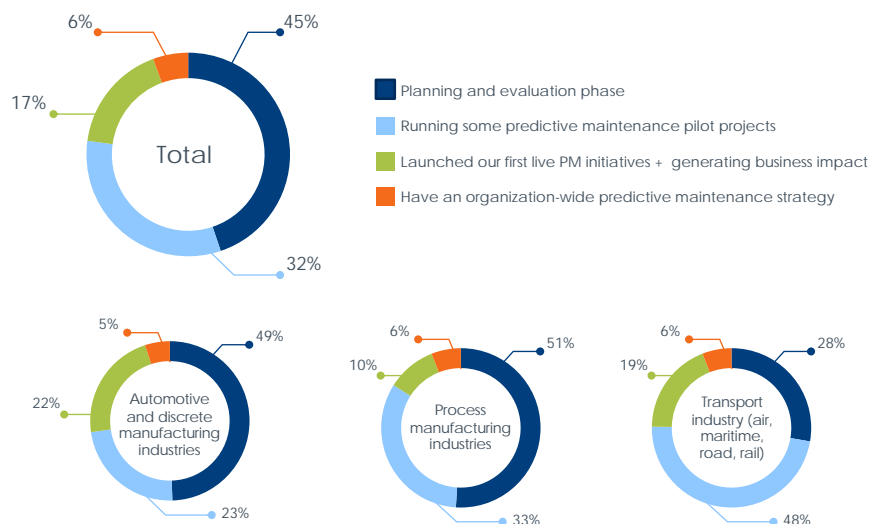

Fig. 3: Which of the following options best describes the current status of your predictive maintenance initiatives?

An overall look at the results paints a picture of a very active market as a total of 55% of the companies are at least running pilot projects with predictive maintenance, with transport being the frontrunner, as 62% of the companies in this sector are running these initiatives.

It is also worth mentioning that automotive and discrete manufacturers come on top by percentage of companies that generate business impact: 29%. This comes as a result of continuous investment in the automation of said industries and in the capability to deliver predictive maintenance-based processes where much of the production is already done by robots and many of which come with their own analytics platforms.

Predictive maintenance in action: Nestlé

Nestlé boosted its corporate coffee machine offering that serves more than 2,500 of its customers with IoT to enable their remote configuration and predictive and more efficient maintenance. Its older machines are retrofitted with IoT capabilities.

55% of the companies are beyond the planning and evaluation stage of predictive maintenance initiatives.

What are the major goals of predictive maintenance initiatives?

	Reduce repair time and unplanned downtime	Improve the lifetime of aging industrial equipment	Improve customer satisfaction	Optimize scheduling	Development of new products and business models	Drive cost savings and operational efficiency	Improve safety and security of your machinery and business environment	Reduce delays in production or transport	Reduce planned downtime
Major goal	91%	86%	70%	44%	44%	37%	34%	34%	11%
Minor goal	9%	13%	28%	40%	42%	61%	66%	64%	77%

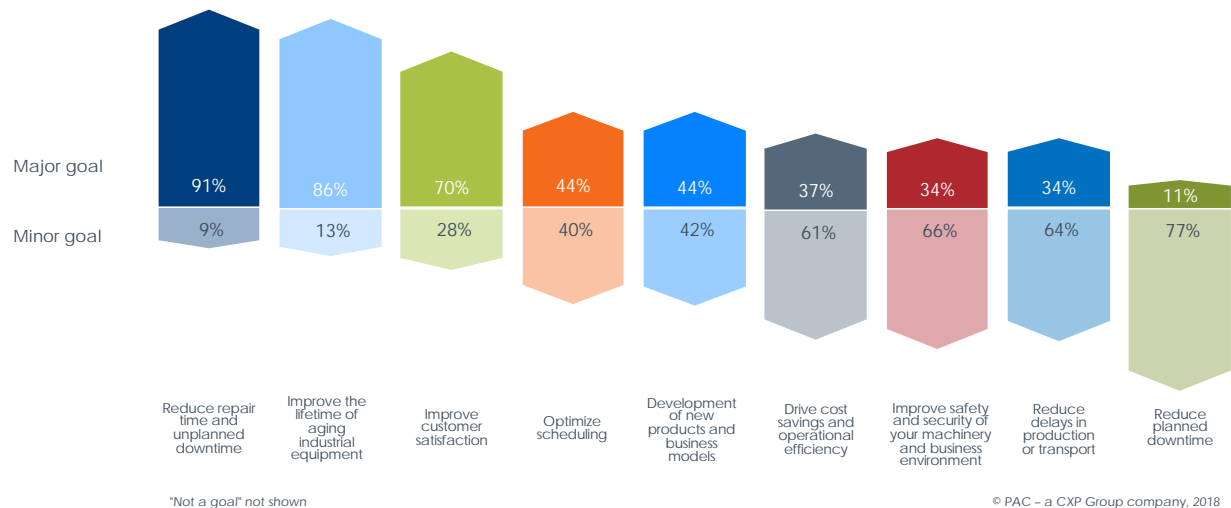*"Not a goal" not shown*

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Fig. 4: Will the following aspects be a major goal, minor goal, or not a goal of your predictive maintenance initiative in the next 2 years?

Reduction of repair time and unplanned downtime tops the list of major goals. This is in line with the companies' perception of their existing maintenance processes which more than 90% of them do not deem as very efficient. This is not surprising as the consequences of unplanned downtime can be multifold and include negative customer experience, delays, and potential penalties, or even worse accidents and therefore liability as well. Another important driver is the improvement of the lifetime of aging equipment. This is also not surprising considering the cost pressures faced by these companies, and even more challenging economic environments in certain European regions. Thus, the companies want to improve asset utilization and maximize return on investment. The next most important thing is improving customer experience which will be the critical factor when consumers are choosing a product or transport operator, thanks to really fierce competition in both the manufacturing and transport markets. It is also interesting to notice that almost half of the companies want to use predictive maintenance in the development of new products and business models.

When it comes to the pain points of moving forward with predictive maintenance initiatives there are several aspects to flag up. Naturally as Europe is a heavily regulated market when it comes to the privacy of the data and its security, most companies are very cautious and point out this as the major challenge. This is not surprising as there are a growing number of cyber-attacks happening, and that could even cause accidents in manufacturing facilities. Furthermore, thanks to the growing adoption of IoT, there are more and more connected devices and machines which could be potential endpoints of the breach in cyber-attacks. Therefore, special care needs to be taken when connecting the machines to the network. Moreover, products also collate customer data thus companies need to take special care when embedding connectivity in them.

Another important challenge that might make companies think twice before investing in predictive maintenance solutions is a lack of confidence in internal analytics capabilities. This is very important as the

> Reducing repair time, unplanned downtime, and improving lifetime of aging industrial equipment are major goals for the majority of the companies.

> 83% of the companies will invest in predictive maintenance, while 49% have already invested.

deployment of IoT and predictive maintenance means companies will unlock new data streams that may become difficult to manage, and thus making it difficult to obtain an insight. As a result, companies need to make sure they have trained personnel to deal with growing amounts of data and who have the right set of skills to obtain valuable insights. On top of this challenge, even when companies manage to do this they still need to redesign their maintenance processes and practices based on these predictive insights and optimize the whole flow, which is a major challenge for almost 70% of the companies. Finally, it is worth mentioning that on top of these challenges the purchase cost of the enabling technology solutions is a major challenge for two thirds of the companies, which again is in line with the cost pressure that companies in these sectors face.

PAC advises a structured approach in moving forward with predictive maintenance related initiatives. Before major technology investments companies should leverage the existing data they have about the machines or products operations, services schedules and outcomes, maintenance history data, condition data and environmental data. Spotting patterns and trying to predict the outcomes here would be the first step. Then, the deployment of more advanced IoT solutions to connect more assets and bring new data streams and process it in the platforms could be the next step for providing better predictions. The most advanced step could be real time monitoring with edge-based analytics and predictions to obtain insights as soon as possible. Of course, moving from maintenance on frequent schedule to a real time insight-based schedule is the key, and therefore processes will need to be redesigned on the basis of these insights. In order to revolutionize their maintenance processes, it is clear that the companies will need someone's guiding hand, since as already mentioned internal analytics capabilities are an obstacle on the road to obtaining insights from data and enabling predictive maintenance. Furthermore, as the redesigning of processes around maintenance to accommodate predictive insights is regarded as the third biggest challenge, it is expected that companies will need significant help from vendors in this area as well.

Still, there are plenty of fish in the sea of vendors, and various players are playing in this IoT related market from hardware and industrial companies, IT services and software companies, to network and infrastructure providers. Being able to choose the right set of partners for this journey will be the decisive factor for the success of predictive maintenance initiatives.

Companies mostly need a hand with the analytics of asset data, setting up an appropriate infrastructure as well as with solution implementation.

CONCLUSIONS

Major challenges with existing maintenance processes for European manufacturers and transport operators are unplanned downtime and aging IT infrastructure. The former impacts day to day operations and negatively affects customer experience while the latter diminishes ability to grow and adopt digital technologies.

The fact that the majority of the companies see the maintenance processes of their industrial equipment, vehicles, and products as not very efficient means there is plenty of room for improvement. The concept of predictive maintenance can be the key to unlocking higher levels of operational efficiency and optimizing the cost structure of maintenance processes.

Apart from streamlining operations and cutting internal costs, predictive maintenance can be a powerful tool for providing better customer experience and developing new business models. This can be the success factor for customer retention and future growth.

More than half of the companies surveyed are at least running pilots for predictive maintenance initiatives while almost a quarter already generate a tangible business impact. There are no significant differences between the levels of maturity of predictive maintenance adoption among the European countries and in total, more than 80% of the companies plan to invest over the next two years.

This study reveals that investments into predictive maintenance initiatives are mostly being driven by the lines of business such as production, after sales services, and product development departments. Still in order to bear fruit with these investments, companies will need to have a clearly defined strategy that embraces collaboration as well as underlying technology.
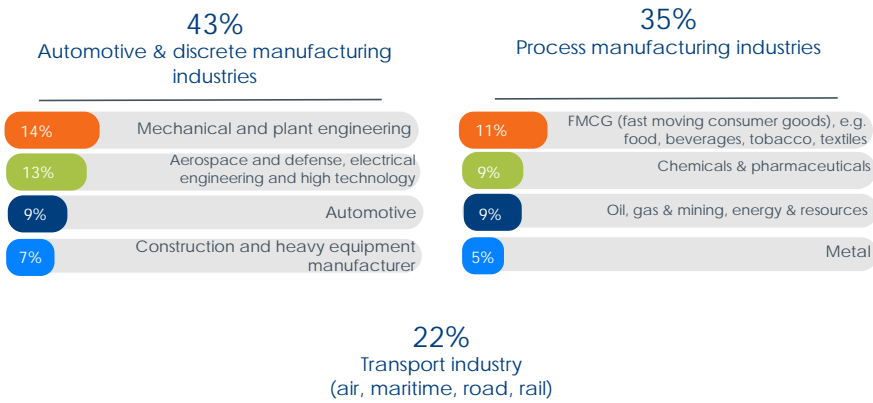
The major driver of adoption of predictive maintenance among European companies is the reduction of repair time and unplanned downtime which directly improves the utilization rate of assets. Another important driver is the improvement to the lifetime of aging industrial equipment as investment into new equipment requires major capital investment.

A major challenge slowing down the adoption apart from cyber related concerns is the lack of confidence in internal analytics capabilities as well as underlying infrastructure that should enable predictive maintenance. Thus, companies are turning to vendors for support, and the results show that these are mostly infrastructure providers as well as industrial companies providing industry specific technologies.
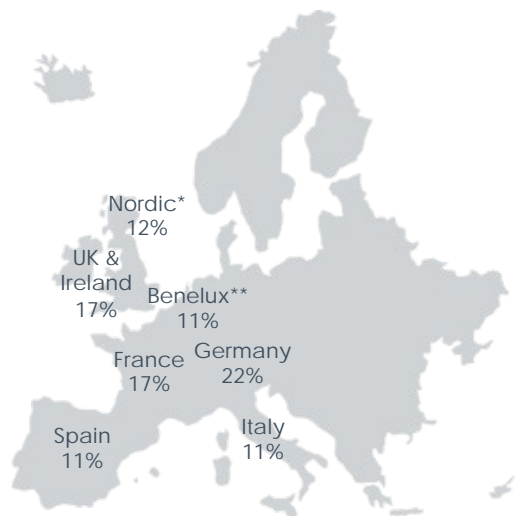
METHODOLOGY

This study is based on interviews with senior business and IT decision-makers with responsibility for predictive maintenance at 232 European manufacturing and transport companies with more than 1,000 employees from the UK and Ireland, France, Germany, Italy, Spain, the Nordics (Sweden, Denmark, Norway and Finland) and Benelux (Belgium and the Netherlands) regions. The study was completed during the first half of 2018. Here is a more detailed breakdown of the participants region, per industry and company size by number of employees:

43%
Automotive & discrete manufacturing industries

14%	Mechanical and plant engineering
13%	Aerospace and defense, electrical engineering and high technology
9%	Automotive
7%	Construction and heavy equipment manufacturer

35%
Process manufacturing industries

11%	FMCG (fast moving consumer goods), e.g. food, beverages, tobacco, textiles
9%	Chemicals & pharmaceuticals
9%	Oil, gas & mining, energy & resources
5%	Metal

22%
Transport industry
(air, maritime, road, rail)

n= 232

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Nordic*
12%

UK & Ireland
17%

Benelux**
11%

France
17%

Germany
22%

Spain
11%

Italy
11%

30%	More than 5,000
35%	Between 2,001 and 5,000
34%	Between 1,000 and 2,000

n= 232

* Nordic region (Sweden, Denmark, Norway, Finland)
** Benelux region (Belgium, Netherlands)

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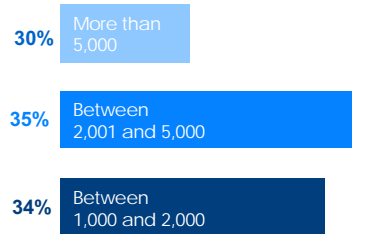
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