Results of the PredMAIn Survey

The PredMAIn Survey collected data on the status quo of the implementation of predictive maintenance practices and processes in Small- and Medium-sized Enterprises (SMEs) in the Interreg program area Austria-Czech Republic.

Introduction

Since October 2021, a consortium in the Interreg research project "PredMAIn" has been developing a comprehensive knowledge package on AI-based predictive maintenance. With the right selection of sensors, Predictve Maintenance can detect changes in the operating condition of components long before a failure occurs. This gives maintenance personnel enough time to replace components in good time.

The aim of the research project is to pass on extensive expert knowledge to SMEs across borders. This should facilitate access to and implementation of predictive maintenance and create a competitive advantage.

In order to include the view from practice in the study, the *Software Competence Center Hagenberg GmbH*, together with *Intelligent Predictive Networks GmbH*, have carried out a study with the aim of ascertaining the status quo, where the small and medium-sized enterprises from the project region stand today with regard to "Predictive Maintenance".

In this report you will find a summary of the most important results of this study.

Composition of the sample of surveyed companies

- Study carried out in summer 2022
  - Online survey

- 40 companies participated -> 24 companies matching the SME criteria were included in the study
  - (SME criteria: # of employees < 250 or revenue < €50 Million)
  - "Drop Outs" because of no clear declaration if SME or enterprise companies

- 67% of the companies are from Austria, 33% are from Czech Republic

- "Metal", "IT" & "Automotive" with 21% each have been most dominant among the participants
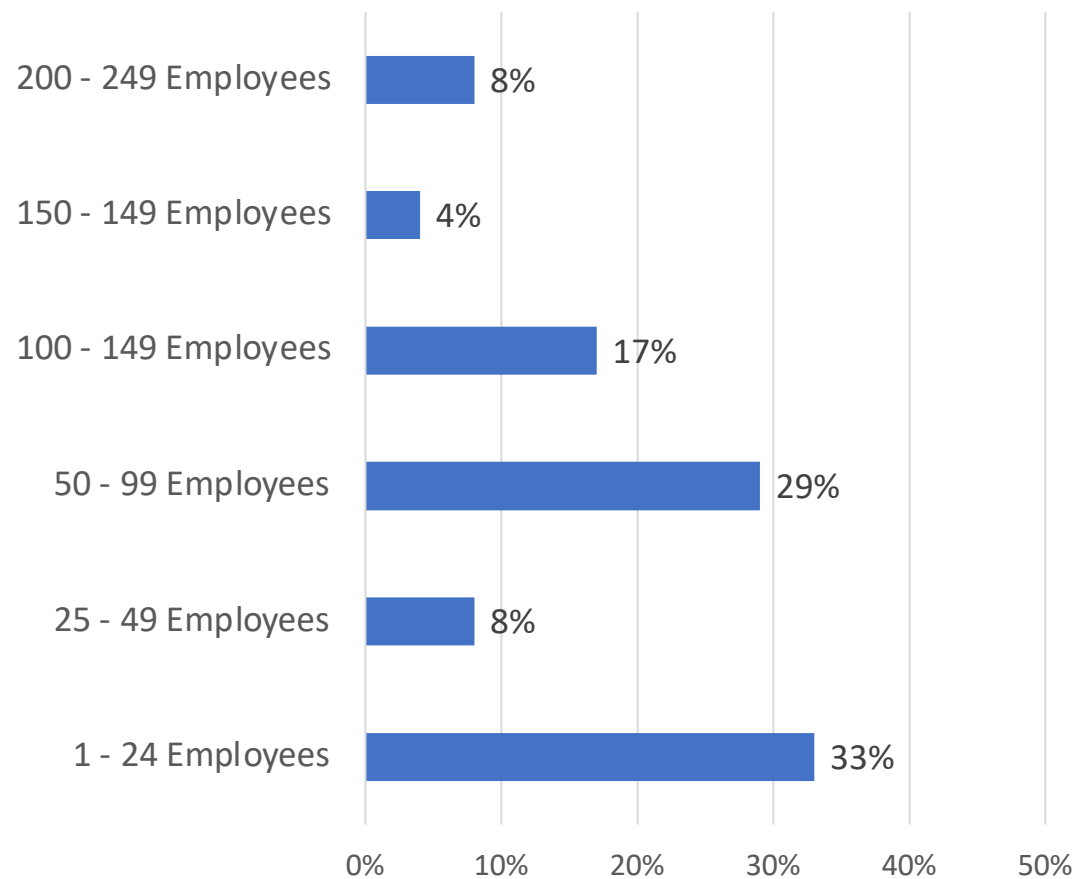
Type of machines and equipment maintenance is being carried out by the participating companies

- Optical quality control equipment
- Food production equipment
- Metalworking machines
- Air humidification equipment, water treatment equipment
- Mining machinery, motors, conveyor belts, vibratory rollers
- Automated teller machines and kiosk systems
- lasers, press brakes, welding machines
- CNC machines, compressors
- Hydroelectric power plants
- 3D printers, CNC milling machines, 3D scanners

Self assessment of maturity level

At the beginning of the survey, participants were asked to give a personal assessment of the maturity level with regard to predictive maintenance in their company.

In the evaluation, companies that indicated a "Medium & High Level" of maturity were combined into one class and contrasted with companies with a "Low Level" of maturity in the evaluation.

- **Low Maturity Level**
  - Our company has not yet dealt with PdM
  - First "idea" to do Industry 4.0, but "no idea" what PdM can do for us.
  - No database and no know-how in the field of predictive analytics yet.
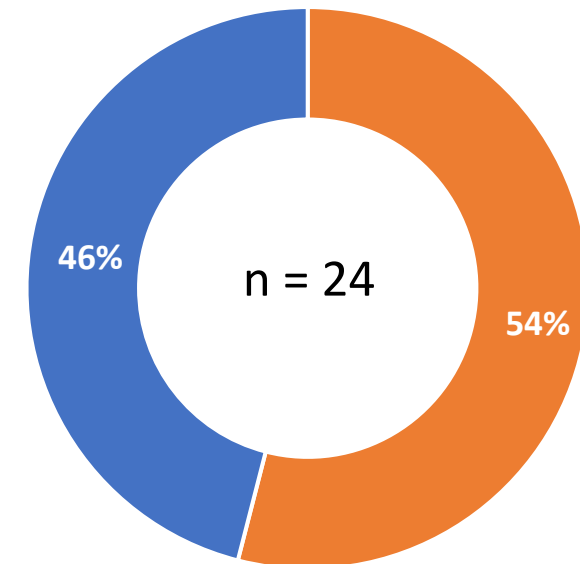
- **Medium Maturity Level**
  - First considerations regarding the use cases of PdM made.
  - Unstructured database distributed across various data sources available for initial analyses.
  - Little or no know-how in the field of predictive analytics. First analyses carried out with excerpts from the existing databases.

- **High Maturity Level**
  - Specific use cases for PdM identified and documented
  - Database available and continuous data collection started.
  - (Basic) know-how in the field of predictive analytics available.
  - Conducting analyses on a regular basis and first attempts with prognosis models started
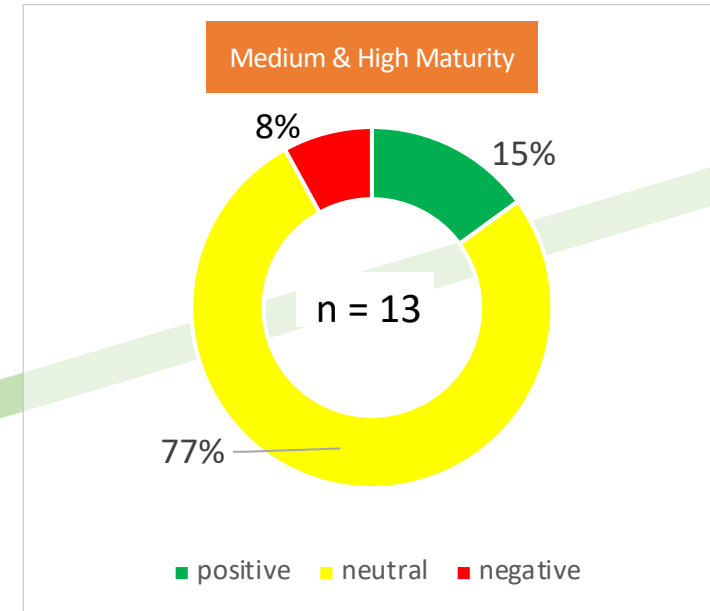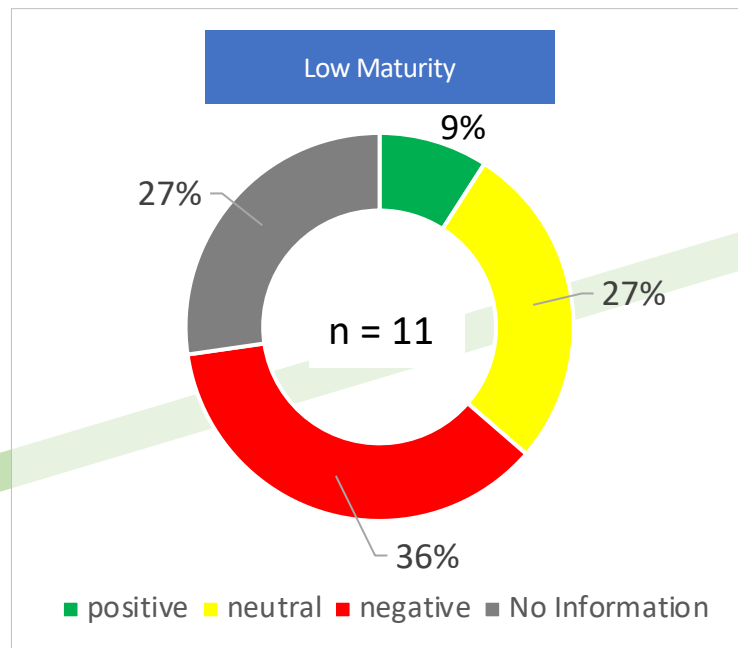

46%

n = 24

54%

■ Medium and High Maturity Level

■ Low Maturity Level

Satisfaction with the results of PdM

"Although satisfaction with PdM increases with maturity, the 'neutral' rating predominates"

Medium & High Maturity

8% 15%

n = 13

77%

- positive
- neutral
- negative

Low Maturity

9%

27% 27%

n = 11

36%

- positive
- neutral
- negative
- No Information

PdM means high effort, from initial planning to implementation and realization of initial results.
PdM does not "happen" overnight. A business case has to be developed, the data to be collected has to be defined, in many cases sensors have to be retrofitted, and the build-up of robust data series may require several years, depending on the error pattern. Exploratory data analyses must be performed, models developed and implemented in daily practice.

It is interesting to note that even among the companies with a Medium & High Maturity level, a "neutral assessment" predominates. It may be that no 'really convincing results' have yet been achieved that justify a higher rating from the perspective of these companies. External support may be required to build up the relevant know-how and (with the appropriate lead time) to achieve positive results.

Goals pursued with PdM
"Cost and availability targets prevail"

Goal	Medium & High Maturity	Low Maturity
Increasing the availability of machines and systems	4,5	3,4
Reduction of operating costs	4	3,8
Increasing the service life of machines and systems	3,9	3,9
Reduction of maintenance costs	4,1	3,4
Quality management and quality control	3,7	3,7
Improved energy management	3,5	3,8

0 = very small relevance
5 = very high relevance

Medium & High Maturity

Low Maturity

Main goals for PdM are increase in availability & lifetime and reduction of costs

The unsurprising result for the goals of PdM was that cost and availability issues are the primary driver of PdM initiatives. These "classic issues" are often seen as the initial trigger for PdM initiatives.

However, this very often changes as the project progresses. After the data acquisition and data preparation phase, companies very quickly recognize that "additional potentials" are still in the data, which can be realized by means of suitable visualization techniques, analysis methods and application of machine learning algorithms.

Obstacles to adopting PdM
"How to approach PdM and cost seem to be the biggest obstacles"

- The results are a bit ambiguous, as we would have expected them to be the other way around - the high values for the obstacles for the low maturity companies and the low values for the medium and high maturity companies.
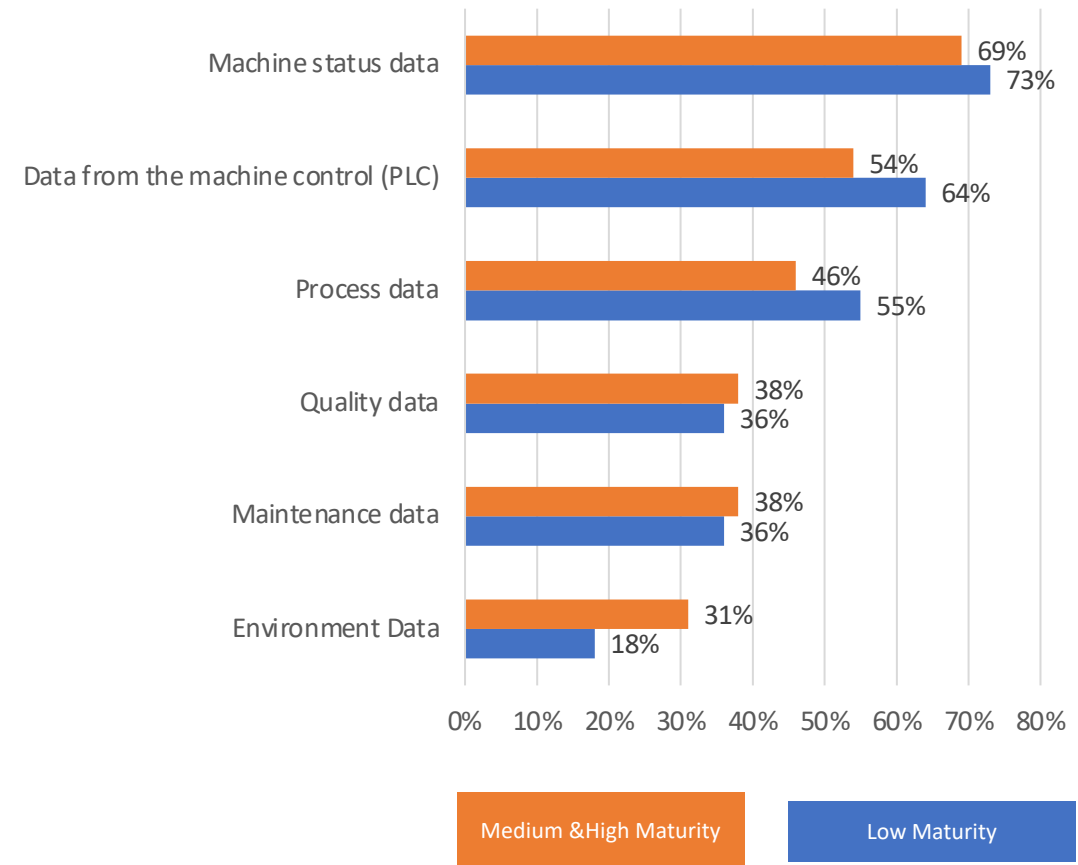
- Companies with Medium & High Maturity have more experience and therefore have a more realistic view on obstacles, because in all categories Low Maturity companies seem be less affected by obstacles than their Medium & High Maturity counterparts.

- Specifically "lamented" are the lack of know-how in the approach and limited technical resources for the implementation of PdM. In addition, the availability of relevant data is also a problem.

- Another common problem in practice is also reflected in the survey results: the lack of evaluation of the financial impact of a PdM initiative, or put more simply, the lack of a "robust" business case.

0 = very small obstacle
5 = very big obstacle

Lack of know-how in the approach/implementation of PdM — 3,6 / 3,1
Financial impact (cost, revenue) not defined — 3,5 / 3,0
Budget constraints — 3,5 / 2,7
Availability of relevant data — 3,6 / 2,0
Changes/improvements are not considered necessary — 3,0 / 2,5

Medium &High Maturity / Low Maturity
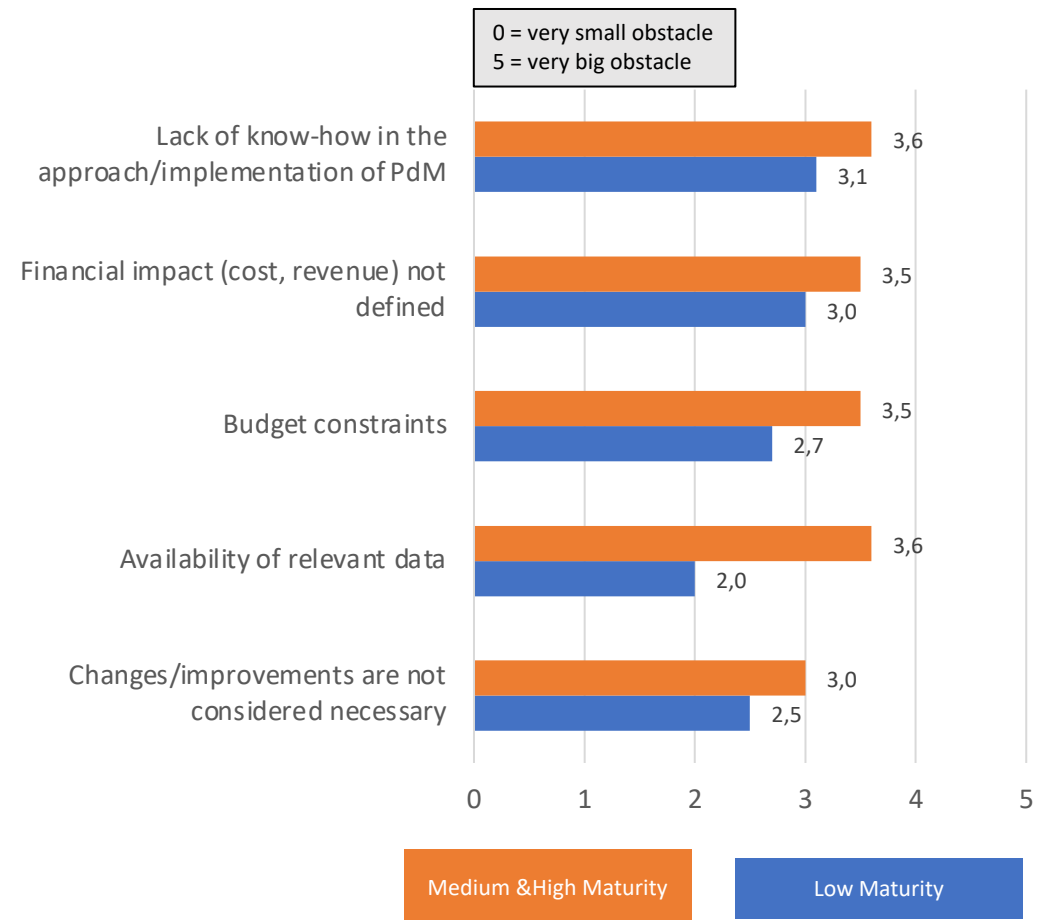
Type of data collected for PdM

"The use of product- and process-related quality data is rather low"

- Where the 2018 Austria study* showed that the higher the maturity level, the more diverse the data sources used for PdM, this is not the case in the SME environment. All seem to use the same „data sources".

- Compared to the other data classes, the collection of product- and process-related quality data is rather low across all maturity classes. However, depending on the production process, it is precisely this data that has a high to very high information content with regard to the condition of the machine and/or the means of production used on it.

- In the 2018 Austria study, companies with a high maturity level drew on more diverse data sources than companies with a low maturity level.

* Predictive Maintenance in österreichischen Unternehmen – Österreich Studie 2018

Chart:
Data type	Medium & High Maturity	Low Maturity
Machine status data	69%	73%
Data from the machine control (PLC)	54%	64%
Process data	46%	55%
Quality data	38%	36%
Maintenance data	38%	36%
Environment Data	31%	18%

Legend: Medium & High Maturity (orange), Low Maturity (blue)

Partners for the implementation of PdM
"Customer specific PdM requirements are best supported by technology partners"

- Technology partners come first in terms of "importance". Frequently, the introduction and enhancement of PdM does not represent the company's core competence and the companies expect their technology partners to make the greatest contribution in the implementation of PdM. The special, customer-specific requirements must be supported by appropriate technologies and it is therefore hardly surprising that the technology partners are given the highest priority.

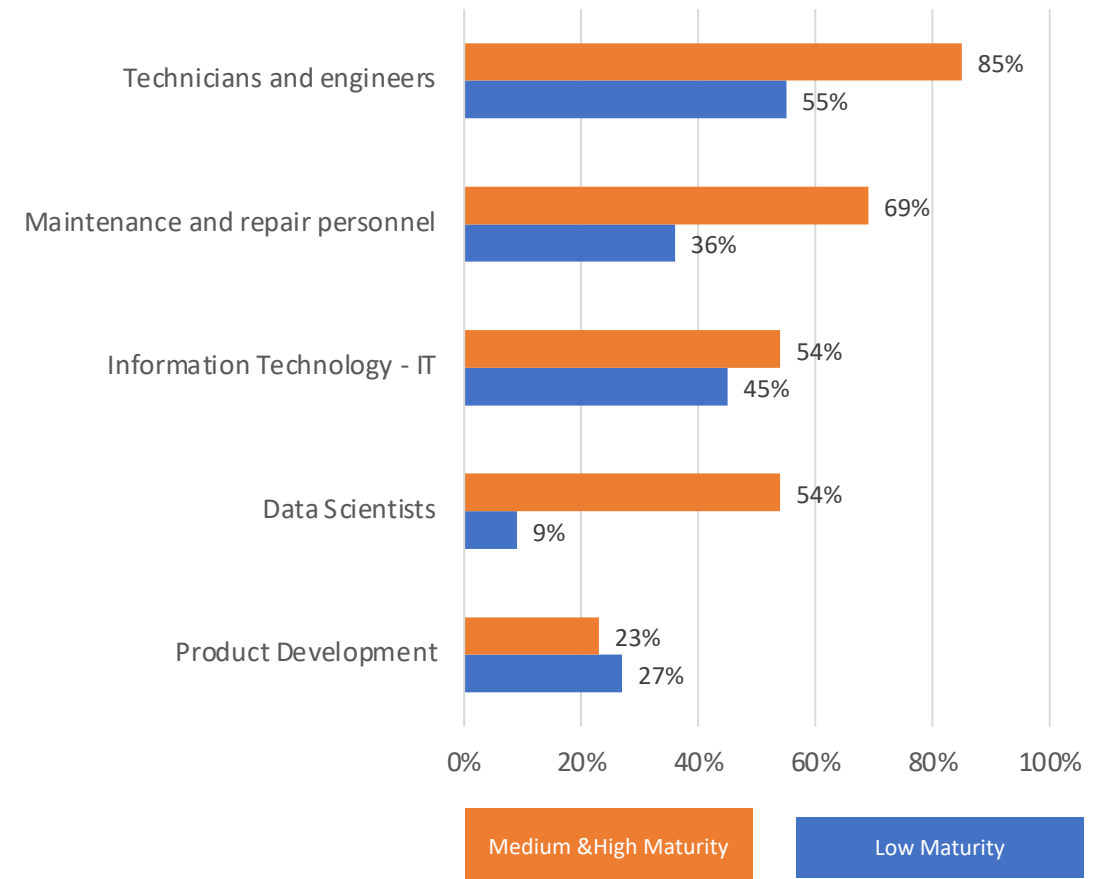- At this point, it should also be pointed out that such partnerships go beyond pure technology. Especially in the customer-supplier chain, it is important to clarify how the "data ownership" between the companies is structured. Each of the partners has a (legitimate) interest in accessing the data generated in such projects and using the insights gained to better understand and optimize their own products and develop new services.

- It is also encouraging to see that universities are at the forefront of important partners. As it seems, universities are "close to the business community" and these teaching and research facilities are readily called upon by companies for PdM projects due to the concentration of knowledge and methodological expertise.

0 = very small relevance
5 = very high relevance

Technology Partners: Medium & High Maturity 3,8; Low Maturity 2,8
Universities: Medium & High Maturity 3,1; Low Maturity 2,5
Suppliers: Medium & High Maturity 3,2; Low Maturity 2,2
Companies in the same industry: Medium & High Maturity 2,9; Low Maturity 1,9
Consulting Companies: Medium & High Maturity 2,1; Low Maturity 2,1
Distributors: Medium & High Maturity 2; Low Maturity 1,9
Companies from other industries: Medium & High Maturity 2,1; Low Maturity 1,5
Public sector companies: Medium & High Maturity 2,2; Low Maturity 1,1
Start-Up companies: Medium & High Maturity 1,8; Low Maturity 1,5

Medium &High Maturity   Low Maturity

Functions involved in the implementation of predictive maintenance
*"PdM initiatives are run by Production and Maintenance"*

- For PdM mainly specialists from the functional areas of maintenance & repair, technology and IT are used.

- A discrepancy between the medium and high maturity assessment and operational practice is somehow evident. Data Scientists are available in only 54% of companies with Medium & High Maturity Level. This means that only every second of the companies - which attest to a medium & high degree of maturity - can fall back on corresponding "data specialists". Whether this specialist function provided by data scientists can be covered by specialists from other areas is questionable.

- It is possible that companies make use of external specialists who have in-depth know-how in the area of predictive analytics.

Chart — Functions involved (Medium & High Maturity vs. Low Maturity):

Function	Medium & High Maturity	Low Maturity
Technicians and engineers	85%	55%
Maintenance and repair personnel	69%	36%
Information Technology - IT	54%	45%
Data Scientists	54%	9%
Product Development	23%	27%

Legend: Medium &High Maturity, Low Maturity

Technologies for condition detection - currently in use

"PdM initiatives are run by Production and Maintenance"

- The Austria 2018 study* had shown that the higher the maturity level, the more technologies are used for recording the condition of machinery and equipment. In the SME environment, these differences are not so clear cut.

- The "classics" electrical condition measurement, vibration, acoustics, lubricant and infrared analysis prevail.

- Interesting is the low rate of adoption of electrical condition measurement within the companies with Low Maturity. Current and voltage are usually easy to detect and are therefore included first in the analyses.
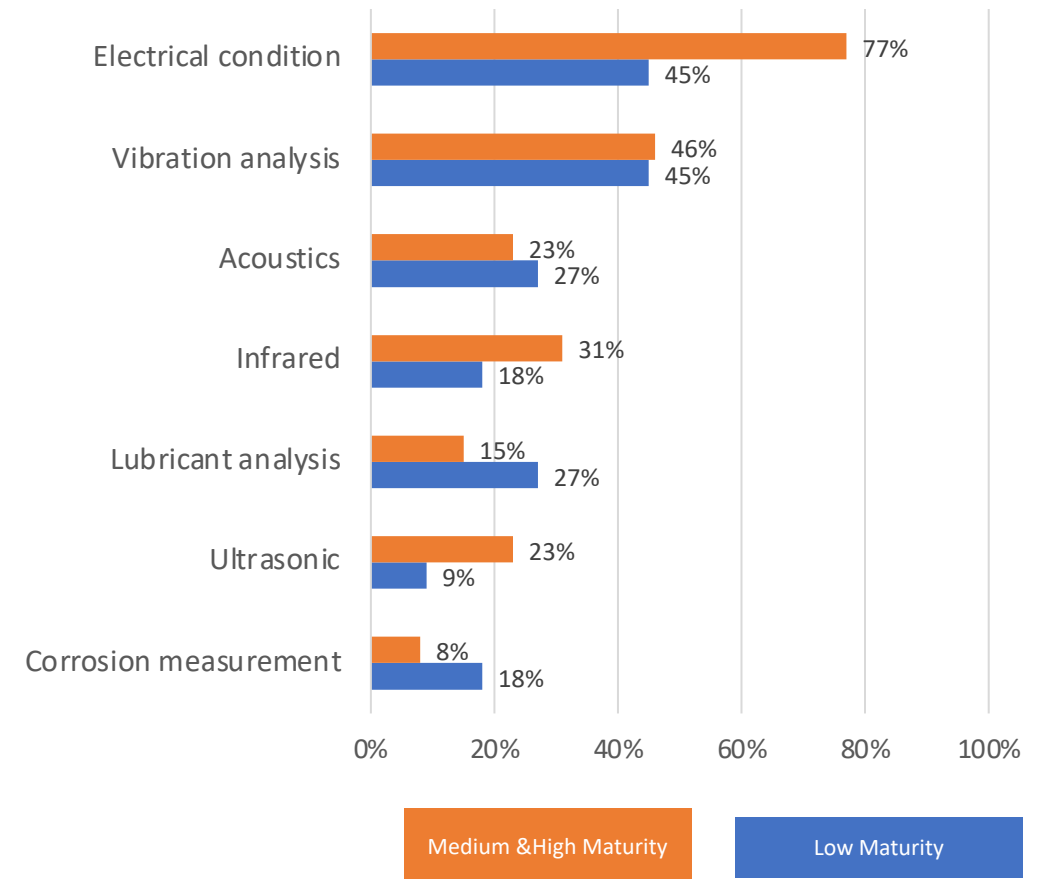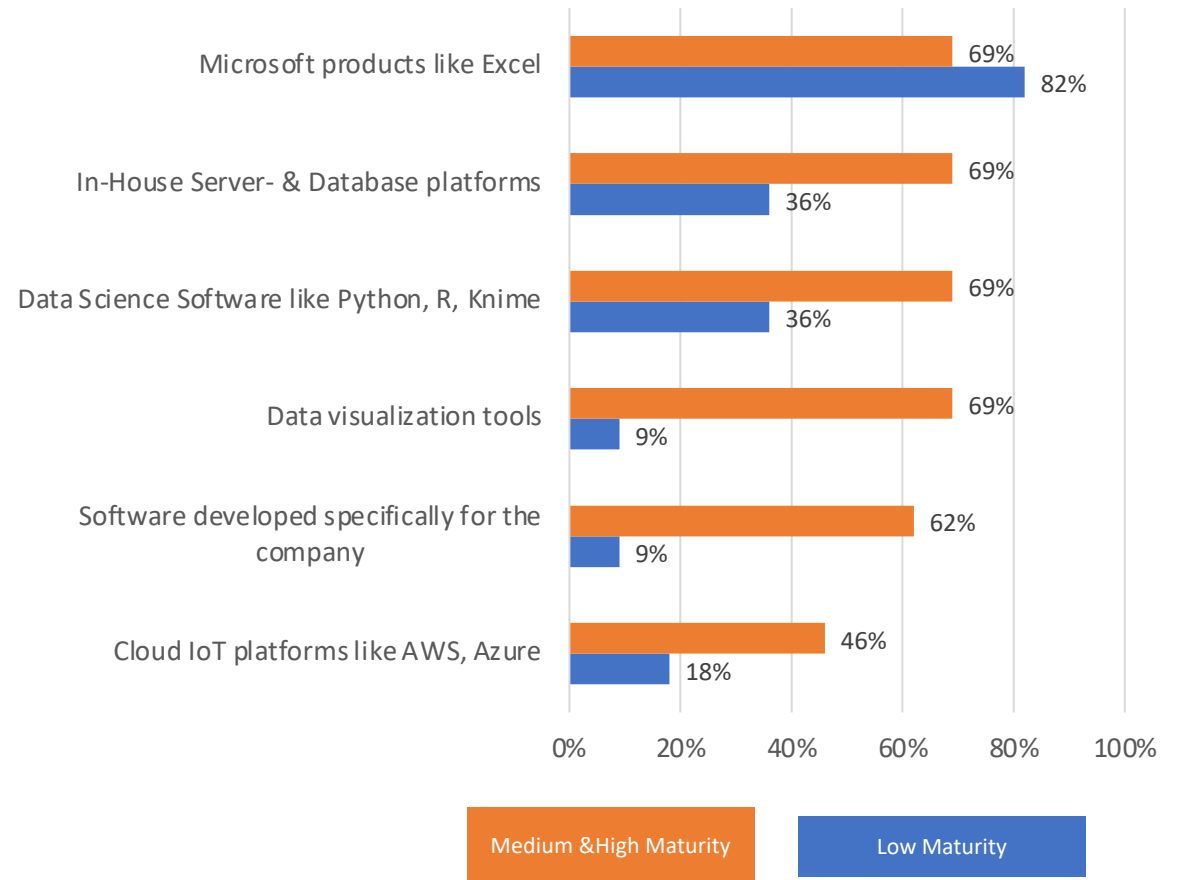

* Predictive Maintenance in österreichischen Unternehmen – Österreich Studie 2018

What IT infrastructure is used for PdM in your company?
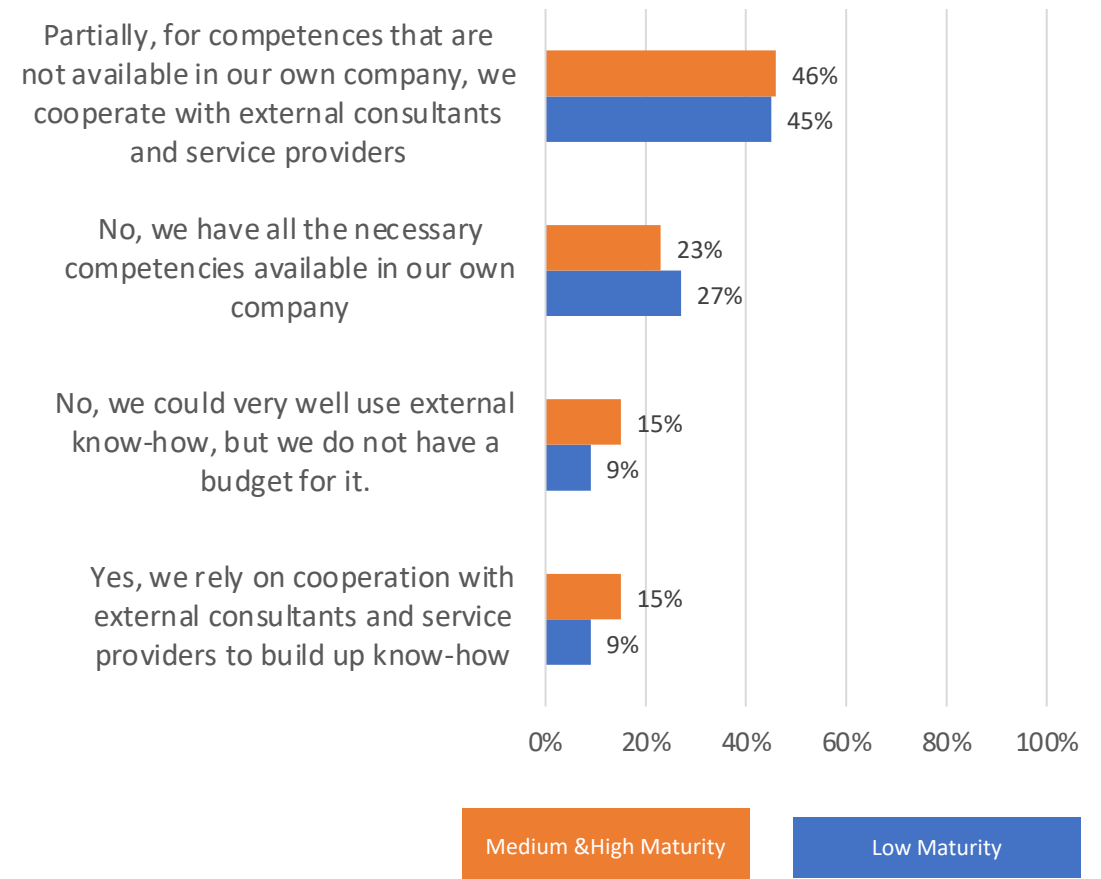*"Medium & High Maturity companies have a more specialized IT for PdM"*

- Medium & High Maturity companies have a more specialized IT infrastructure then their Low Maturity counterparts.

- No surprise is the use of Microsoft products - especially Excel, which is still the leading data science platform in unofficial "studies". The high proportion of in-house server and database platforms is in all likelihood due to the fact that companies still do not want to take production data "off-site" and that many issues relating to IT security and compliance have not yet been resolved when connecting cloud environments to production IT.

- The same applies to the high proportion of software developed specifically for the company. Another reason for this could be that the standard software products available do not offer the flexibility that companies consider necessary for implementing PdM.

Microsoft products like Excel — Medium & High Maturity: 69%, Low Maturity: 82%
In-House Server- & Database platforms — Medium & High Maturity: 69%, Low Maturity: 36%
Data Science Software like Python, R, Knime — Medium & High Maturity: 69%, Low Maturity: 36%
Data visualization tools — Medium & High Maturity: 69%, Low Maturity: 9%
Software developed specifically for the company — Medium & High Maturity: 62%, Low Maturity: 9%
Cloud IoT platforms like AWS, Azure — Medium & High Maturity: 46%, Low Maturity: 18%

Legend: Medium &High Maturity / Low Maturity

Do you work with outside consultants in your PdM program?
"PdM initiatives are mainly done with internal resources"

- The data do not really show a difference between Low and Medium/High Maturity companies

- Internal and external collaboration is important. This requires companies to be aware of their own strengths and equally aware of their weaknesses. In the case of the latter, it is important to develop further with external help in order to exploit the potential that presents itself.

- IPN's experience also shows that initial internal initiatives are often launched and external specialists are only brought on board when the project is critical or on the verge of failure.

- The 2018 Austria Study* showed that companies with a high level of maturity collaborate more with external partners

Partially, for competences that are not available in our own company, we cooperate with external consultants and service providers: 46% / 45%

No, we have all the necessary competencies available in our own company: 23% / 27%

No, we could very well use external know-how, but we do not have a budget for it.: 15% / 9%

Yes, we rely on cooperation with external consultants and service providers to build up know-how: 15% / 9%

Medium &High Maturity / Low Maturity

* Predictive Maintenance in österreichischen Unternehmen – Österreich Studie 2018

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