CONFERENCE OMAINTEC 2023 EXHIBITION

THE 20TH INTERNATIONAL OPERATIONS & MAINTENANCE CONFERENCE IN THE ARAB COUNTRIES

A Road Map for Digital Transformation in Maintenance

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An Initiative by

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Introduction

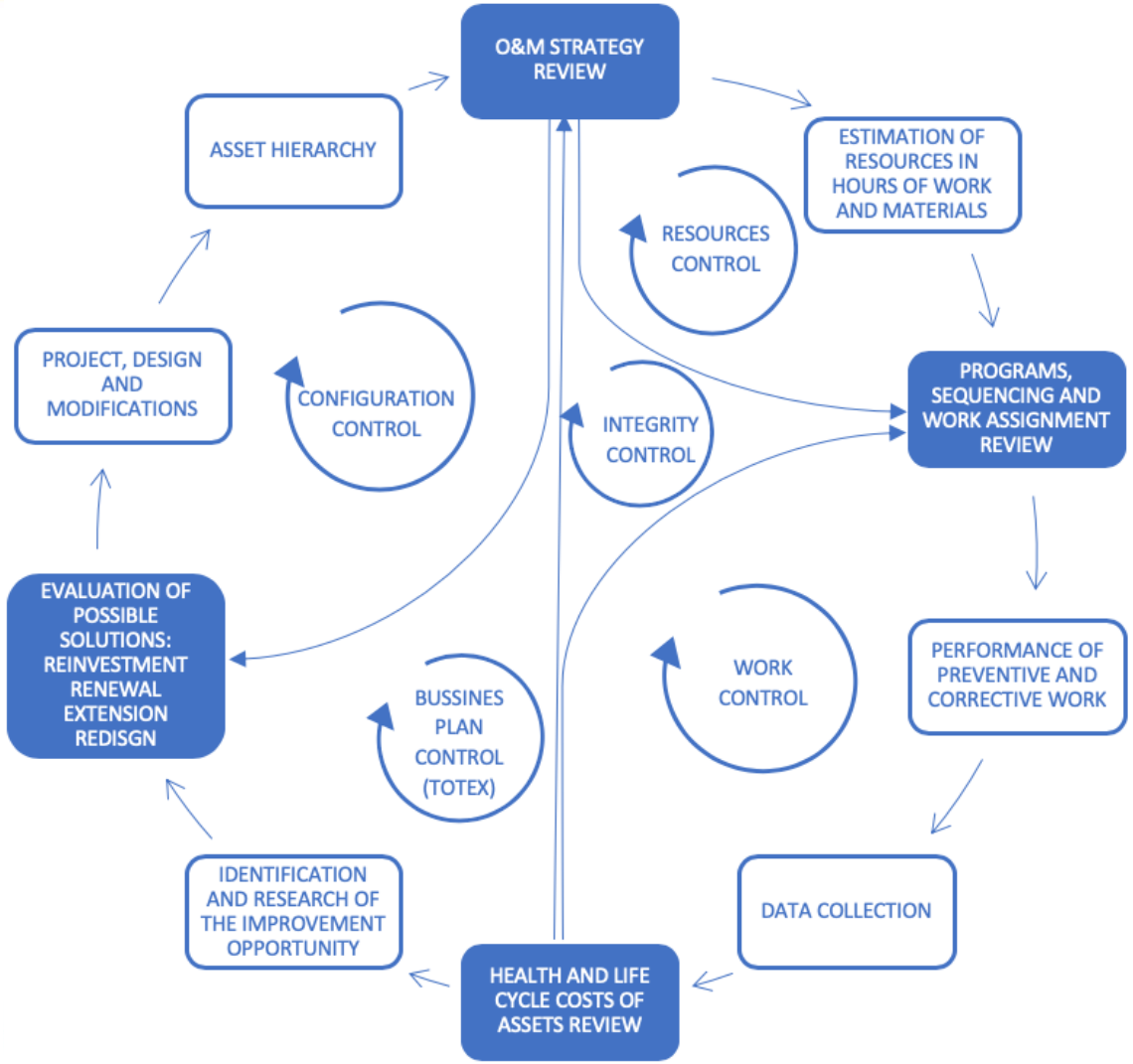
- Can maintenance benefit from Digital Transition? why?
- What are the new technologies and tools with the greatest potential?
- How can this transformation process be orchestrated and realized?
- How to incorporate new emerging Asset Management platforms and systems?

It is a high-impact organizational challenge for the company and a major technical challenge.

It requires:

- A strategic planning process.
- The definition and control the data models for asset management,
- Designing new and/or more efficient processes using data.

What is the situation?



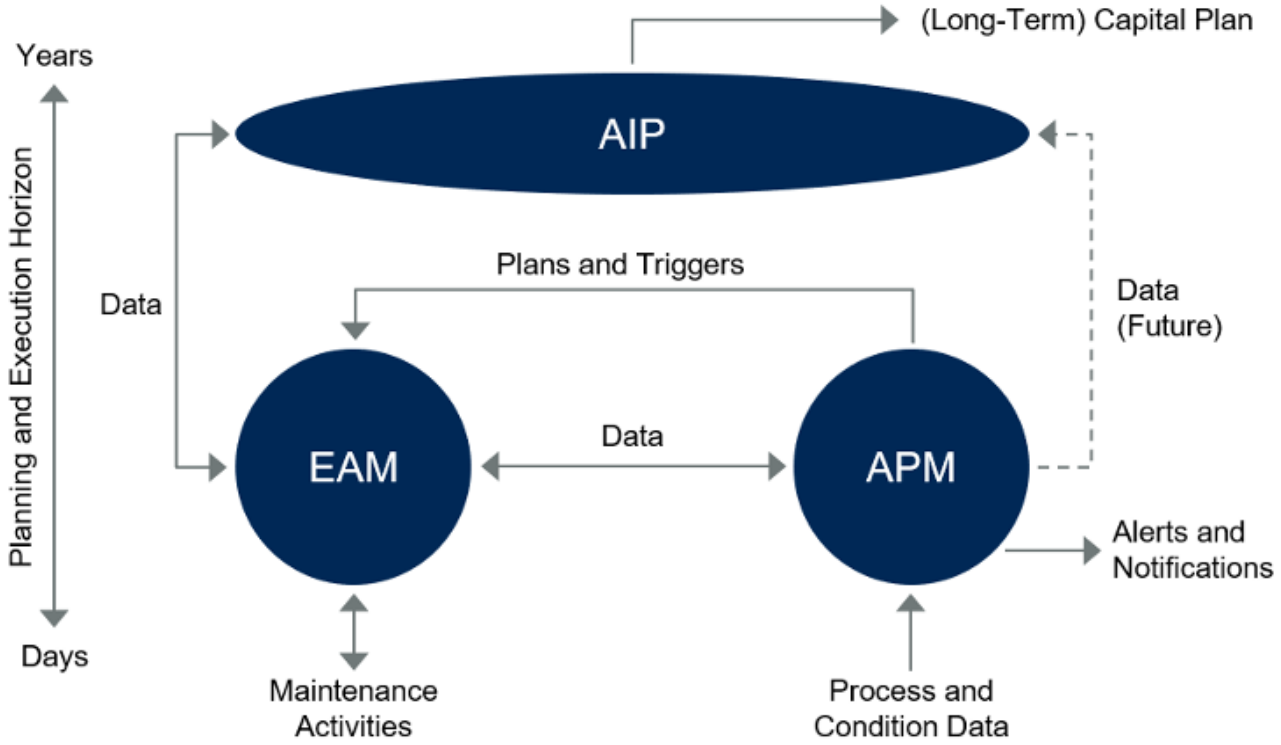
What is the current situation?

- Unequal attention to operational areas of management during the last decades (right side),
- A more balanced and strategic vision is needed (left side of Figure 1)
- Align resources and investments to business priorities.

For example, simple and robust methods are still needed for the evaluation of asset investment projects, or to consider life-cycle extension prior to reinvestment, etc.

The new informations systems

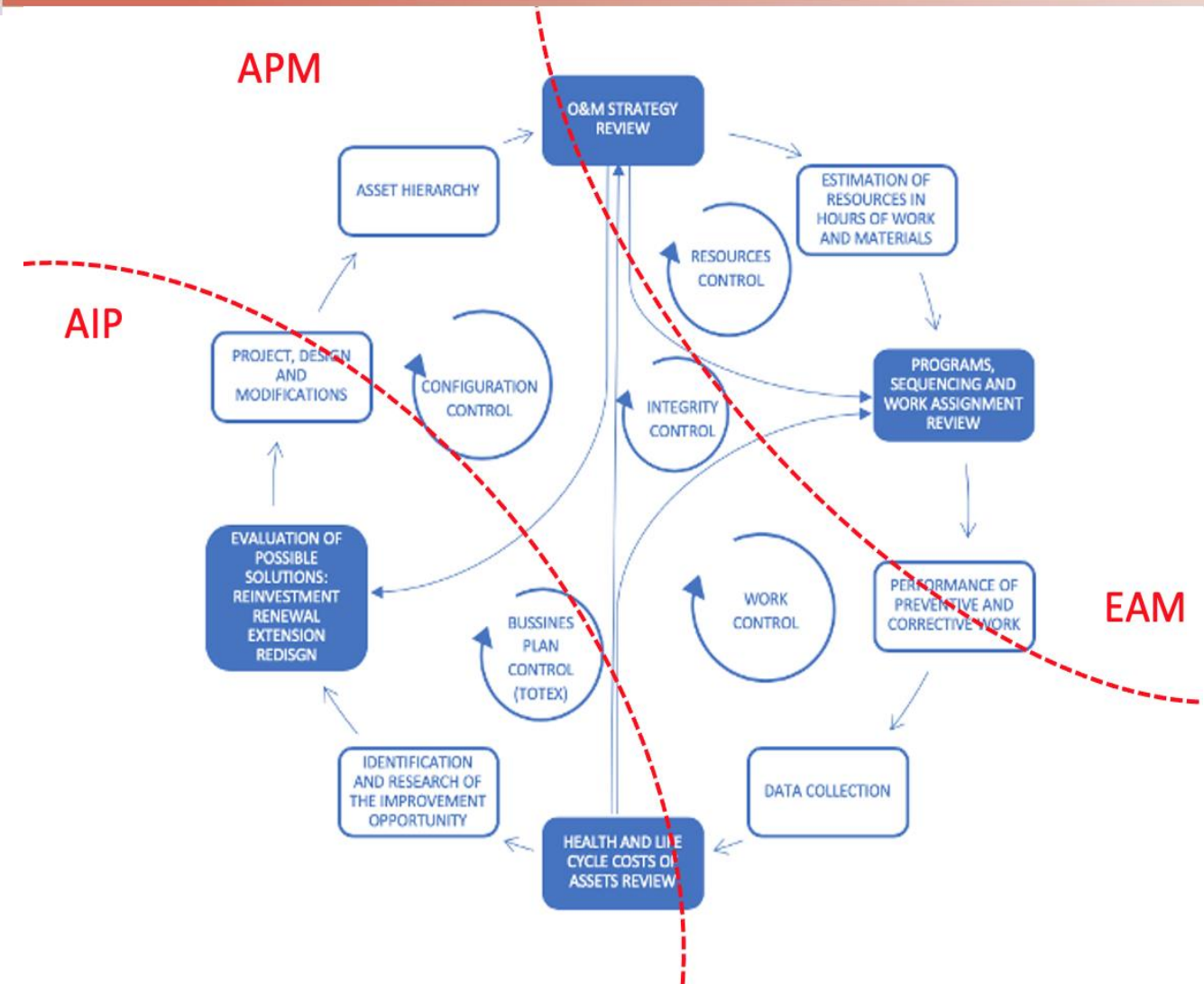
Three different types of asset management systems on the market: EAM, APM and AIP solutions.



Source: Gartner
ID: 388410

- **EAM:** Manage asset inventory, configuration and maintenance execution.
- **APM:** Reduce corrective maintenance, increase availability and reduce the risk of failure (especially when assets are critical); Increase the organization's ability to comply with regulations related to asset inspections and maintenance.
- **AIP:** Improve long-term complex strategic and tactical decisions related to CAPEX/OPEX budget allocations and overall asset management planning; Predict current and future asset performance; Link expected performance to different investment options over a predefined medium- or long-term horizon.

Management areas and Information systems



Key Asset Management areas and new EAM, APM & AIP systems *(Crespo, DMM, 2022)*

The new intelligent asset management platforms

A new class of cloud computing services is born, providing a platform that supports the development, execution and management of AM applications.

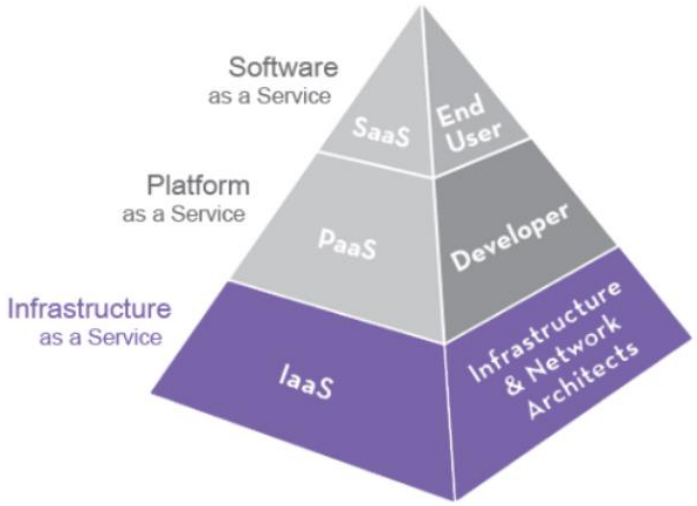
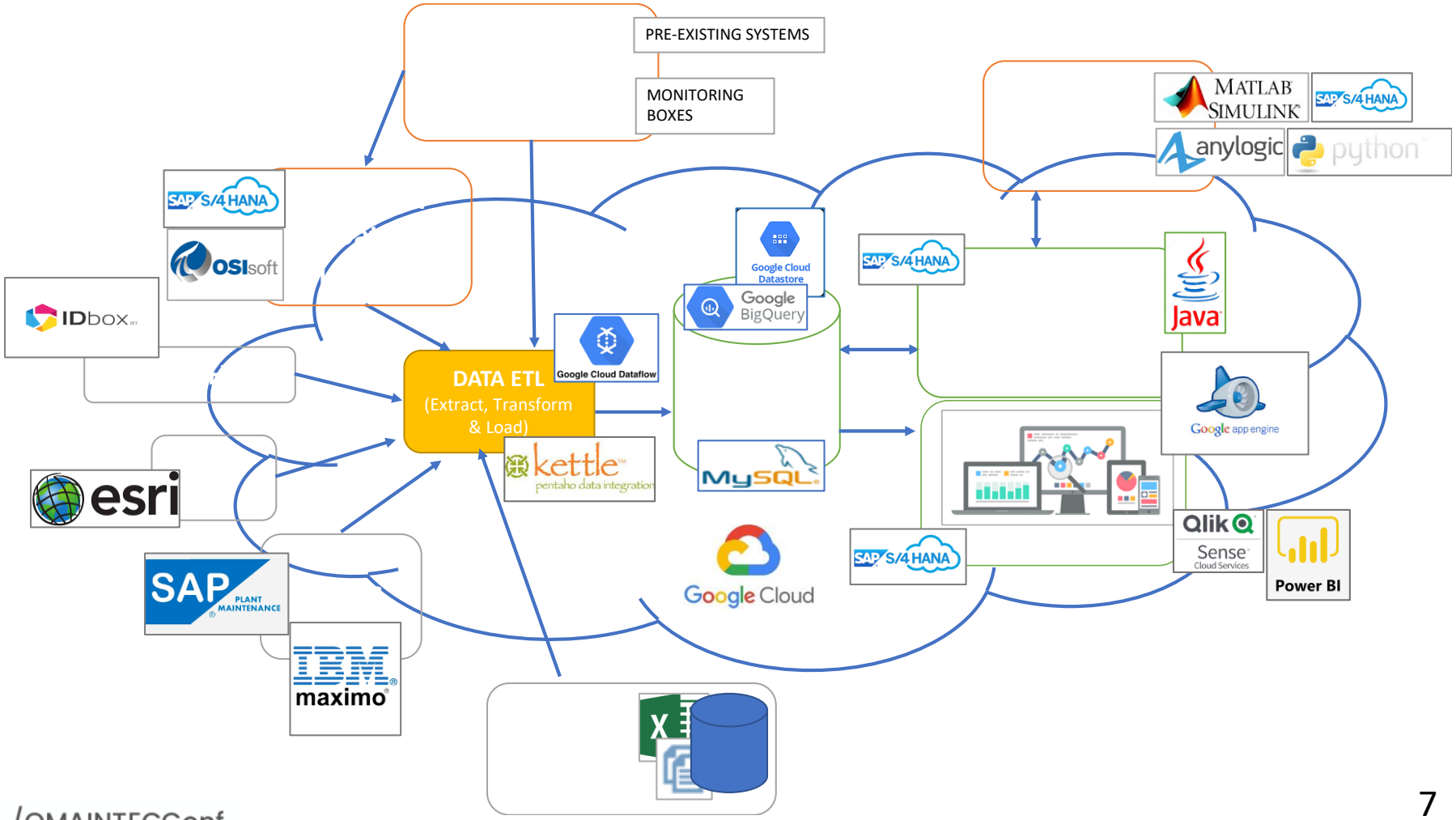


Figure. IAMP Software pyramid

- **Infrastructure as a Service (IaaS):** Lowest level that contains, among other capabilities, operating systems, networks and storage.
- **Platform as a Service (PaaS):** Middle level and includes services related to application development and deployment.
- **Software as a Service (SaaS):** Top of the pyramid and represents the applications (Apps) for end users.

The new ecosystem



The DMM Framework (Crespo, 2022)

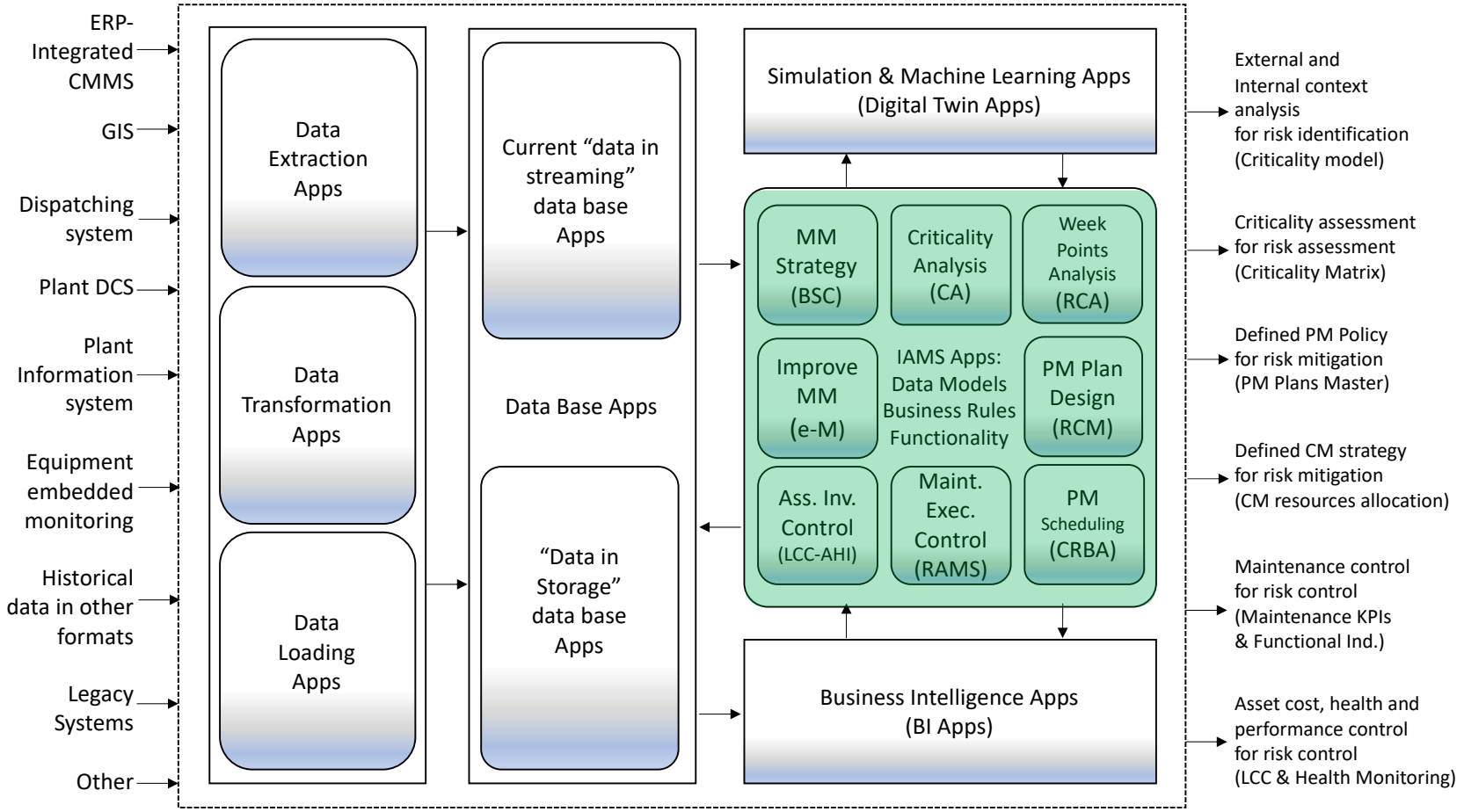


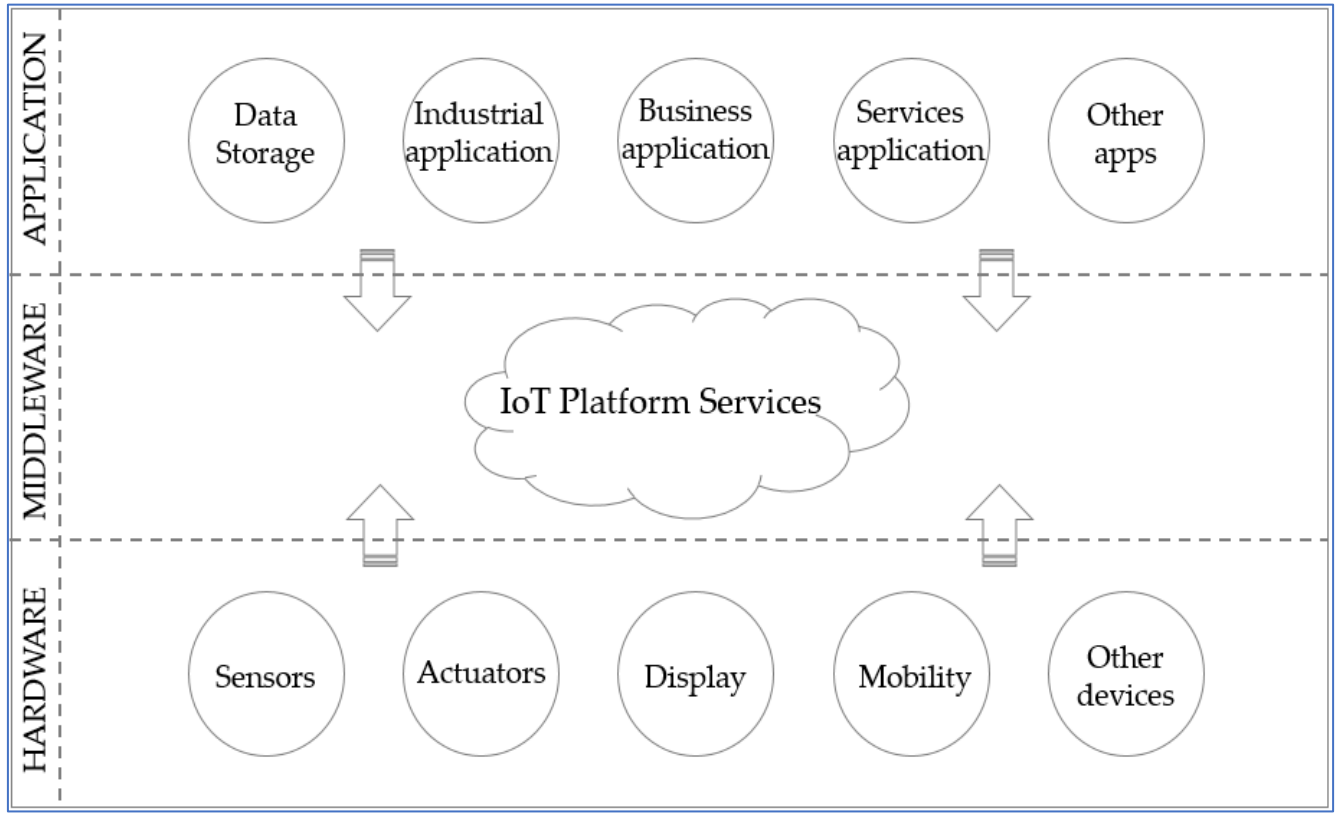
Figure . A functional perspective of the new digital framework for Intelligent Asset Management *(Crespo, DMM, 2022)*.

ETL Process

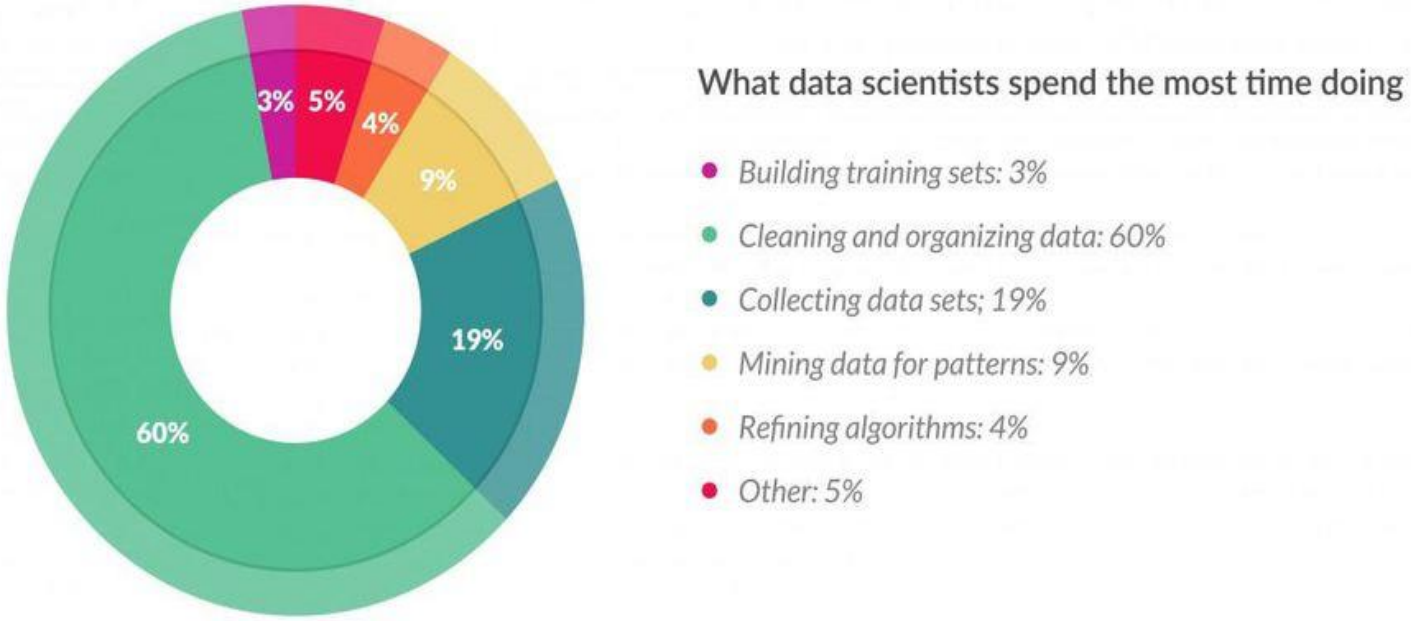
Internet of Things (IoT) Technologies.

The new IoT platforms introduce a multitude of exciting possibilities:

- Device management,
- Data collection and storage,
- Creation of virtual machines,
- Configuration and control of remote devices,
- Data reliability and security,
- Etc.



ETL Process



BIG DATA

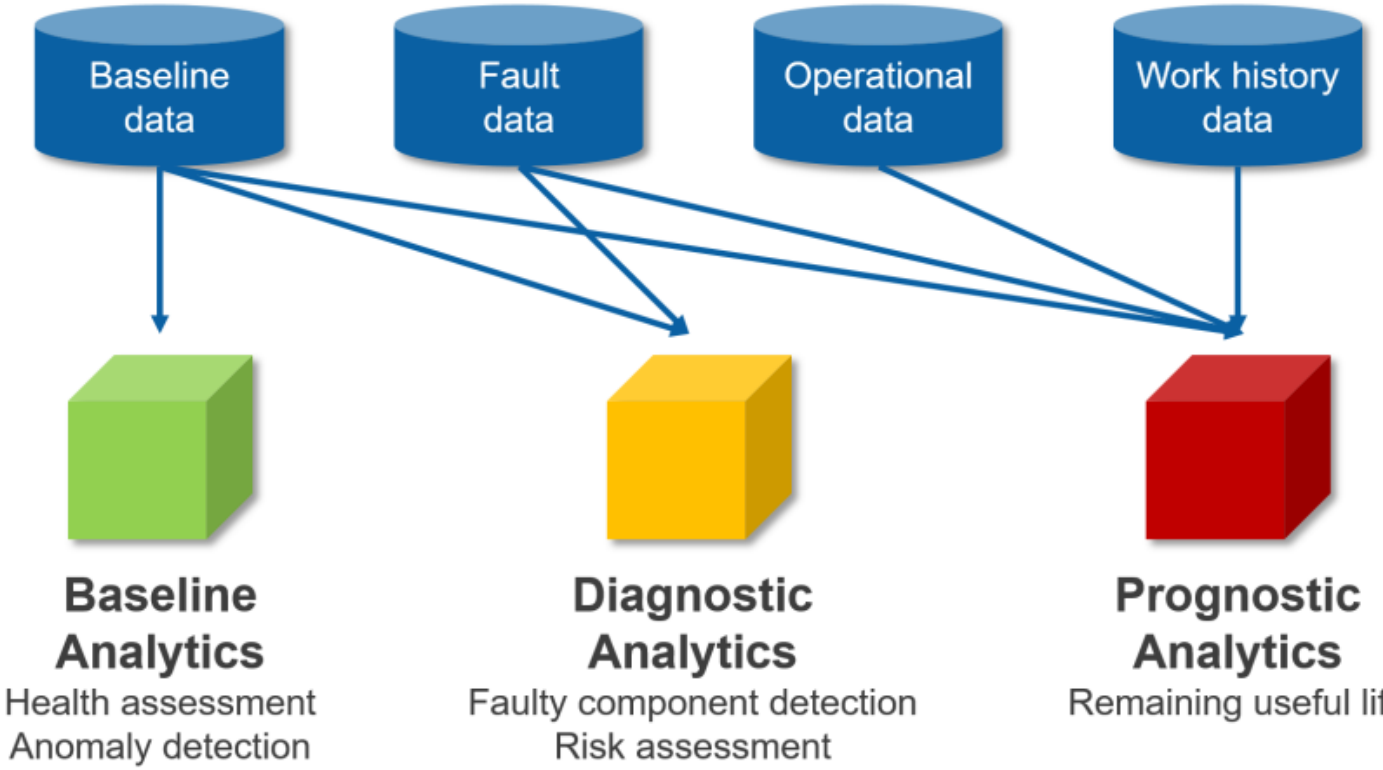
- IoT Platforms provide health monitoring and predictive analytics data that must be stored and processed differently,
- Too large volume, with very high velocity, high variability, low veracity (high noise level) and are very diverse data.
- Big Data technologies provide analytical functions that can facilitate the collection and processing of data with these characteristics.

Simulation and ML Apps

Predictive Analytics

Models for:

- o Anomalies detection,
- o Fault diagnosis
- o Remaining useful life determination



Business Intelligence Apps

- **Augmented reality (AR).** New form of human-machine interaction that superimposes computer-generated information (virtual data) on the real environment (real objects).

- **Business Intelligence and Data Visualization (BI & DV) tools.** BI tools are a set of technologies and processes that provide business metrics for their users; data visualization (DV) processes allow information to be transmitted quickly, efficiently and intuitively.

- **Other complementary technologies.** For example, the use of mobility systems remains an important component in advancing asset management strategies and optimizing field work.

Technical Challenges

Assets, by definition, have characteristics of **non-ergodicity**.

What does this mean?

It is necessary to show that a given process on several assets working in parallel corresponds to studying the same process throughout the life cycle of a single asset.

Otherwise, more models will be required for the same assets.

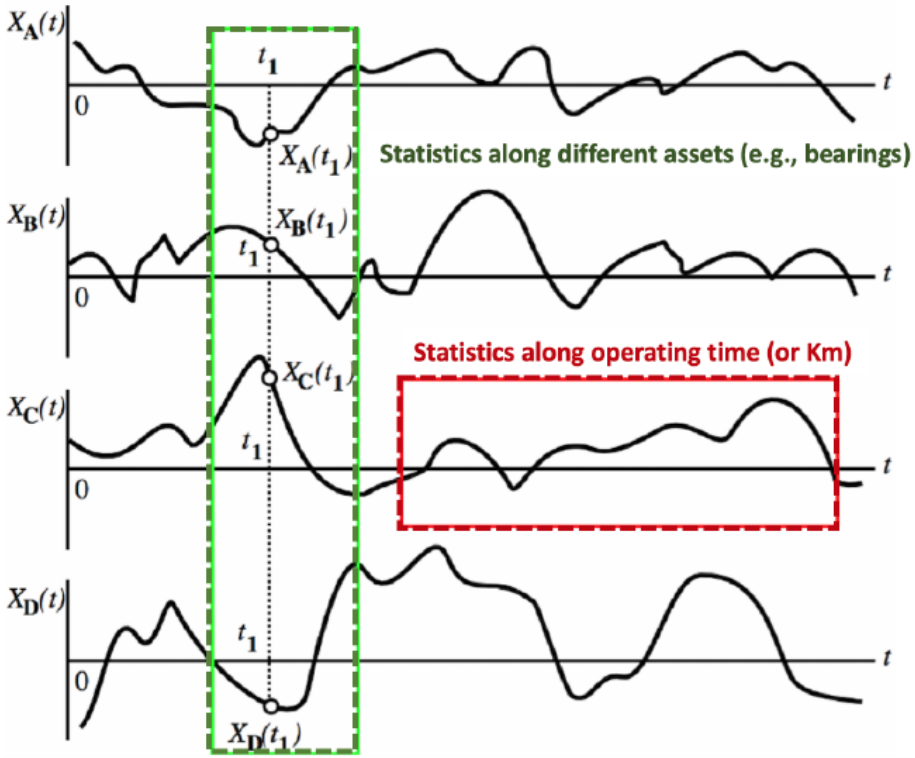


Figure. Ergodicity for collaborative learning

Technical Challenges

The curse of dimensionality.

This name is given to a phenomenon that appears in Machine Learning models when algorithms must learn from a large volume of features, with abundant values within each one.

What does this mean?

- It complicates the generation of data-driven ML models.
- It forces the development of digital twins based on physical models.

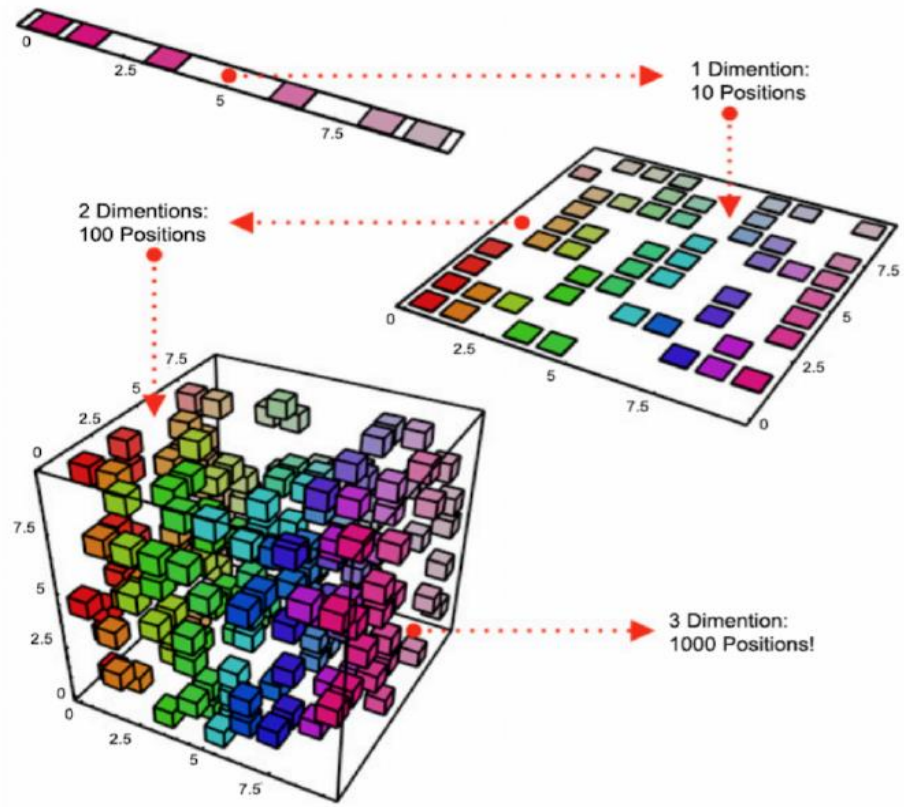


Figure. Dimensionality

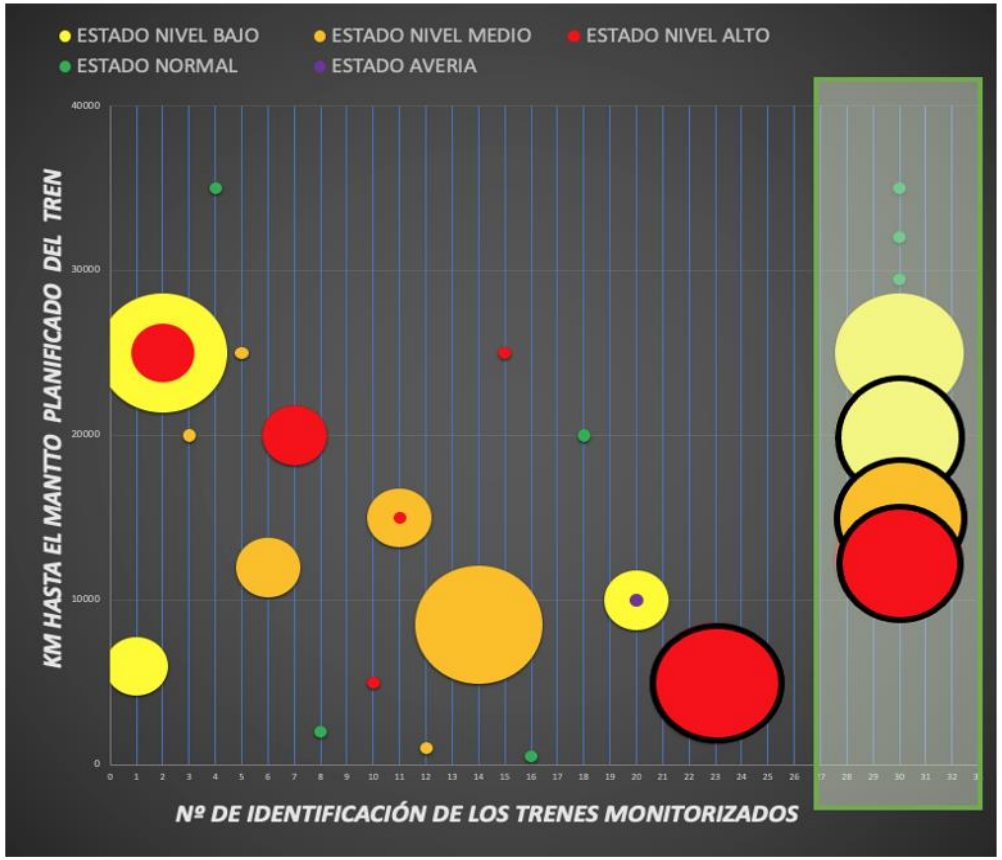
Technical Challenges

Dynamic risk assessment

With high digitization, there is more information about the operation and condition of assets.

Linking this information to a reasonable measure of failure risk, and of the asset, becomes fundamental to the maintenance decision-making process.

What does this mean?
A more sophisticated form of dynamic
sophisticated way of dynamically assessing the risk of failure and the escalation of that risk to the main system under analysis is required.



Technical Challenges

Dynamic scheduling of maintenance activities.

The massive use of CBM generates a dynamic and highly complex decision making.

Large amount of information available, with the number of events and alarms, many of them interconnected.

The management of these complex scenarios becomes a barrier to the practical implementation of CBM solutions within PM plans.

What does it mean?
Facilitate the understanding of the information provided by the solutions and connection with the maintenance action scheduling processes, which include human participation.

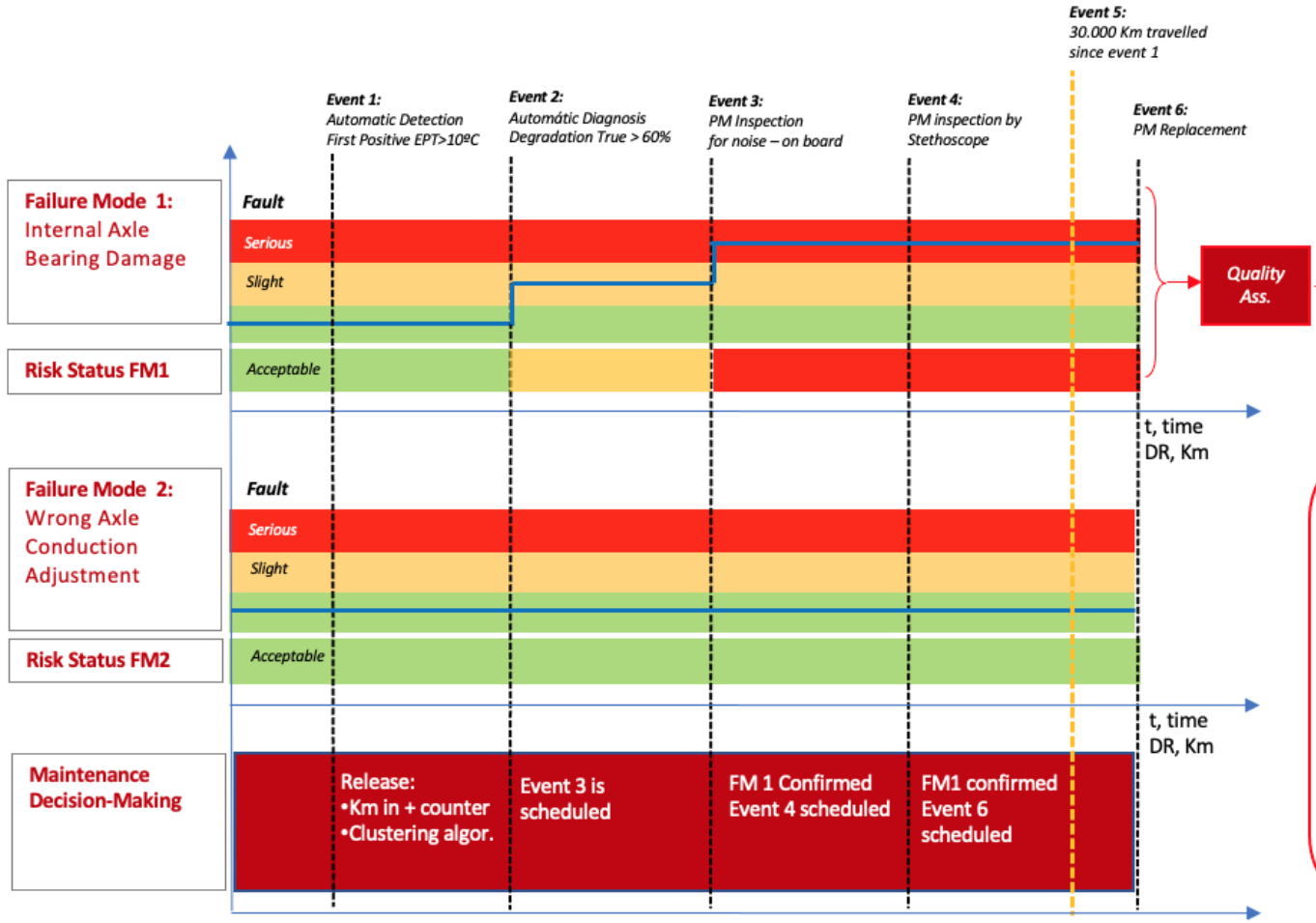
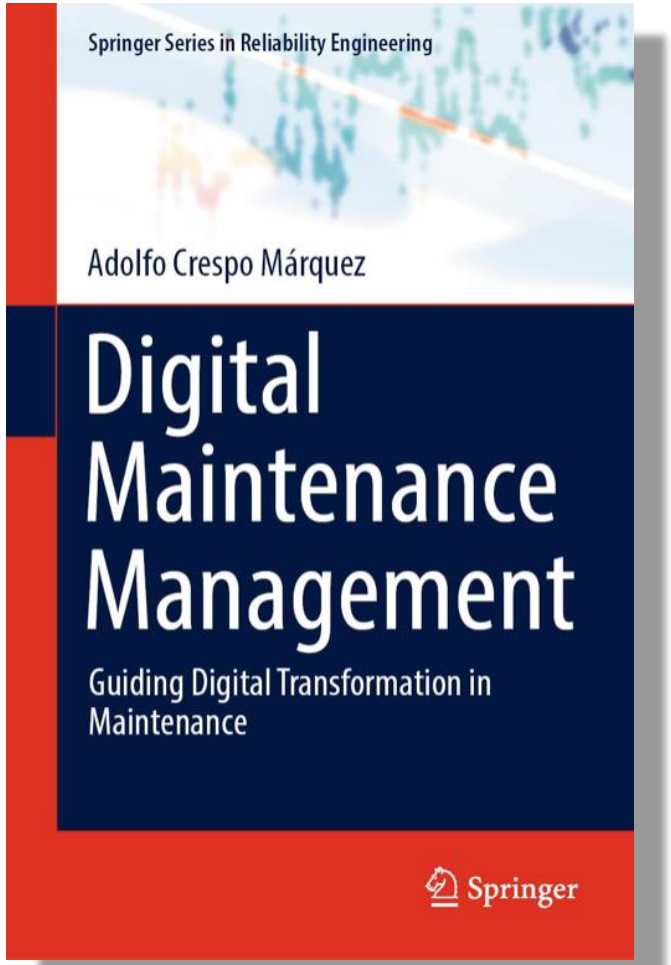


Figure . Sequence of events for the execution of CBM maintenance tasks.

Conclusions

- Digital Transformation is changing the way maintenance is managed.
- A non-trivial process, the sequence of implementation, the use of different tools and technologies requires analysis and strategic planning.
- Manufacturers and asset users and managers must prepare for different possible scenarios according to the digital configuration of the asset.
- In the new maintenance ecosystem, critical attention must be paid to the data model, the ownership of data masters, the possibilities these masters offer for management and the control of access to them.
- One of the biggest challenges will be to provide people with the right support and training for better change management.



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THANK YOU!

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