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Business Case

“Asset MAnagement in the new Dlgital Twins environment” (AMADIT)

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<The PM² Methodology originated from the European Commission. Open PM² provides many guidelines and templates to facilitate the management and documentation of your projects.>

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1 PROJECT INITIATION REQUEST INFORMATION

Project Title:	<i>“Asset Management in the new Digital Twins environment” (AMADIT)</i>		
Initiator:	<i>Adolfo Crespo Márquez, Antonio Sánchez Herguedas</i>	Organisation / Unit:	<i>USE</i>
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2 CONTEXT

2.1 Current Situation Description

In many different types of industry asset managers have been forced to confront the significant structural challenges facing the industry head-on. Despite the unprecedented nature of the past two years, the next five years are expected to be even more transformative than the previous five.

The asset management industry is facing pressure from investors and regulators to prioritize value for money and sustainable finance, while also dealing with decreased fees due to fierce competition. This is taking place as the industry tries to regain lost revenues and navigate post-pandemic sociopolitical challenges. If asset managers can realign their strategy to prioritize their customers and use advanced technology, they will be successful in the future.

According to reports from various institutions, such as the Industrial Internet Consortium, maintenance is one of the business areas where this transformation is expected to have the most significant impact.

2.2 Current Situation Impact

The goal of this coordinated project proposal (DIGEST) is to contribute to this vision. To meet the expectations of clients and always provide them with a more personalized and seamless experience, asset managers must develop innovative solutions. A key objective for asset managers should be to provide clients with a high level of automation and digital flexibility to achieve end-to-end process efficiency.

New technologies, changing market rules, and customer demand have all prepared the path for asset management to go beyond the limits of traditional business process outsourcing.

As more systems are connected within the ecosystems of industrial facilities and infrastructure, digitalization will be the driver for a breakthrough. This may result in more complex scenarios where cooperation between resources and stakeholders is crucial. Gaining knowledge in several strategic, operational, and maintenance management domains can facilitate such cooperation, and this is the strategy adopted in DIGEST, which integrates three different subprojects addressing different use cases and sharing clear intersections and common approaches.

Concerning the current market situation, Gartner distinguishes between three different types of asset management systems in the market: Enterprise Asset Management (EAM), Asset Performance Management (APM), and Asset Investment Planning (AIP) Solutions as indicated in Figure 1.

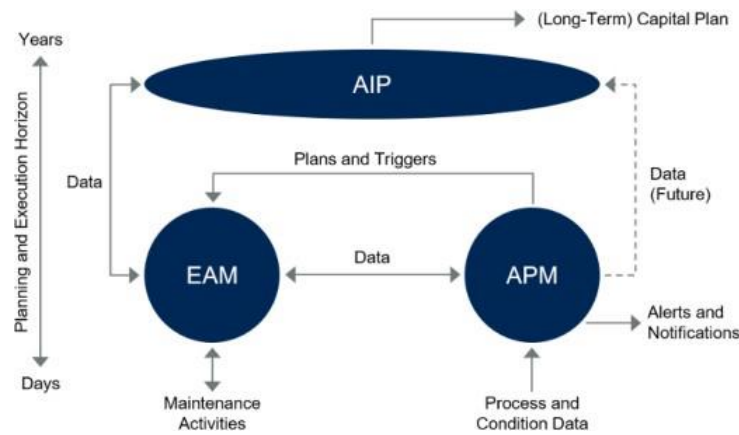


Figure 1. The flow of data in advanced asset management systems

However, we strongly believe that Digital Twins (DT) can be extended further in many different sectors (including industry but also other business services such as finance, health, or education) from the technical point of view but also from the involved asset management perspective, which demands the integration of operations and maintenance policies. Therefore, a relevant research question to be addressed is, **how do we articulate transparency on data from assets, performance, and optimization and scheduling models to foster an increased digitalization level at process or service levels?**

The different systems will handle a predetermined data model to generate an output. These outputs can be for different purposes: to identify risk in assets, to assess that risk, to mitigate the risk, etc. DT and BI apps can interact with IAM apps to allow the introduction of powerful data analytics and visualization tools. In this scenario, the data model becomes critical to each one of the processes that the different applications support. This is even more critical when talking about the digitalization of legacy assets, where data collection sometimes is a difficult task. Therefore, the need for comprehensive reference frameworks is evident, although some have already been proposed:

- BIM / AIM.- Building / Asset Information Modelling is a framework for the construction industry where the life cycle of buildings is considered from its digital dimension (from design to operation and maintenance).
- Cognitive DT (CDT).- Although it is not just a reference framework but a concept, it proposes to extend the DT throughout the life cycle, as BIM does.
- RAMI 4.0.- Is a well-known reference framework developed by the German Electrical and Electronic Manufacturers' Association (ZVEI) to support Industry 4.0 initiatives. It focuses on industrial production as the primary area of application, including discrete manufacturing for the process industries.

Then, is it relevant to conceptualize the digital transformation of an asset?

There is a highly significant challenge to build reference frameworks and methodologies addressing coherently the issues that arise at strategic, operational and also at component levels. Its importance becomes clear in the analyses of the opportunities and advantages to be gained when different processes requiring the usage of assets (maybe owned by different stakeholders) are considered, and decisions must evaluate not just the current operation but those coming soon. Asset health can impact on the delivered quality of products or services.

Looking to the successful implementation of such frameworks and methodologies, other challenges must be considered, such as: the integration of human operators, energy and environmental criteria and constraints; interoperability (data & systems) between and across levels; transparency in data and decisions when different stakeholders are involved.

2.2.1 Current Impact on Processes and the Organization

This section describes the organisational impact of the current situation as described. This impact can be detailed by describing:

- The impact in the organisation's strategy;
- The impact on the business processes;
- The impact on people;
- The impact on the IT landscape.>

Although a detailed analysis of the Business Process may be carried out at a later stage of the project, the impacted business processes can belong to one of the following business process categories:

Process Category	Yes/No	Process Category	Yes/No
Legislation Lifecycle	YES	Procurement	YES
Coordination	YES	Document Management	YES
Grant Management	YES	Human Resources	YES
Communication and Dissemination	YES	IT	YES
Financial Management	YES	Others	NO

The AMADIT project inside the DIGEST one offers an engineering-centered perspective on assets by integrating their description, operating models, and data management. The project's primary focus is on operations that can impact on the asset's dynamic status. The goal is to dynamically include these activities in the decision-making process, with the aim of increasing value creation while also considering the effect on the asset's status. Decisions on maintenance are crucial in this scenario. To extend the useful lives of production assets while keeping costs in mind, the DIGEST project must investigate tools for integrating service and production scheduling, considering factors such as income, loss-of-production cost, maintenance cost, and all associated opportunity costs.

2.2.2 Impact on Stakeholders and Users

It is expected from the project:

- To develop methodologies for the management of the components (digital twin, data management, model management, agent management) in a flexible context such as microservices.
- To verify and validate statistical learning models adjusted to empirical data obtained from assets and operating processes.
- To explore digital twin strategies based on the results and findings related to the other objectives, according to the proposed framework, considering the required transparency levels. It will specifically look at the integrated maintenance and operation schemas, which is a clear bottleneck to overcome.
- To integrate environmental factors and energy-related aspects in the description of the processes linked to assets, making them aware of such elements.
- To integrate the principles of circular economy in the semantic description of assets, since they can influence maintenance policies, or asset usage strategies.

2.3 Interrelations and Interdependencies

The AMADIT project is closely interrelated to its twin one running at Madrid Polytechnic University in the framework of the coordinated project DIGEST. The DIGEST project offers an engineering centred perspective on assets by integrating their description, operating

models, and data management. The project's primary focus is on operations that can impact on the asset's dynamic status. The goal is to dynamically include these activities in the decision-making process, with the aim of increasing value creation while also considering the effect on the asset's status. Decisions on maintenance are crucial in this scenario. To extend the useful lives of production assets while keeping costs in mind, the DIGEST project must investigate tools for integrating service and production scheduling, considering factors such as income, loss-of-production cost, maintenance cost, and all associated opportunity costs. There exists interdependencies as well related to infrastructure and/or data provided by the use cases to be defined to develop the proposals.

3 EXPECTED OUTCOMES

Dissemination is defined as “the public disclosure of the results by an appropriate means (other than resulting from protecting or exploiting the results), including by scientific publications in any medium”. The AEI goal for dissemination is “to transfer the knowledge and results with the aim to enable others to use and take up results, thus maximising the impact of funded research”. Information delivery and dissemination is integrated directly into the AMADIT research through the work-packages (WP) activities. Following partners’ approval and needed checks, the results from research will be delivered to target audiences.



Results and outputs, using the following dissemination channels will be prioritised:

- Scientific publications
- Project events
- Conferences and workshops
- International events
- Collaboration and synergies with other projects

The dissemination strategy for AMADIT is constantly evolving with the following targets:

- Pull clear, easy and precise messages or important conclusions from research data.
- Identify leading ‘carriers’ of communication.
- Create steady groups of activities to ensure the dissemination strategy succeeds.

Moreover, AMADIT achievements and findings will be shared to key stakeholders as a focus while integrating feedback into the specification, design, development and evaluation work for the project. Regarding this, AMADIT aims to:

- Publish results in international journals, conferences, and workshops to inform the scientific community about AMADIT, its goals, activities and results and to gather valuable information on related issues and efforts.
- Increase the impact of the project through synergetic activities.

The strategy for dissemination is built around the questions below:

- a) What is the subject of dissemination?
- b) Who is it addressed to (target audiences)?
- c) What is the most effective way to reach that audience (tools, channels)?
- d) When, and by whom, will actions be executed to achieve the above (activities)?

The following subjects have been identified within the DADIBAS project:

1. AMADIT project (general objectives, expected impacts, progress and activities)
2. Main findings
3. Techniques and methodologies (using cases, scenarios, architecture, piloting, ex ante and post ante evaluation)

4. Technologies and technological approaches (AI, BIM, Modeling, Algorithms)
5. Human Centric approaches: worker evaluation, skills and training, ethics.

One of the main dissemination objectives is to create awareness of the AMADIT project impacts and benefits. Identification of the target audiences is paramount for expanding awareness. The individuals, organisations and groups will be vital to project success. Upon initial review, the AMADIT stakeholder groups have been identified within the initial proposal phase. Key stakeholders involved in the project’s communication activities are shown in the Table below:

Target Group	Means
Manufacturing Industry Stakeholders	Publications, blogs, articles/videos, newsletters and access to datasets, networks.
IT (AI and Data) Industry. Players for Manufacturing	IT (AI and Data) Industry Players for Manufacturing
Industry Associations and Technology Clusters	Newsletters, participation in events/workshops (benefits to end-users, skills development, details on results).
Researchers and Academia	Publications, website, blogs newsletters, provision of open data repositories, participation in events.
Citizens/General public	Events, blogs, website.

Specifically, the dissemination strategy must include a communication one, which will rely on KPIs, and the initial proposal to start the definition will be,

Communication Activity	Target KPI
Creation of light content for non-specialized audience in the channels adopted in this task, as well as contributing to “lighter” versions of project newsletters, leaflets, flyers, etc	> 50 visitors in non-specialized area
Contribute to Exhibitions / workshops with free access, where visitors will have the possibility to realize in a lively way the DIGEST benefits. For example, visitors will have the opportunity to explore how technology contributes to different use cases.	1 exhibitions/ workshops > 50 non-specialized attendees
DIGEST recognition: will elaborate on building the DIGEST “image” to the external world brand with a logo, a motto, and design/template following its ubiquitous appearance. Harmonized design and templates will adorn the project website, flyers, reports, videos, presentations, and any dissemination or communication activity.	> 50 responders identified DIGEST
Promotion of the DIGEST activities and benefits to the public will be conducted in cooperation with local authorities/institutions, also covered by local media (e.g. broadcasters, papers, magazines)	> 1 event > 3 appearances to local media

The entire project addresses various use cases that involve different factors and technologies, and a significant impact is expected to occur over the next four years. As a result, it is anticipated that more than 15 scientific papers will be produced and published in relevant, JCR-indexed journals, adhering to the EU's recommendation for open-access publications.

Additionally, the project aims to actively participate in more than 20 international conferences, as outlined in the scheduled tasks and allocated budget.

Looking to maximize the impact of such publications, special effort will be done in two different axes: The first one by using the well-known platform <https://researchoutreach.org/> to additionally connect research with outreach, and the second one by using the 'Easing the Science Units existing at the different universities to again make specific and additional outreach action.

The technical impact of the project can also be estimated based on the research teams' ability to generate interest from companies, as demonstrated in the support letter section, and their willingness to apply the project's outcomes to real-world use cases.

4 SOLUTION DESCRIPTION

To reach the established goals DADIBAS project proposes to develop different work-packages (WPs). Each WP has been configured as a sequence of Tasks organized to produce deliverables. In the following paragraphs each WP will be presented.

4.1 WP1

Its ambition is to handle the daily management of subproject A2 (AMADIT), according to the adopted policies taken in accordance with the Governance structure presented in chapter 5. The list of relevant tasks is,

- T1.1.- Scope & Resource management of Subproject AMADIT.
- T1.2.- Dissemination monitoring.
- T1.3.- Risk and Quality Control.

The foreseen deliverables are:

- D1.1 .- Project Business Case [M3].
- D1.2 .- Project charter [M4].
- D1.3 .- Project Work Plan [M6].
- D1.4 .- Project Final report [M48].

4.2 WP2

This package focuses on establish a reference framework for the advanced digitisation of engineering assets and processes in the context of the current development of digital twins. This includes methodologies for the management of the digital twin considering dynamic management of data, models, and microservices giving rise to a "living" DT that evolves at the same time as the asset it represents. It is proposed 4 milestones for this WP, corresponding with 4 evolutive versions of the asset digitalization framework by integration of results along the project AMADIT. DT proposals will be built and tested over AZURE cloud platform technology combined with ad hoc IoT solutions, aiming to facilitate integrated DT use in a non-intrusive way with pre-existing information systems.

The list of relevant tasks is,

- T2.1.- Asset digitalization models.
- T2.2.- Process and services digitalization models. Interaction between DTs in complex digitalization scenarios.

- T2.3.- Architecture and integration design.
- T2.4.- Definition of a framework for the management of data and digital models.
- T2.5.- Use cases: selection, design, and execution.

The foreseen deliverables are:

- D2.1 .- Framework for the design and use of digital assets: state of the art. Milestone 1. [M12].
- D2.2 .- Framework for the design and use of digital processes: state of the art. Milestone 2. [M24].
- D2.3 .- Framework for the design and use of digital assets in digital processes: state of the art, data & model management. Milestone 3. [M36].
- D2.4 .- Framework for the integration of digital assets and processes and their interaction with the final user: state-of-the-art, integration and interaction strategies. Milestone 4. [M48].
- D2.5 .- Use cases report. [M48].

4.3 WP3

The aim of this WP is to develop APM models for the development of digital maintenance strategies. APM models include models for the management and dynamic representation of risk as a basis for the control of asset performance, based on algorithms for the detection, diagnosis and prognosis of failures. They also include models for the digitisation of maintenance decision-making, models for dynamic maintenance planning and scheduling based on the data, models to assess the impact of operation and maintenance on the environmental, and models to assess the impact of DT technology on the business to guide the development and implementation process in the company. Predictive maintenance tools are usually included in APM solutions, due to reduce corrective maintenance, increase availability, and reduce the risk of failure, especially when assets are critical.

The list of relevant tasks is,

- T3.1.- APM models for the detection, diagnostics and prediction model.
- T3.2.- APM models for digitalization of decision making.
- T3.3.- APM for dynamic maintenance planning and scheduling.
- T3.4.- Models for assessing the impact of DT technology in organisations.

The foreseen deliverables are:

- D3.1 .- APM models for digital maintenance of railway use cases. [M24].
- D3.2 .- APM models for digital maintenance of smart grid use cases. [M36].
- D3.3 .- APM models for digital maintenance of oil & gas use cases. [M48].
- D3.4 .- Model to assess the impact of DT technology, in APM, on organisations. [M48].

4.4 WP4

The development of AIP models and applications is designed to improve complex long-term strategic and tactical decisions. Therefore, the development of these models must consider the challenges of the evolution of the ecological and digital transformation from a long-term perspective. AIP should be linked with smart APM models and integrated as a key element for digital transformation management.

The list of relevant tasks is,

- T4.1.- Identify and categorise possible scenarios and the possible evolution of the ecological and digital transformation until 2030 and 2050..
- T4.2.- Carbon and water footprint, environmental costs, and circularity indicators for operations linked to the maintenance and management of assets.

- T4.3.- AIP models / applications based on asset health indexing and its links to TCO models.
- T4.4.- Digital Twins and AIP models for long-term strategic planning.

The foreseen deliverables are:

- D4.1.- Selection of scenarios where to apply long-term AIP digital tools for strategic management. Milestone 1_Conceptualization. [M12]
- D4.2.- Procedure for incorporating the carbon and water footprint, environmental costs, and circularity indicators to the AIP tools and Apps. Milestone 2_Design. [M24]
- D4.3.- AIP AHI & TCO Apps. Milestone 3_Building. [M36].
- D4.4.- AIP DTs for strategic management. Milestone 4_Commissioning. [M48]

5 GOVERNANCE

5.1 Project Owner (PO)

The direct nominated PO is the Spanish “Agencia Estatal de Investigación” as the agency providing support for the project.

5.2 Solution Provider (SP)

A joint governing structure will be implemented to harmonise the activities of the researchers on an individual level and efficiently achieve the expected DIGEST objectives. The project management structure involves the roles a) Project Coordinator, b) Project Assistant, d) Training Coordinator, and f) Work Package Leader. These appointed people will function under the supervision and management of the following project bodies:

- **The Management Board (MB)**, for the whole DIGEST project, composed of the Project Coordinators of the subprojects responsible for resolving and monitoring the project progress as well as monitoring the contributions, and responsible for monitoring the success and the impact of the project, and potentially a Project Assistant. The Project Coordinator of Subproject A1 is mandatory in charge of operating the link between DIGEST consortium members and the Agencia Estatal de Investigación (AEI) of the Spanish Minister of Science and Innovation. It will be responsible for monitoring and supporting the SC and the SB. All financial issues are excluded from the duties of this committee because the AEI is funding each university independently. In case of the absence of the project coordinator in charge, the role will be taken by the second project coordinator, which is an enforced position in all the subprojects. Annual project meetings will be scheduled at different places, looking to align them with WorkShops or other relevant events.
- **The Steering Committee (SC)**, at the subproject level chaired by the subproject coordinators of the subproject and including all WP leaders, the Project Assistant and the Training Coordinator. The SC will monitor both the progress of the WPs and the research training programme, looking to maximise the links between the research and the training activities or challenges. The monitoring duties of SC include both academic and non-academic aspects, such as ethics, IPR, gender mainstreaming, public outreach, data policy, and management, as well as financial and administrative matters. To this aim, each of these responsibilities will be assigned to one of the SC members. At least one SC meeting will be organised every six months, while running them in parallel with other subproject activities, such as network workshops and annual meetings, would be considered.
The SC as per subproject will take the responsibility for the subproject configuration of Deliverables, including reports, code repositories, and any other digital element. It will verify that the policies on open access are met. Formal and informal cooperation between SC managers is not only expected but promoted.
- **The Supervisory Board (SB)**, is chaired by an annually elected representative and is cochaired by a member of the RT from each subproject, appointed by the Subproject

coordinator. Cooperation between SB and SC will facilitate the advice on the management, scientific, and training angles of the programme. It will advise young researchers (YRs) on their progress, the expected, and obtained results throughout the programme and counsel them about their career plans. Doing it from the Project fosters their interaction and allows YRs to learn from distinct cultural approaches or practises.

From a top-level view, it will be an ‘action’ methodology because it is characterised by “Research strategies that tackle real-world problems in participatory, collaborative and cyclical ways to produce both knowledge and action.” [38] Since all subprojects have use cases driven by real-world problems and are going to be addressed in collaborative and somehow cyclical ways, it is the preferred one, and the key elements will be considered for tasks dealing with such real problems.

The general policies adopted in the DIGEST project, as well as the daily management operations of the subprojects, will be carried out by adapting the PM² project management methodology, developed and endorsed by the European Commission. To this end, the PM² promoted templates will be adopted and customized.

The WPs that deal with modelling will follow the CRISP/DM methodology to follow the creation and validation, and the integrated tasks will select the development strategy that is better suited to them (PM², Scrum, Kanban, etc.) where the subproject team will have the ability to choose the most appropriate approach, considering the context and constraints.

To this end, the tasks linked to WP1 will follow the PM² method, while each use case will setup its own methodology.

5.3 Business Manager (BM)

The role of Business Manager will be taken, when needed, by a WP responsible having good knowledge of the relevant Use Case and s/he will keep the user voice as well.

5.4 Project Core Team (PCT)

The research team (including both researchers and working team) will be known as PCT and they will be in charge of developing the DADIBAS project from the technical and operative point of view.

5.5 Project Manager Team (PM)

The role of Project Manager is carried out according to the project proposal and they will be in charge of definition.

APPENDIX 1: REFERENCES AND RELATED DOCUMENTS

No additional documents, except the project proposal which has been summarized in this document were used yet.

ID	Reference or Related Document	Source or Link/Location
1		