EnerMan

Energy Efficient Manufacturing System Management

D7.6 - 1st Exploitation Report, EnerMan Business Models and Market Analyses

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EnerMan

Short Description
This deliverable provides an overview of the exploitation and business plan of EnerMan project outcomes. The deliverable shows a preliminary market survey and elaborates on the exploitation plans, which will help identify the exploitable project results and the business-oriented exploitations plans.

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1. EXECUTIVE SUMMARY

This deliverable summarises the work which has been and will be carried out as part of Task 7.4. This task focuses on the exploitation strategies, business modeling and market uptake. The study will define and implement the specific steps necessary to ensure the long-term sustainability of EnerMan beyond the project frame, ensuring that the EnerMan model is a living system, constantly updated with new sets of data and adapted to the Industry 4.0 trends. For EnerMan to be able to realize these goals, it is essential to define a well-tailored exploitation plan and perform a well-structured market analysis. More specifically, this deliverable aims to provide an introductory work and lay the foundation for the market survey, considering different industry-level business cases and involving all Consortium partners and more vendors, more potential production partners, and service providers. Additionally, this report will discuss the consortium-wise and individual exploitation plans. Finally, the Exploitation plan timeline will be presented in this report.

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2. INTRODUCTİON

2.1. Purpose and Scope

To ensure the successful implementation of the EnerMan project and sustainability and broader exploitation of its outcomes, the exploitation strategies, business modeling, and market uptake need to be defined. The task involves a market survey based on the concepts and sensing principles achieved in earlier tasks. The planned dissemination and marketing activities should involve all the Consortium partners and involve more vendors more potential production partners, and service providers. Moreover, market-related feedback of dissemination and publicity activities shall be considered and documented. The result of this task shall be a market survey considering different industry-level business cases and exploitation plans. Task 7.4 will define and implement the specific steps necessary to ensure the long-term sustainability of EnerMan beyond the project frame, ensuring that the EnerMan model is a living system, constantly updated with new sets of data and adapted to the Industry 4.0 trends. The preliminary consortium-wise and individual exploitation plans developed before the start of the project will be elaborated during the project based on the feedback collected through dissemination and testing activities.

These exploitation plans will address two main aspects: First, identifying exploitable project results and the definition of the corresponding IPR protection mechanisms (including ownership, licensing regime, patentability). INTRACT, the Innovation Manager of the EnerMan project, will assist each partner in IPR management. If necessary, IP studies will be conducted for those new algorithms that could potentially be patented. Secondly, the development of the two-business oriented exploitation plans led by the two partners INTRACT and STS. Using the business canvas methodology, both companies will identify the target customers, value proposition, revenue streams, cost structure, and commercial strategy to be followed after the project completion.

2.2. Structure of the document

To this end, the following document contains a brief report of the preliminary exploitation strategy and the market analysis of the EnerMan outcomes. The second section of this report starts with introducing the concepts used in the exploitation strategy and market analysis: business models generation, market analysis, and value network analysis. The third section of the report discusses the exploitation strategy and provides a timeline of the activities. The 4th section of the report consists of a preliminary market survey for the vital exploitable results of EnerMan. The report ends with a conclusion, summary, and outlook.

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2.3. Glossary of acronyms

Acronym	Definition
AI	Artificial Intelligence
BEMS	Building energy management system
CO_2	Carbon Dioxide
cPPP	Contractual Public-Private Partnerships
CPS	Cyber Physical Systems
DSO	Distribution System Operators
EU	European Union
ESCO	Energy Service Company
HVAC	Heating, Ventilation, and Air Conditioning
HW/SW	Hardware and Software
IEMS	Industrial Energy Management Systems
IIoT	Industrial Internet of Things
IPR	Intellectual Property Rights
KER	Key exploitable Results
ML	Machine Learning
R&D	Research and Development
SaaS	Subscription-as-a-Service
SMEs	Small and Medium Enterprises
SWOT	Strengths, Weaknesses, Opportunities, and Threats
VNA	Value Network Analysis

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3. BUSİNESS MODELS, MARKET AND VALUE NETWORK ANALYSES

Since the business models, the market analysis and value network will be used throughout the exploitation and market analysis work of the EnerMan project, it is necessary to provide a brief description and theoretical background about these concepts. The first subsection will focus on the business models, while the second subsection will address market analysis, and the third subsection will focus on the value network analysis.

3.1. Business Models Generation

According to Mahadevan (2000), a business model is a unique blend of three streams that are critical to the business. These include the value stream for the business partners and the buyers, the revenue stream, and the logistical stream. A business model concept that facilitates description, discussion, and a good level of understanding allows a decent discussion and development on business model innovation. The concept must be simple, relevant, and intuitively understandable, while at the same time should still be ready to capture the complexities and dynamics of how enterprises function. Moreover, the concept should become a shared language that enables us to simply describe and manipulate business models to develop new strategic alternatives. Osterwalder & Pigneur (2010) have discussed this, and according to them, a business model can be described through nine building blocks.

3.1.1. *Customer Segments*

This block defines the various individuals or organizations an enterprise aims to succeed and serve. A business model may represent one or several large or small Customer Segments. Here are some examples: mass market, niche market, segmented, diversified, multi-sided platforms/markets.

3.1.2. *Value Propositions*

This block describes the bundle of products and services that generate value for selected Customer Segment. A Value Proposition block solves a customer's problem or satisfies his need through a concrete mixture of elements catering to its needs. Among those elements are newness, performance, customization, "getting the task done," design, brand/status, price, cost reduction, risk reduction, accessibility, and convenience/usability.

3.1.3. *Channels*

This block describes how a corporation communicates with and reaches its Customer Segments to deliver its Value Propositions.

3.1.4. *Customer Relationship*

This block describes the types of relationships an organization establishes with specific Customer Segments. Those are personal assistance, dedicated personal assistance, self-service, automated services, communities, and co-creation.

3.1.5. *Revenue Streams*

This block represents the cash an organization generates from each Customer Segments. The prices must be subtracted from revenues to make earnings. These are several ways to get Revenue Streams: asset sale, usage fee, subscription fees, lending/renting/leasing, licensing, brokerage fees, and advertising.

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3.1.6. *Key Resources*

This block describes the most important assets required to create a business model work, allowing an enterprise to make and offer a Value Proposition, reach markets, maintain relationships with Customer Segments, and earn revenues. Essential Resources are categorized as follows: physical, intellectual, human, and financial.

Key Activities:

This block is a follow-up from the Key Resources block. Key Activities concern on production, problem-solving, and platform/network.

Key Partnerships:

This block describes suppliers' and partners' network that makes the business model work, optimize business models, reduce risk, and acquire resources.

Cost Structure:

This block is the ultimate block that describes all costs incurred to operate a business model. Cost structures can have the following characteristics: fixed costs, variable costs, economies of scale, and economies of scope. Moreover, based on its cost, business models are often classified into value-driven and cost-driven.

All the aforementioned building blocks are therefore implemented into EnerMan model. The business model canvas of EnerMan is shown in the section 3 - Exploitation Strategy.

3.2. Market Analysis

A market analysis is essential to capture the dynamics and attractiveness of a specific market in order to adopt favorable positions compared to competitors, convince the investors, and to project feasibility of the market now and in the future, before deciding to start a business activity. An attractive market is signified by the long-term return on investment (ROI), which plays a significant role in making a business investment decision (Aaker & McLoughlin, 2010). Aaker & McLoughlin (2010) explained eight dimensions of a market analysis:

3.2.1. *Emerging Submarkets*

This step involves identifying attractive or promising market parts. The characteristics of emerging submarkets are lower price points, reaching customers who were non-users, venturing to a new yet essential segment, responding to customer trends, and utilizing a new technology.

3.2.2. *Actual and Potential Market and Submarket Size*

The size of total sales in the present and the future is examined in this step. The actual size of a market relies on the number of people who show the need, resources, and willingness to exchange these resources in return for obtaining what they want (Kotler, 2008). The sources could include financial analyses from competitors, trade associations, investors, and government data.

3.2.3. *Market and Submarket Growth*

This step investigates the expected size of the different submarkets over time and their expansion or contract speed. The easiest way would be to inspect historical data. However, the turning points when the rate and direction of growth change should also be noted.

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3.2.4. *Market and Submarket Profitability*

The possibility of revenue generation in the different submarkets is covered in this step. Among the aspects that could affect this step are competitors' awareness and the relative bargaining power of suppliers and customers.

3.2.5. *Cost Structure*

This step examines different production and depreciation costs that may arise to develop strategies. Porter's value chain model is a helpful tool to notice where value-added processes take place and which costs can be reduced.

3.2.6. *Distribution Systems*

Research about current and potential distribution channels used to advertise the products and services, including their trends, is conducted in this step. This step summarizes a complete path through which products and services flow from manufacturer to customer or payments from customer to manufacturer (Rusinova, 2014).

3.2.7. *Trends and Developments*

Awareness of trends relevant to the market is of importance in this step. Trends can be technological advances, consumer trends, government trends, and economic trends. Developments can be defined as the process of growing to become more advanced given the current resources and trends.

3.2.8. *Key Success Factors*

This step involves identifying critical success factors, assets, and competencies required to succeed in the market competition. This step also discusses how they will affect each other in the future, and which strategies can be incorporated to neutralize the assets and competencies of competitors.

3.3. Value Network Analysis

When launching a certain product or process not only the market to which the outcome of a company is introduced but also the overall competitive environment of this firm might be of interest. In this context, a promising approach by (Peppard and Rylander, 2006) is described to characterize a firm's competitive ecosystem in addition to the market analysis, which might help strategic management to derive correct strategic countermeasures to cope with rapid market changes and competition. Particularly, it explains how stakeholders of a company can interact with each other. This approach extends the traditional linear approach of Supply Chain Management into a symbiosis network. It means that strategy managers no longer search for a firm's position along the linear value chain but rather concentrate on the value-creating system itself. Such networks are characterized by the free and dynamic interaction between the actors, such as suppliers, service providers, manufacturers, retailers, customers, competitors, regulators, and institutions. With the increasing number of players, highly complex economic systems dynamics of interaction and digital networking are emerging (Göpfert, 2019). That allows to mutually increase the benefits by successful market exploitation with joint commercial activities (Hein et al., 2017).

The need for coordination across firms, industries, and service domains becomes even more apparent as faster digitalization advances. Traditional products are starting to embed digital technologies, requiring the supporting IT infrastructure and tailored service, forcing companies to shift towards a network strategy (Pagani, 2013). Examples from the mobile and energy industry show proof of this shift (Peppard and Rylander, 2006; Hein et al., 2017). In order to guide firms towards an effective

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competitive positioning at the market, a five-step technique by (Peppard and Rylander, 2006) that aims to exploit the network of stakeholders is presented ideally. By applying the so-called Value Network Analysis (VNA), firms learn to exploit the competitive ecosystem and co-create value. More precisely, it allows them to acquire a strong market position that enables agile responses to ongoing market changes. The five specific stages elaborated by (Peppard and Rylander, 2006) are represented by a specific workflow with several theoretical approaches, which are investigated, aggregated, and extended by recent literature (Feng et al., 2010; Hein et al., 2017).

3.3.1. *Definition and delimitation of the network*

Regarding step, an intense description of the qualitative value of a network is required. By doing so, the limits of the entire analysis are defined, and the network focal is selected. This entity, represented either by the focal project or by the focal business unit, will lead required business activities such as feasibility checks, negotiations and coordinating the entire co-value creation (Hein et al., 2017).

3.3.2. *Identification of the participants in the network*

At stage two of the VNA, the user needs to identify the stakeholders, which are described by their capabilities, targets, and requirements (Feng et al., 2010). Stakeholders can either be identified by interviews with the network focal and the application of snowball sampling or by referring to pre-created lists of stakeholders per industry (Hein et al., 2017).

3.3.3. *Identification of the added value for each network member*

In continuation, step three includes a detailed analysis of the values brought to each stakeholder by participation in the symbiosis (Feng et al., 2010). The needs are often qualitatively modelled by directed graphs representing value flows among stakeholders, and between stakeholders and the focal organization (Hein et al., 2017). In a second step, the paths along the graphs can be quantified by utility values perceived by each actor (Feng et al., 2010).

3.3.4. *Creation of a value linkage matrix*

Based on those quantified evaluations all linkages between the participating stakeholders are collected in a network value flow matrix, which represents step four of the proposed VNA process (Hein et al., 2017).

3.3.5. *Analysis and design of a network value map*

Finally, the last step of the analysis is carried out by analysis and interpretation of the aggregated benefits, indicated by value loops, that each stakeholder delivers to the ecosystem (Hein et al., 2017). This overall view on the entire symbiosis enables to understand the role and power of a single participant but also the effects on the overall value dimension by influence of the broad network on each actor. According to (Peppard and Rylander, 2006) most of the analyses show that end customers are likely to be the key to value creation.

The Aaker and McLoughlin's Market Analysis and Peppard and Rylander's Value Network Analysis will both be used in the exploitation strategy and the market analysis of the EnerMan project to identify the stakeholders and prepare the market survey for the outcomes of the EnerMan project.

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4. EXPLOİTATİON STRATEGY

The Exploitation strategy will be elaborated and updated along with the project. It will focus on identifying, coaching, integrating and synchronizing individual and joint exploitation plans of the project partners in order to facilitate, boost and accelerate the post-project uptake of EnerMan results.

Inputs to support the exploitation of EnerMan results will mainly come from the technical work packages such as WP3, WP4, WP5, among others which contribute to the market survey on the basis of the concepts and sensing principles achieved in earlier tasks. Additionally, the planned stakeholder' analysis, dissemination, and marketing activities should also contribute to the exploitation strategy of EnerMan project.

The exploitation activities will encompass:

- The identification of key exploitable project results (KER). This includes all the scientific and technical knowledge, products and services of the project susceptible to be exploited, and their classification according to their commercial potential.
- Assessment of the PESTEL analysis and the SWOT analysis and competitors in order to evaluate the EnerMan framework strength and weakness against our competitors and to identify new opportunities and risks.
- A methodology and strategy for appropriated IPR protection mechanisms (including ownership, licensing regime, patentability). The project partner INTRACT, as Innovation Manager, will assist each partner in IPR management. If necessary, IP studies will be conducted for those new algorithms that could potentially be patented.
- Market analysis using Aaker and McLoughlin's Market Analysis approach. The market analysis is used for identifying relevant target markets/groups and assessment of the competitive environment surrounding the project.
- Value network analysis based on Peppard and Rylander's Value Network Analysis approach. As a complement to the market analysis, the value network analysis visualises the stakeholders and the exchange of tangible and intangible value.
- Include the feedback from the early tasks such as the dissemination activities, stakeholders' analysis, and all relevant functions into the exploitation strategy.
- Preliminary roadmap for the exploitation plan to establish the appropriate exploitation agreements with key partners.

4.1. Exploitation approach

The preliminary Exploitation Plan developed before the start of the project will be continuously refined and updated throughout the EnerMan project. Based on this plan, the Key Exploitable Results (KER) will be defined and reformulated when needed, given the project advancement and potential changes and developments that might occur. After the KER list is prepared, a market and value chain analysis will take place to fully understand the potential for EnerMan technology and innovations in the market. Hereby, the work done on the EnerMan communication activities and stakeholders' engagement which will be reported in Deliverable 7.9 (D7.9) will be of support and importance. A more precise joint and, individual exploitation plan will be developed once the KER, value chain and stakeholder analyses are completed.

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Therefore, the more concrete activities associated with the Exploitation preparation consists of the following:

- Regular weekly and/or bi-weekly meetings for the task participants to continuously update and refine the exploitation strategy and track the progress.
- Surveying EnerMan project partners to refine and update, if necessary, the KER, the business model canvas. Additionally, conducting the Kano Model analysis, PESTEL analysis and the SWOT analysis. This can be done either through online surveys or through meetings with WP leaders and project partners. The Exploitation Workshops planned will be used for a consortium-wide discussion on these topics
- Surveying EnerMan project partners to refine and update, if necessary, the market analysis and the value network analysis. This can be done either-wide discussion through online surveys or through meetings with WP leaders and project partners. The Exploitation Workshops planned will help for this purpose
- Informing all the partners and stakeholders about the progress by means of newsletters and/or website updates on the progress of EnerMan and its exploitation strategy;
- Participating in relevant events with the goal to meet relevant stakeholders and engage with relevant actors to set up the basis for an effective exploitation of EnerMan project results.
- Connecting with the relevant European projects to share knowledge and potentially find additional exploitation routes. The funded project SC3 could be considered as one example.

The two reports: second Exploitation Report, EnerMan Business models and market analyses in addition to the EnerMan communication activities and stakeholders' engagement final report will encompass a very structured and transparent innovation and technology overview and mapping all the stakeholders engaged in the project. The end result of Task 7.4 is a market survey considering different industry-level business-oriented exploitation plans led by INTRACT and STS. This overview would allow to exploit further the generated and accumulated knowledge beyond the project and its end with the final goal to implement the specific steps necessary to ensure the long-term sustainability of EnerMan beyond the project frame, ensuring that the EnerMan model is a living system, constantly updated with new sets of data and adapted to the Industry 4.0 trends. The EnerMan Exploitation strategy timeline is shown in Figure 1:

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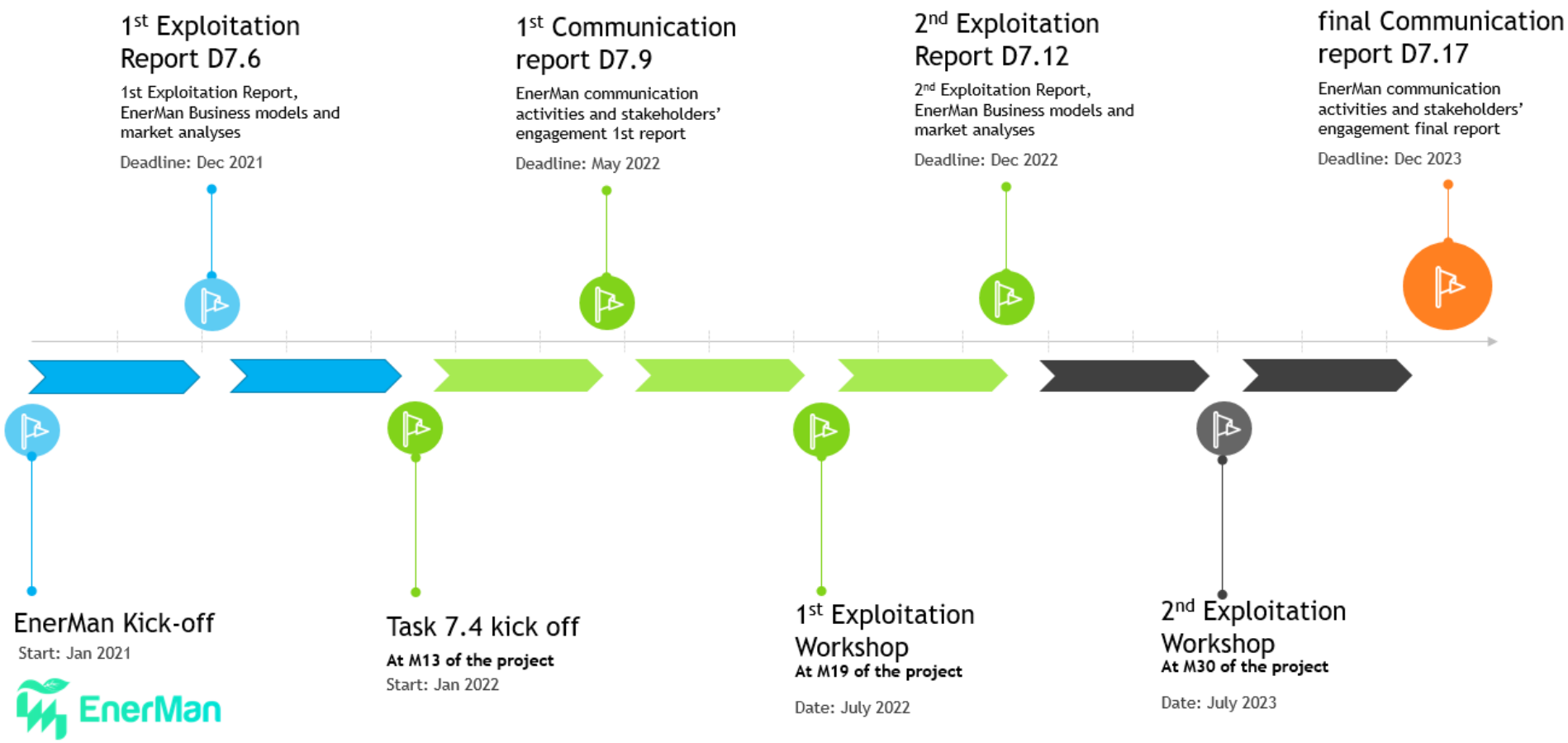

Figure 1:EnerMan Exploitation strategy timeline

4.2. Joint and Individual Exploitation Plans

4.2.1. *EnerMan Business Plan for joint exploitation*

The business model of EnerMan is considered a multi-sided one, meaning that there is more than one type of customer that are interested in the framework provided. The business model canvas is shown in Table 1.

Value Proposition: One EnerMan core value proposition is to provide "An intelligent and autonomous energy management and cost optimization framework capable of simulating factory operations using digital twin technology and predict possible outcomes through AI predictive analytics." EnerMan will offer clear value propositions both as a complete, packaged offering and as individual, customizable components, as with AI predictive analytics, digital twin models and software, agile event monitoring and identification, and ML situation assessment. Another essential value proposition is that the framework considers the human factor (operators and other actors), therefore introducing the "Human-in-the-loop" concept, which contributes to a more realistic prediction of possible outcomes and proposed countermeasures. We also consider the market potential of manufacturing industries and SMEs, as well as and raising awareness of the benefits of the aforementioned technologies to policy makers and regulatory bodies, standardization bodies, and the general public as distinct value propositions.

Customer Segments: The evident core customer group for EnerMan is the manufacturing industry spanning across several sectors such as the automotive, machinery, semiconductors, food, raw materials processing (e.g. aluminium, steel), and other actors within the Industry 4.0 framework. In some cases, e.g. in the automotive industry, the community of customers implies the entire base of customers, as the topic of "CO_2 neutral supply chain" and "CO_2 neutral development & production" has started in the entire automotive industry. Therefore, the community consists of customers from the segments of passenger cars, on-road and off-road powertrains up to large engines. In addition to these, potential customers are energy utilities, ESCOS, DSOs (Distribution system operators) and other smart energy solution providers that can potentially liaise for service provision with industrial actors. Last but not least, the project's customer segments comprise standardisation bodies, decision & policymakers and regulators, which the EnerMan consortium will approach through organisation of standardisation workshops as part of 7.3 and participation in numerous standardisation meetings. It is very necessary as part of this refining and update of this task is to consider the following points:

- Since subscription is a revenue stream of EnerMan it is necessary to identify the subscribers to the EnerMan
- İdetify the target audience, such as Manufacturers, Equipment supplier, Electricity market operators (Demand response).
- Identify the customers' requirements and features using Kano model

Channels: We believe the safest route to building and maintaining long-lasting customer relationships with the basic customer segments, manufacturing industries and Industry 4.0 actors, is via personal introductions to key stakeholders. This is especially true for the industrial partners (CRF, PRIMA, IFAG, J&J, ASAS, AVL, YIOTIS, STOMANA, SIMPLAN) of the EnerMan consortium, who can significantly contribute towards this end. These relationships will initially form through pilots' implementation and then be nurtured throughout the project and beyond to produce new opportunities either through partners' contact lists, by invitation in any of EnerMan's community events and other dissemination

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activities, or through direct contact externally. The project will also be highly visible in every digital channel, emphasizing digital communication over GDPR-approved segmented mailing lists. This will be the focus of Task 7.1 dedicated to Dissemination and Communication activities.

Key partners: These partners are mostly represented in the canvas as EnerMan consortium partners. They are the front-line companies and organizations to exploit the project technologically and commercially. We will also approach EU officials and cPPP representatives, achieving business development goals, getting marketing and business consulting, and collaborating with third party software and hardware vendors and service providers. All the stakeholders of EnerMan will be analyzed as part of Task 7.4 and reported in the deliverables D7.9 and D7.17.

Key activities and resource allocation: The activities vs. resources relationship closely follows the EnerMan work plan. Capitalizing on the talented human capital and expert business and technical leadership offered by the consortium, EnerMan goes through key activities, from user-driven requirements specification to the exploitation plan, with a significant emphasis on technology validation, which is the primary focus of the project. Resources to be utilized include human labor, technological components, models and methodologies, and evaluations.

Cost Structure: Most of the costs to bring EnerMan to commercial maturity are personnel-related for R&D, business development, hardware and software costs associated wiwith implementing the EnerMan framework, and expenses for standardization/certification activities. Third-party costs involved will cover software and hardware costs, including licensing and infrastructure costs and marketing expenses.

Income streams: EnerMan, offered either as a complete suite or individual components, will present significant customization potential. This is associated with consulting or customization fees for integrators and SMEs involved. Other essential revenue streams include subscriptions to the EnerMan framework over a SaaS (Subscription-as-a-Service) model and to the EnerMan framework, for developers and partner businesses looking to extend the EnerMan core functionalities to address an extended market. Income generated by follow-on support and training fees is also accounted for. It is also necessary to focus on answering the following questions

- What would the subscription include?
- What would the pricing of the subscription be based upon?
- Is EnerMan a product, service or product-service system offered i.e. does the subscriber get designated hardware?
- Comparison between Platform-as-a-Service, Software-as-a-Service

To ensure the success of the proposed Business Plan, the consortium has identified a robust set of metrics that will allow us to monitor success, fine-tune offerings, and driving sales quarterly:

- **Financial reports:** Reports will be used to measure the profits and losses and identify whether the correct balance of revenue streams is being achieved to meet overheads and grow the business.
- **PESTEL analysis:** this analysis will be used to identify threats and weaknesses which are going to be used in the SWOT analysis
- **SWOT analysis:** SWOT analysis will be completed to evaluate the framework against our competitors and identify new opportunities that can be used to boost sales.

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- **Self-awareness check:** The consortium will regularly meet to discuss their ideas for the business. As a geographically-dispersed consortium, EnerMan understands that such face-to-face meetings are critical for ensuring the framework's future matches the team's vision.

Table 1: EnerMan Business Model Canvas

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td>EnerMan technology providers</td><td>Implementation of EnerMan framework</td><td>Intelligent and autonomous energy management and cost optimization framework</td><td>Successful pilots</td><td>Manufacturing industry (automotive, machinery, semiconductor, food, etc.)</td></tr>
<tr><td>Manufacturing industries & SMEs</td><td>Assessment and technological validation</td><td>Digital twins to simulate factory operations</td><td>Strategic partnerships</td><td>Industry 4.0</td></tr>
<tr><td>Standardisation and Certification experts</td><td>Promotion of EnerMan outcomes</td><td>AI to predict outcomes</td><td>Standardization</td><td>Energy utilities, ESCOs, DSOs</td></tr>
<tr><td>Universities and research institutes</td><td>Public engagement</td><td>Consideration of human factor (Human-in-the-loop)</td><td>Dissemination</td><td>Standardization bodies</td></tr>
<tr><td>IPR expert</td><td>Key Resources</td><td>Generate market opportunities</td><td>Channels</td><td>Potential investors</td></tr>
<tr><td>European officials and cPPPs</td><td>Technical infrastructure</td><td>Raise technological level of research centers</td><td>Collaboration with key stakeholders</td><td>Decision & policy makers, regulators</td></tr>
<tr><td>3rd party HW/SW vendors</td><td>Skilled employees</td><td></td><td>Online sharing tools</td><td>Research community</td></tr>
<tr><td></td><td>Software & Hardware tools</td><td></td><td>Promotional events</td><td>General public-EU citizens</td></tr>
<tr><td></td><td>Data provision</td><td></td><td>Project website & Standardization</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">Cost Structure</th><th colspan="2">Revenue Streams</th></tr>
<tr><td>R&D</td><td>Standardization/audit costs</td><td>Consulting services</td><td>Engineering services</td></tr>
<tr><td>Marketing cost</td><td>Business development</td><td>Framework licenses</td><td>Follow-on support & technical service</td></tr>
<tr><td>HW/SW licenses</td><td>Human talent</td><td>Staff training</td><td>Subscription to EnerMan framework</td></tr>
</table>

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4.2.2. *EnerMan Business Plan for Individual Exploitation*

Apart from the joint exploitation strategy, consortium partners have expressed high interest in exploiting the project results individually. In this respect, the partners' exploitation plans are provided in the project proposal. Those plans are, to a great extent, complementary, reflecting the consortium appropriateness and complementarity in planning to exploit the project findings. The sustainability strategy of EnerMan will be supported by four exploitation axes to be implemented by the partners:

1. **Exploitation axis for research purposes:** EnerMan's research partners will continuously use the final outputs to generate new knowledge and publish results.
2. **Exploitation axis for commercial purposes:** This plan involves directly exploiting the results and the actionable tools to deliver added-value services such as tailor-made tools (e.g., decision-support systems), bespoke analysis/reports (e.g., simulations), certification services, or consultancy support.
3. **Exploitation axis for direct internal use:** The end-users involved in the consortium will continue to use the project results in their day-to-day business.
4. **Exploitation axis for dissemination/awareness purposes:** Finally, the associations involved in the consortium will use the results to support future dissemination, awareness, and advocacy work. The partners will pursue a variety of exploitation modalities together with the exploitation path, as outlined in the following table.

The detailed exploitation modality for each partner in the EnerMan program is described in detail in the program proposal. These individual exploitation plans will be refined and updated throughout the lifetime of the EnerMan projecomplete

INTRACT will conduct the full IPR Protection Plan of EnerMan as the innovation manager of the project. The IPR plan for the EnerMan project will be built step by step during the entire duration of the project by gathering all IP processes of partners regarding their results. However, global management has been set up to avoid as much as conflict and ensure the coherence of the dissemination and protection processes during the project. The IPR Protection Plan of EnerMan is described in full detail in the Deliverable D7.5.

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4.3. Key exploitable results

As discussed in the previous section, the core EnerMan value proposition aims to provide an elligent and autonomous energy management and cost optoptimizationamework capable of simulating factory operations using digital twin technology and predicting possible outcomes through AI predictive analytics. This value proposition, offered both as a complete, packaged offering and as individual, customizable components, represents the Key Exploitable Results (KER) of EnerMan. The KER of EnerMan is summarized in the following figure 2.

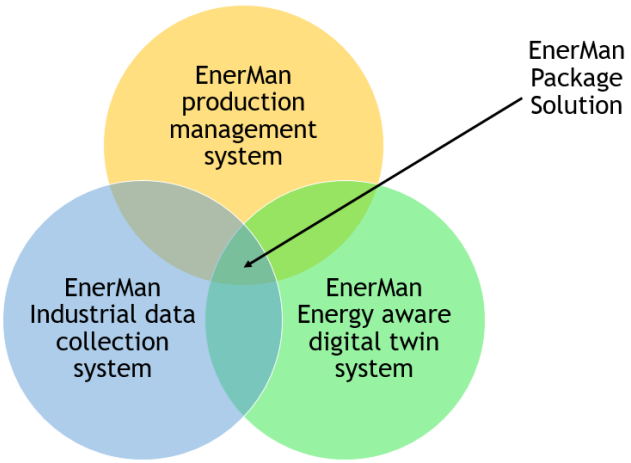

Figure 2: Key exploitable results of EnerMan project

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5. MARKET AND VALUE ANALYSİS OF ENERMAN KEY EXPLOİTABLE RESULTS

This section will introduce a preliminary market survey of the three KERs of EnerMan as individual and customizable components discussed in the previous section. This part will be continuously updated and refined throughout the project with the aim to provide a market survey for the EnerMan KERs as individual components and as a packaged system as well. The second Exploitation Report, EnerMan Business models and market analyses which is due on M24 of EnerMan project will feature the entire market and value network analysis of the EnerMan KERs.

5.1. EnerMan Industrial Data Collection System

This industrial data collection system consists of hardware and software components, includes the cyber physical systems CPS, the Industrial Internet of Things IIoT, and the Artificial Intelligence AI part. A brief market research of these components will be shown in the subsections below.

5.1.1. *Cyber Physical Systems (CPS)*

In regards to energy efficiency, CPS is utilized to monitor the energy consumption patterns of components' machining during the manufacturing lifecycle (Liang et al., 2018). Together with Big Data analytics, intelligent learning, and optimization algorithms, CPS is integrated for the systematic implementation of manufacturing intelligence (Liang et al., 2018). CPS can also be designed for intelligent manufacturing with extensive data collection, processing, and visualization (Liu & Jiang, 2016). Moreover, CPS can be utilized to reduce the impact of the computation on the cooling need by maintaining safe operating temperatures in data centers (Gupta et al., 2010).

Given the demonstrated benefits of CPS in energy efficiency and sustainability, CPS has also gained increasing recognition. CPS market is estimated to be worth USD 12,356.23 million by 2028 (Data Bridge, 2021). Its compound annual growth rate (CAGR) has also increased from an estimated 8.7% between 2018 and 2028 to 10.55% between 2021 and 2028 (Future Market Insights, 2018; Data Bridge, 2021).

More (2021) identified the leading companies of CPS based on their production, price, revenue, and market value as follows:

Table 2: Leading companies of CPS based on More (2021)

Company	Headquarter	Market Value	Market Share
Microsoft Corporation	Redmond, USA	EUR 300.25	8.72%
Hitachi Vantara	Santa Clara, USA	EUR 111	<0.01%
VMware Inc	Palo Alto, USA	EUR 109	8.7%
SAP SE	Walldorf, Germany	EUR 124.66	6%
Hewlett-Packard Enterprise	Spring, USA	EUR 27.3	22.6%
Honeywell International Inc	Morristown, USA	EUR 196.2	3.17%
Oracle	Austin, USA	EUR 84.29	1.32%
IBM Corporation	Armonk, USA	EUR 104.45	32.91%
Schneider Electric	Rueil-Malmaison, France	EUR 160.18	33.2%

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Dell EMC	Round Rock, USA	EUR 49.49	16.7%

5.1.2. *Industrial Internet of Things (IIoT)*

IIoT enables more transparency along the value chain, which allows for better environmental management and eventually leads to a more sustainable supply chain. IIOT also offers potentials for end-of-life processes and smart maintenance services. Moreover, energy can be saved by optimizing or replacing specific physical components with digital technologies. This can be done by applying new software that enables energy optimization functionality or improving business processes based on the additional data generated in digitized factories (Beier, Niehoff, & Xue, 2018). The market value of IIOT is shown in the figure below (Statista, 2021):

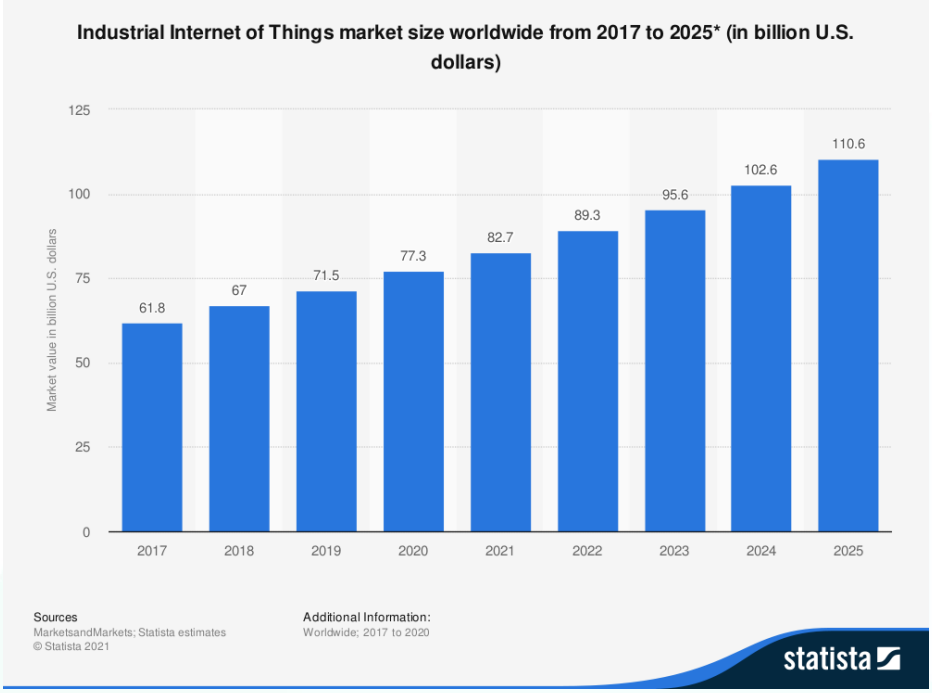

Figure 3: Worldwide IIoT market size in billion US dollars (Statista, 2021c)

According to More (2021), the leading IIOT companies are as follows:

Table 3: The leading IIoT companies (More 2021)

Company	Headquarter	Market Value	Market Share
ABB	Zürich, Switzerland	USD 35.69	19.2%
General Electric	Boston, USA	USD 100.67	3.44%
ARM Ltd.	Cambridge, UK	n/a	41%
Rockwell Automation, Inc.	Milwaukee, USA	EUR 301.7	33.99%
Cisco Systems, Inc.	San Jose, USA	EUR 47.15	49.9%
Texas Instruments, Inc.	Dallas, USA	EUR 170.92	2.9%

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Intel Corporation	Santa Clara, USA	EUR 44.03	89.8%
Honeywell International Inc.	Charlotte, USA	EUR 196.35	3.17%
Huawei Technology Co., Ltd	Shenzhen, PRC	n/a	20%
Dassault Systems	Velizy-Villacoublay, France	EUR 55.29	16.5%

5.1.3. *Artificial Intelligence (AI)*

AI can revolutionize the energy industry by performing various tasks, such as forecasting, operating efficient power systems, and enabling efficient inverter control of photovoltaic systems (Ahmad, et al. 2021; Wiechmann, 2021). Moreover, the AI could be a powerful tool to meet the global consensus of our future energy supply, which will help us to reduce consumer electricity costs, reduce greenhouse gas emissions, as well as help grid utilities maintain the power's system reliability (Ahmad, et al., 2021).

Calcea (2021) listed companies below as companies leading the way for AI investment among top power companies:

Table 4: AI investment in top power companies (Calcea, 2021)

Company	Headquarter	Market Value	Market Share
Siemens AG	Munich, Germany	EUR 155.26	9.16%
Vestas Wind Systems AS	Aarhus, Denmark	EUR 31.29	20.3%
Schneider Electric	Rueil-Malmaison, France	EUR 160.18	33.2%
Southern Co	Atlanta, USA	EUR 54.34	7.01%
Electricite de France	Paris, France	EUR 12.7	n/a
Centrica Plc	Windsor, UK	EUR 3.02	n/a
Intel Corporation	Santa Clara, USA	EUR 44.03	89.8%
EnBW Energie Baden-Württemberg	Karlsruhe, Germany	EUR 78.6	n/a
Umicore NV/SA	Brussels, Belgium	EUR 44.2	n/a
Duke Energy Corp	Charlotte, USA	EUR 88	n/a
Chubu Electric Power Co Inc	Nagoya, Japan	EUR 8.8	n/a

5.1.4. *Emerging Submarket of IDC*

The energy management systems market can be categorized by offerings, components, services, types, end-users, and market verticals (Yadav, 2018):

- Offering
    - System
    - Service

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- Component
    - Sensor
    - Controller
    - Software
- Service
    - Monitoring & Control
    - Implementation & Integration
    - Maintenance
    - Consulting & Training
- Type
    - Home Energy Management System
    - Building Energy Management System
    - Industrial Energy Management System
- End-User
    - Residential
    - Commercial
- Market Vertical
    - Power & Energy
    - Telecom & IT
    - Manufacturing
    - Enterprise
    - Healthcare

5.2. EnerMan Energy-aware Digital Twin System

For Digital Twin applications, market analysts foresee a significant market growth, specifically in production and logistics areas, which are a focus of the EnerMan project (Haße et al., 2019). According to market analyses, the post-COVID-19 period is expected to show even larger booms in digitalization, which explains the rapid growth forecasts in the segment (Research and Markets, 2021). By improving and extending the automation, capturing, and exchange of data, Digital Twins are the key to a digital transformation of various industries towards an Industry 4.0.

5.2.1. *Market Value of Digital Twin Systems*

Regarding the market value of digital twins, the projected growth rate is 41.7% annually, leading to a forecasted market value of $63.5 billion by 2027 (Research and Markets, 2021). The bar chart (figure 4) additionally indicates the four most critical use cases of Digital Twins, among which the application of Predictive Maintenance and Business Optimization plays a leading role. These numbers, however, do not yet include effects from applying Digital Twins to support the path to more energy-aware and sustainable economy. In this context, studies, e.g., from Accenture and Dassault Systèmes, see a vast potential of Digital Twins to accelerate sustainable production and logistics processes. This, will also foster the use of Digital Twins and lead to even more robust growth than expected. More specifically, their study results point out that Digital Twin concepts have the potential to deliver around one trillion USD of economic value and more than seven Gt CO_2 emissions reductions until 2030 (Bentley & Murdzhev, 2021).

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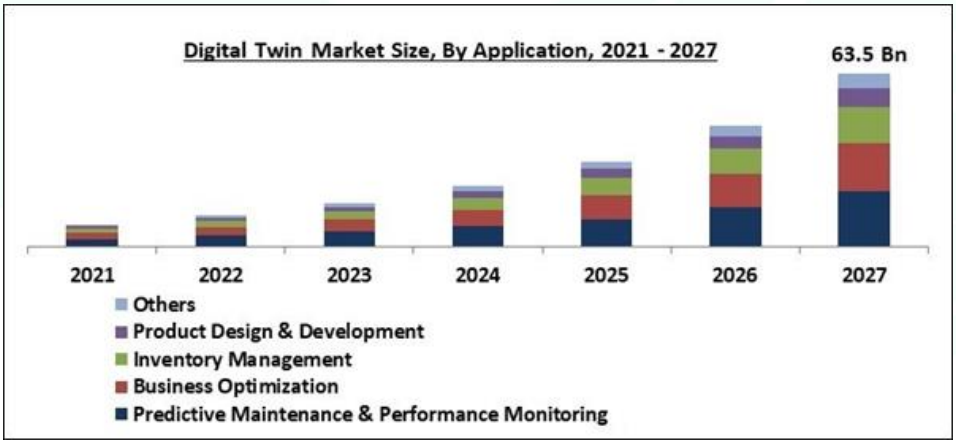

Figure 4: Estimated Market Size for Digital Twins (Research and Markets, 2021)

5.2.2. *Market Leaders, Market Shares, and Geographical Locations*

The top ten market leaders of Digital Twin systems by revenue are the following (Emergen Research, 2021b):

- Microsoft Corporation
- Bosch
- General Electric Company
- IBM Corporation
- Siemens
- Oracle Corporation
- Cisco Systems
- Dassault Systèmes
- Ansys
- PTC Inc.

The majority of those companies' product portfolios already offer Digital Twins that help improve the energy performance of e.g., processes or buildings and reduce the carbon footprint (Microsoft Corporation, 2021; Siemens AG, 2021).

In addition to the above-mentioned relevance of Digital Twins for areas such as logistics and manufacturing, industries like automotive, residential and commercial industry show similar application of such systems. With the objective to learn and recover from the losses of the pandemic, enterprises are likely to even improve their end-to-end operations by extended procurement activities of Digital Twin solutions (Research and Markets, 2021).

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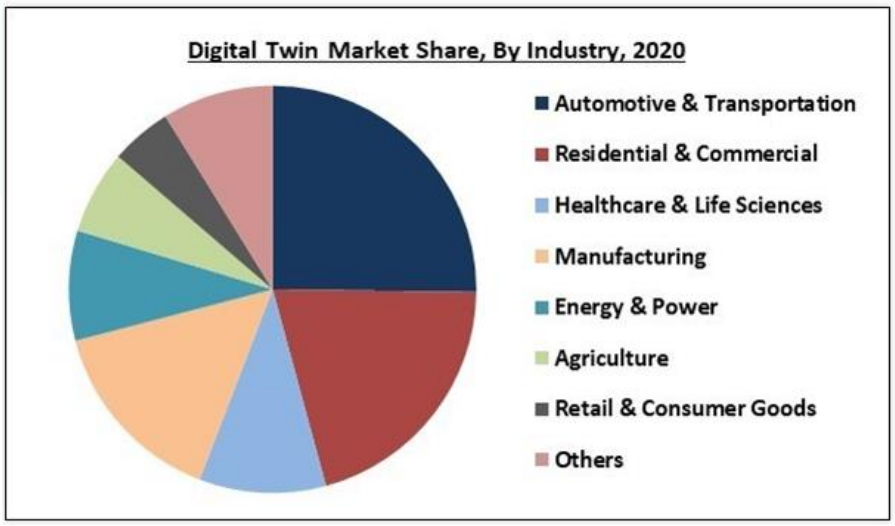

Figure 5: Digital Twin revenue-based Market Share by Industry 2020 (Research and Markets, 2021)

Regarding its geographical regions, the market for Digital Twins is most apparent in the following areas

- North America
- Europe
- the Asia Pacific
- Latin America

Market experts expect the highest growth rates for the Asia Pacific region due to recent developments and supporting infrastructures towards an Industry 4.0, in China and India predominantly (Research and Markets, 2021).

5.2.3. *Emerging submarkets of Digital Twin Systems*

The submarkets can be classified accordingly (Research and Markets, 2021; Emergen Research, 2021a):

By type

- System
- Process
- Product

By technology

- Internet of Things
- Artificial Intelligence and Machine Learning
- Blockchain
- Big Data Analytics
- Virtual Reality, Augmented Reality and Mixed Reality
- 5G

By application

- Predictive Maintenance & Performance Monitoring

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- Business Optimization
- Inventory Management
- Product Design & Development

By industry

- Automotive & Transportation
- Residential & Commercial
- Healthcare & Life Sciences
- Manufacturing
- Energy & Power
- Agriculture
- Retail & Consumer Goods

All mentioned submarkets have in common that a Digital Twin enriched by the ability to focus on energy efficiency could be applied to the field and improve its users' energy-awareness.

5.3. EnerMan production management system

Production management system assists users to master several aspects of production processing from a centralized to a decentralized environment. The energy management system allows users to collect information on energy consumption by monitoring, examining, and visualizing it (Yadav, 2018). Both systems are emerging technologies and gaining popularity because they increase productivity and maintain a competitive advantage in the market. Also, by closely monitoring, the overall cost could be reduced.

5.3.1. *Market value*

In figure 6, the market value of energy management systems is analyzed for 2019, 2020, and 2025 for residential, commercial, and industrial areas. Among three, the industrial sector shows significant value. For example, in 2020, the market value of industrial global energy management systems was estimated to be around 4.43 billion U.S. dollars, and in the next five years, it is expected to grow up to 12.37 billion U.S. dollars.

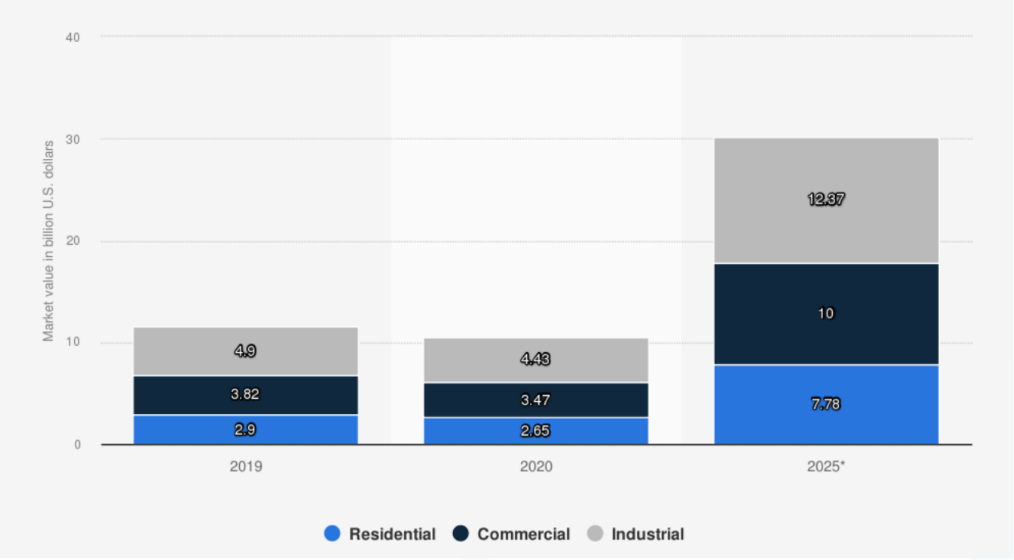

Figure 6. The global market value of energy management systems depending on its application (in billion USD) (Statista, 2021a)

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According to the 2019 and 2020 market value is approximated to be the same for all three domains, without a noticeable acceleration being observed. Until 2025, each dimension's market value is foreseen to increase significantly – the residential area by 194%, the commercial area by 188%, and the industrial area by 179%. From 2020 to 2025, the energy management systems' domain's market value will grow substantially more compared to the 2019-2020 period. This market value development is affected by the acceleration of energy consumption during the post-pandemic period (Statista, 2021a).

North America was the region with the largest market size in energy management systems, worth approximately 3.83 billion U.S. dollars in 2020. In comparison, the market value of China was estimated to be 0.55 billion U.S. dollars and the total global market value was assumed at 10.55 billion U.S. dollars (Statista, 2021b).

5.3.2. *Competitors their market shares, geographical locations*

Major players in the energy management systems markets are C3 Energy, Delta Electronics Inc., DEXMA, General Electric Company, GridPoint Inc., Honeywell International Inc., Johnson Controls International PLC, Schneider Electric S.E., Siemens AG, and Yokogawa Electric Corporation (Yadav, 2018). Each player's strategy to seize the market is varied in launching the products, acquisition, and collaboration.

Table 5. Key players in the energy management systems Corporation (Yadav, 2018)

Company	Headquarter
C3 AI Energy Management	Redwood City, California, United States
Delta Electronics Inc.	Taipei City, Taipei, Taiwan
DEXMA Energy Intelligence and Management	Barcelona, Spain
General Electric Company	Boston, Massachusetts, United States
GridPoint – The Future of Energy	Reston, Virginia, United States
Honeywell International Inc.	Charlotte, North Carolina, United States
Johnson Controls International PLC	Cork, Ireland
Schneider Electric S.E.	Rueil-Malmaison, France
Siemens AG	Munich, Germany
Yokogawa Electric Corporation	Musashino, Tokyo, Japan

5.3.3. *Emerging Submarkets*

The energy management systems market can be categorized by offerings, components, services, types, end-users, and market verticals (Yadav, 2018).

- Offering
    - System
    - Service
- Component
    - Sensor
    - Controller
    - Software
- Service

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    - Monitoring & Control
    - Implementation & Integration
    - Maintenance
    - Consulting & Training
- Type
    - Home Energy Management System
    - Building Energy Management System
    - Industrial Energy Management System
- End-User
    - Residential
    - Commercial
- Market Vertical
    - Power & Energy
    - Telecom & IT
    - Manufacturing
    - Enterprise
    - Healthcare

5.3.4. *Building Energy Management System*

Building an energy management system (BEMS) is a way to control and monitor the building's energy needs because managing the energy needs in buildings effectively and intelligently can have significant benefits. For instance, BEMS encompasses heating, ventilation, and air conditioning (HVAC), lighting or security measures (CTCN, 2021). Global top 10 market leaders in BEMS are listed below (Lubwa, 2021).

- Cisco
- Honeywell
- Johnson Controls
- Schneider Electric
- United Technologies
- Emerson Electric
- Siemens
- Bajaj Electricals
- Bosch
- Building Logix

5.3.5. *Industrial Energy Management System*

Industrial Energy Management Systems (IEMS) is a customizable and integrated energy management solution for the purpose of controlling, automation, monitoring, and reporting. It is mostly designed for the following reasons (Grid Solutions, 2021).

- Accurate monitoring of energy consumption
- Analysis of operational data
- Automated alerts and alarming
- System events meeting application
- Operational requirements

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6. CONCLUSİONS

This deliverable summarised the work which will be carried out as part of Task 7.4 that will begin in M13 of the EnerMan project. Task 7.4 focuses on the exploitation strategies, business modelling, and market uptake. The task will define and implement the specific steps necessary to ensure the long-term sustainability of EnerMan beyond the project frame, ensuring that the EnerMan model is a living system, constantly updated with new sets of data and adapted to the Industry 4.0 trends. In order for EnerMan to be able to realize these goals, a well-tailored exploitation plan is presented in this deliverable, and a well-structured market and value network analysis has been developed as well. The end product of the work in Task 7.4 will be the market survey, which industry-level business cases and involve all Consortium partners and more vendors, potential production partners, and service providers. This market survey will be prepared throughout the lifetime of the EnerMan project. Additionally, this report discussed the consortium-wise and individual exploitation plans. Finally, this deliverable featured the Exploitation plan timeline of the EnerMan project.

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7. OUTLOOK AND NEXT STEPS

The following steps are to put into practice the Exploitation Plan presented in this deliverable. The plan can be continuously refined and updated throughout the EnerMan project. With the kick-off of task 7.4 all the task participants will be convened to regular meetings to constantly update and refine the exploitation strategy and track the progress. Different surveys will be conducted within EnerMan project partners to refine and update, if necessary, the KER, the business model canvas, the SWOT, the market analysis and the value network analysis, and the competitors' analysis. The following steps involve also the organization of the Exploitation Workshops, which will be used for a cons on these topics. Additionally, the consortium needs to be informed about the progress of the exploitation strategy by means of newsletters and/or websites. It is also essential to be connected to partners and stakeholders outside the EnerMan consortium; this is why the participation in relevant events and European projects to share knowledge and potentially find additional exploitation routes. The funded project SC3 could be considered as one example.

The following steps also include the deliverables, which will report about the progress of the exploitation strategy. The deliverable D7.12 named the second Exploitation Report, EnerMan Business models and market analyses due in M24 of the project in addition to the EnerMan communication activities and stakeholders' engagement final report due in M36 of the project will encompass a very structured and transparent innovation and technology overview and mapping all the stakeholders engaged in the project. Partners such as INTRACT and STS will have leading roles in the task 7.4 since they will prepare two business-oriented exploitation plans on different industry levels.

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