EnerMan

Energy Efficient Manufacturing System Management

D7.9 - EnerMan Communication Activities and Stakeholders' Engagement 1st Report

Date : 30/06/2022

Deliverable No : 7.9

Responsible Partner : IFAG

Dissemination Level : Public

HORIZON 2020
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

EnerMan

Short Description
This deliverable gives an overview of all the EnerMan communication activities and stakeholders' engagement activities held in the EnerMan project. The document includes the result metricizes of stakeholder analysis that describes the most significant stakeholders within and around the EnerMan value chain and states their position to set up engagement strategies.

Project Information	
Project Acronym:	EnerMan
Project Title:	ENERgy-efficient manufacturing system MANagement
Project Coordinator:	Dr. Ing. Giuseppe D'Angelo CRF giuseppe.dangelo@crf.it
Duration:	36 months

Document Information & Version Management			
Document Title:		EnerMan Dissemination Plan & Activities 2nd Report	
Document Type:		Report	
Main Author(s):		Ayse Guventurk (INTRACT)	
Contributor(s):		Nilay Yalcinkaya Yoruk (INTRACT) Ender Yalcinkaya (INTRACT) Abdelgafar Ismail (IFAG) Ana Salgado (IFAG) Stina Dellas (IFAG)	
Reviewed by:		Stanislao Patalano, Andrea Rega (UNINA)	
Approved by:		Dr Ing. Giuseppe D'Angelo (CRF)	
Version	**Date**	**Modified by**	**Comments**
0.1	07/06/2022	Ayse Guventurk (INTRACT) Abdelgafar Ismail (IFAG)	Review-ready version
0.2	16/06/2022	Stanislao Patalano, Andrea Rega (UNINA)	General review
0.3	20/06/2022	Torsten Hildebrandt (SIMPLAN)	General review
0.4	29/06/2022	Kubra Yurduseven (INTRACT)	Format review
0.5	30/06/2022	Ing. Giuseppe D'Angelo (CRF)	Submitted version

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

Disclaimer
This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation, or both. The publication reflects the author's views. The European Commission is not liable for any use that may be made of the information contained therein.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

TABLE OF CONTENTS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

TABLE OF FIGURES

TABLE OF TABLES

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

1. EXECUTIVE SUMMARY

A stakeholder is individuals and organization who are actively involved in the activities of an industry, or whose interests may be positively or negatively affected as a result of EnerMan activities. The features and importance of participation in effective energy management should always be welcomed for the development of projects and ideas. An agile, methodical analysis approach should also be considered.

The EnerMan project aims to demonstrate how digital solutions and associated energy models can be integrated and deployed to overcome barriers in wide-scale adoption of energy management systems in industrial applications. One of the major novelties of the EnerMan project is its holistic, multiparametric energy state prediction that aims to simulate the behaviour of existing production line for a specific manufacturing process and machinery, taking into account up-to-date heterogenous measurements and predict energy consumption trends and spurs, along with its impact on the environment and its economic cost, including in the process the energy production market trends (demand-response, balancing, next day predictions etc) and a self-production mode of a factory (virtual generation).

To raise stakeholders' awareness on the project objectives a full plan for the dissemination activities was prepared and this document reports the steps to follow regarding stakeholder engagement with the project. To enhance the EnerMan visibility through the stakeholders from different domain, more than 250 professionals were contacted to invite them into stakeholder community. The stakeholder community was determined after 46 registrations of total invitees. Once the stakeholder registered to the community, an e-mail was sent to all stakeholders to participate in the stakeholder survey which was prepared jointly in ENGINE with other sister projects. This survey was prepared online EU Survey website. The questions were prepared in the basis of multiple-choice answers.

To gain insight in stakeholders' perspective, a targeted study has been conducted on the EnerMan value chain/production lines. The stakeholder analysis enables EnerMan to develop its platform in line with opinions, needs and expertise of stakeholders in the value chains.

The stakeholder analysis shows that:

- Stakeholders are familiar with energy production patterns and trends as well as the energy market trends. However, levels of expertise differ between stakeholder roles.
- Stakeholders have positive attitudes towards the transition to energy efficiency/sustainability measures.
- Stakeholders indicate knowledge providers as the organisation they most often collaborate with.

Overall, different stakeholders require different approaches. Therefore, it is important to find the right way in which these stakeholders are engaged. With its communication, dissemination, and exploitation, EnerMan must aim to increase enthusiasm as well as create the feeling of empowerment amongst stakeholders.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

2. INTRODUCTION AND OBJECTIVES

The Initial point of this report is Task 7.1 - Dissemination and Communication. This precipitated into the deliverable 7.9 (D7.9) on which this work is based on. EnerMan Project aims to introduce energy sustainable production process by determining energy consumption factors as a key performance indicator in the production management loop in the factories. A stakeholder analysis and KER (Key Exploitable Result) analysis have been investigated in this report. Three pilot categories and eight use cases, focusing on different energy-intensive industrial manufacturing sectors such as food, metalworking, and automotive manufacturing, evaluate a task in a demonstration target.

These missions require Requirements, Use Cases, Architecture and Specifications (Work Package 1), Data Collection and Control Plane Design (Work Package 2), Management System (Work Package 3), System analysis and prediction (Work Package 4), Integration and Cross-layer Optimization supporting Energy consumption optimization (Work Package 5), Validation in Real Conditions Industrial Settings (Work Package 6), Communication, Impact, Dissemination and Standardization (Work Package 7), Project Management and Coordination (Work Package 8).

The overall objective of this WP7 is to describe and implement the Communication, Impact, Dissemination and Standardization of the project. To promote the strategic communication and dissemination of the project data/knowledge/progress potential stakeholders should be determined. The exchange of information from different areas of energy management system, such as DSO (Distribution system operators), academicians, end users etc., is vital to create a stakeholder community.

This deliverable focuses on latest updates about the EnerMan stakeholder community analysis. Because of the wide impact area of the topic "energy", stakeholder analysis needs examining all the dimensions. Therefore, this first stakeholder engagement report is a follow-up of the preliminary stakeholder analysis. In this report we enhanced the report by including an analysis for the stakeholders which had been determined in previous report.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

GLASSORY OF ACRONYMS

Abbreviation	Full Name
CAD	Computer aided design
CAM	Computer aided manufacturing
COVID	Coronavirus disease
CRM	Customer relationship management
DSO	Distribution system operator
ERP	Enterprise resource planning
ICT	Information and communication technology
IIoT	Industrial internet of things
IoT	Internet of things
IPR	Intellectual property rights
IT	Information technology
KER	Key exploitable result
LCA	Life-cycle assessment
MES	Manufacturing execution system
SCADA	Supervisory control and data acquisition
SIG	Stakeholder Innovation Group

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

3. STAKEHOLDER MAPPING

In order to identify stakeholders, it is necessary to consider all people, or groups, that are affected by, who can influence, or may have an interest in the research (Durham E., 2014). EnerMan stakeholders have been determined in the "EnerMan Dissemination Plan & Activities", 2nd report, under an umbrella of three different domains as seen in Figure 1. According to the determined domains the stakeholders were categorised carefully to engage them with the project and energy management system role players. Stakeholders are not just members of communities or non-governmental organisations. They are those individuals, groups of individuals or organisations that affect and/or could be affected by an organisation's activities, products, or services and/or associated performance with regard to the issues to be addressed by the engagement. The stakeholder community of EnerMan will take the role of promoting the project to achieve agreed outcomes by engaging the relevant stakeholders.

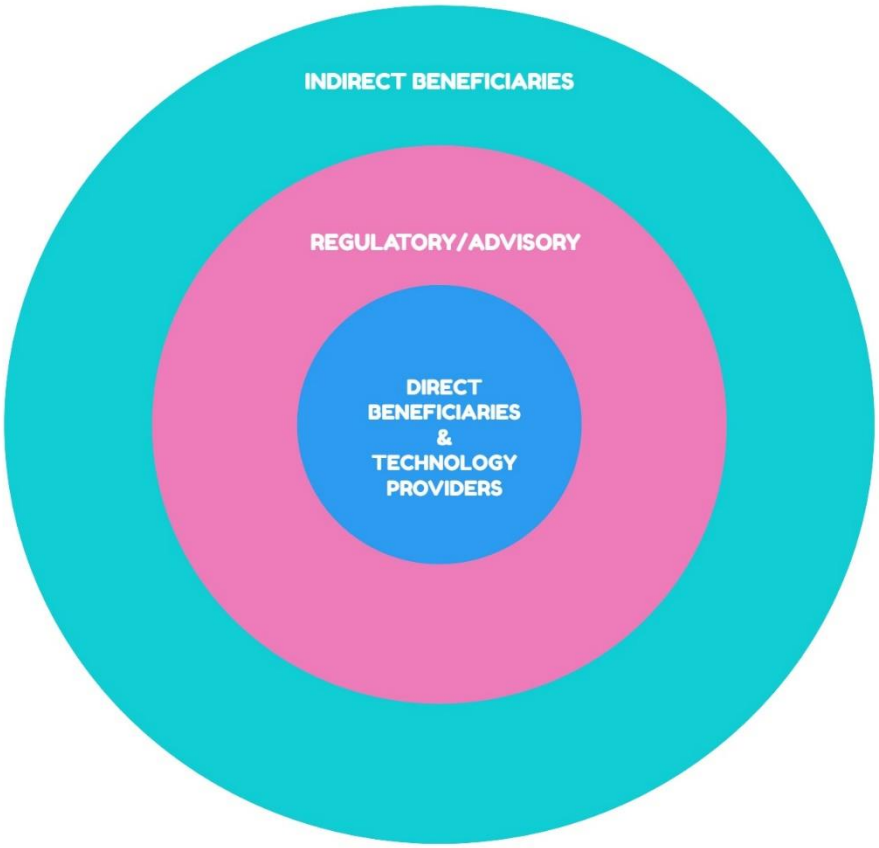

Figure 1 EnerMan stakeholder domain

The stakeholder mapping identified eleven subcategories of stakeholders based on their role in border control, as seen in Figure 2, according to the stakeholders' relevant interference in energy sector.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

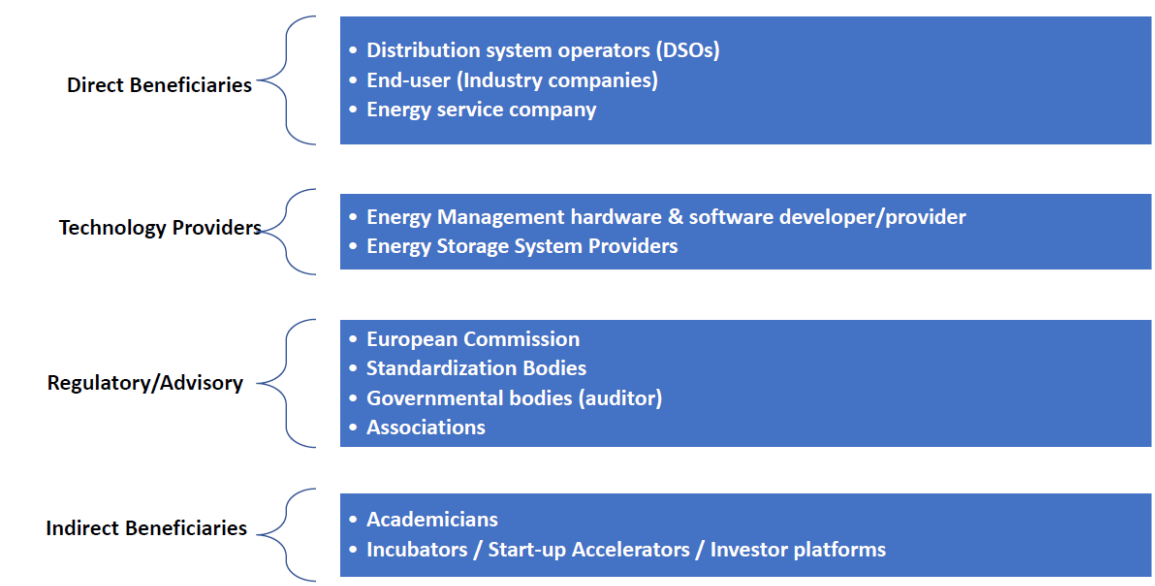

Figure 2 EnerMan stakeholder categorisation

Two maps are used to describe stakeholders that are impacted by the EnerMan solutions. These maps are based on previous work done by Mitchell et al (1997), and the theory behind them is described in the EnerMan H2020 project deliverable D7.8. These maps include the following:

- Power – Legitimacy – Urgency Map (a graphical cluster demonstration)
- Power – Interest Attitude Map (a graphical cluster demonstration)

The details of the above-mentioned maps were provided in the "EnerMan Dissemination Plan & Activities", 2nd Report. Figure 3 and Figure 4 show the categorisation of EnerMan Stakeholders. As a next step, a refined Stakeholder Innovation Group (SIG) was determined fromDSOs, Municipalities, Regulators, and Associations. SIG is a limited group of stakeholders, external to the project, who will be vital to maximizing impact beyond the project.

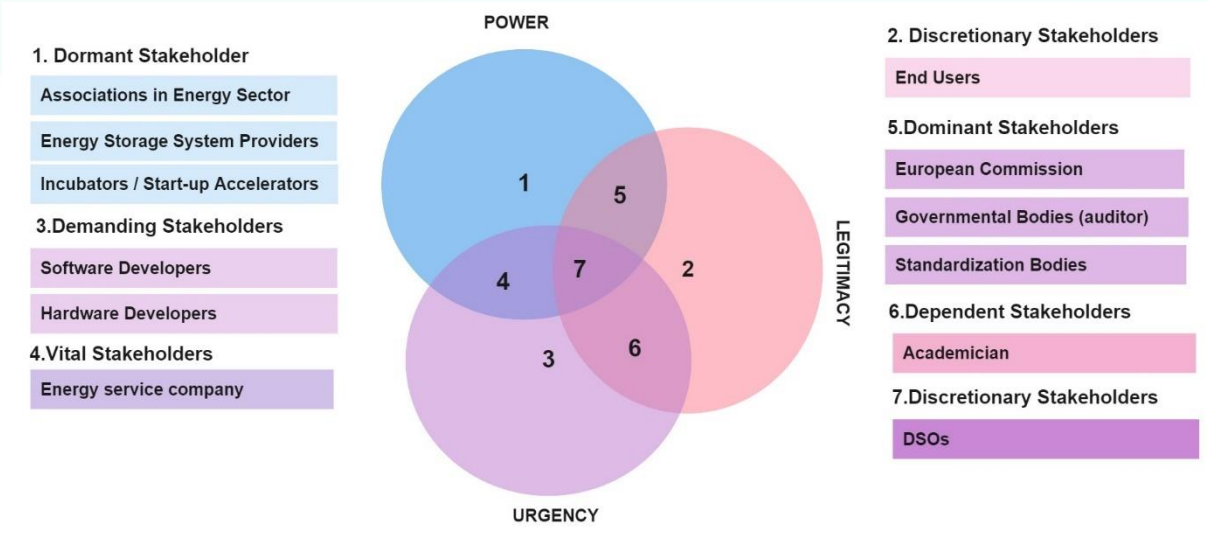

Figure 3 Power-Legitimacy-Urgency mapping of EnerMan stakeholders.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

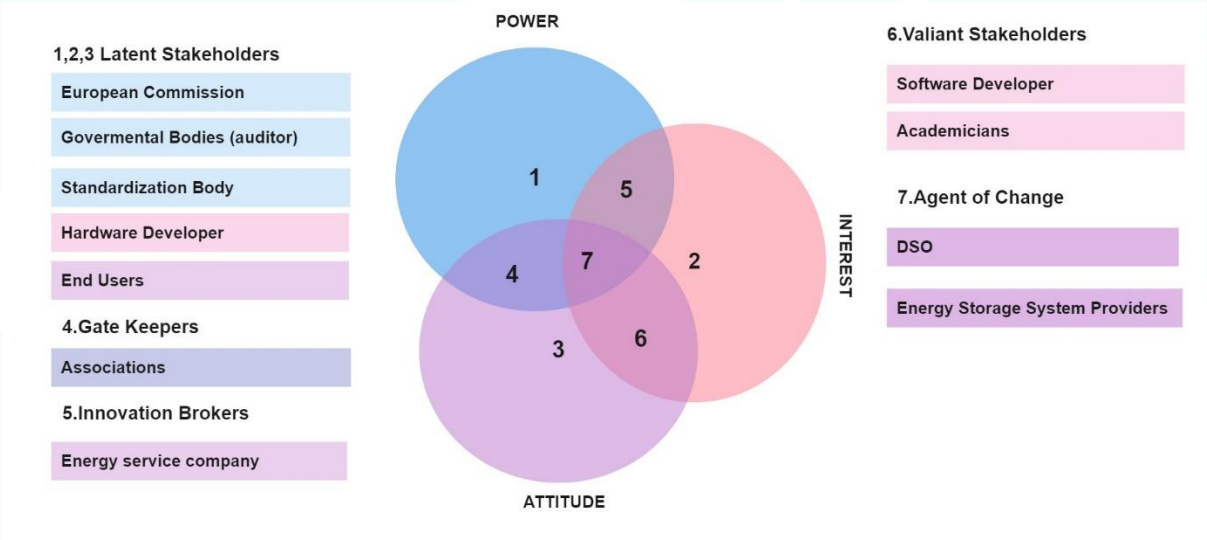

Figure 4 Power-Interest-Attitude mapping of EnerMan stakeholders

Table 1 shows the stakeholders' position in the Power (P) – Legitimacy (L) – Urgency (U) map.

Table 1 Stakeholders' importance according to P-L-U map

Stakeholder Type	**Attributes**	**Mission**	**Benefit/Role**
Dormant Stakeholders	P	Not highly active	Exploitation / market pickup of the innovations
Definitive Stakeholders	P-L-U	High priority	Gain them with exploitation effort
Vital Stakeholders	P-U	Vital	Exploitation activities
Dependent Stakeholders	L-U	Dependent on advocacy of other stakeholders	building alliances with dormant stakeholders /adapting regulations to support the innovation
Demanding Stakeholders	U	Not highly active	solution oriented that can be provided by innovation
Discretionary Stakeholders	L	Not highly active	deal with resistance that innovations often face from incumbents

Table 2 shows the stakeholders' position in the Power(P) – Interest (I) – Attitude (A) Map.

Table 2 Stakeholders' importance according to P-I-A map

Stakeholder Type	**Attributes**	**Mission**	**Benefit/Role**
Latent Stakeholders	P	Not highly active	Alliances holds interest or attitude aspect
Innovation Brokers	P-I	Active	Innovation impact on business
Gate keepers	P-A	Vital	Either block or allow the innovation to enter the market
Valiant stakeholders	A-I	Vital	Explore new market opportunities
Agents of change	P-I-A	High priority	Prime targets for exploitation activities of the innovation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

3.1. Stakeholders Engagement

3.1.1. *Stakeholder engagement strategy*

Firstly, it is vital to indicate why stakeholder engagement is necessary in a project since they may be counted as the veins of project with a constant data flow. Hereby, the reasons for stakeholder engagement are listed to be more precise (Durham E., 2014):

- Raise awareness of the research project.
- Gain trust and improve working relationships, form new partnerships, create new networks, galvanize external support, and provide a clearer understanding of the benefits of the research.
- Encourage a sense of 'ownership' of the project by those likely to benefit, be affected by, or be interested in, research outcomes.
- Provide people with an opportunity for personal development through engagement activities.
- Explore issues, share ideas, and best practices, generate ideas, identify, and raise better awareness of emerging issues.
- Co-design projects with stakeholders that may assist with producing a clearer definition of desired outcomes. Taking a broad spectrum of ideas and thoughts on board enables the adoption of a more holistic approach to address potential problems, limitations, or conflicts.
- Aid the development of a transparent decision-making process and ensure policy decisions can be based upon stakeholder views and enable decision-makers to consider societal 'wants' and 'needs'. This can help reduce conflict and overcome barriers between science, policy makers and society.
- Involve stakeholders to make it easier to obtain endorsement of, or agreement on, resulting decisions from parties likely to either use or be affected by the results of the research.
- Gain access to resources or to obtain information data.
- Create new (or improved) communication channels, identify effective dissemination avenues and improve clarification of 'common' language.
- Provide equal rights and open access to scientific knowledge ('democratizing science').
- Enable researchers to identify cross-cutting issues and ascertain where research may be applied to other areas. It also improves the relevance, value and depth of the research and broadens the knowledge base, identifies knowledge gaps, addresses information needs and creates opportunities to link research more directly to policy and practice.
- Leads to improved risk management.

EnerMan has identified the stakeholder groups in order to determine the roles of each group by the means of engagement and relation to the project. In this first stage it is important to inclusively identify all stakeholders and consider not only what they may be able to contribute to the project but also what will motivate them to become involved. In other words, it is important to lean across what they might gain from engaging. Pre-existing networks has a huge importance initiating the first communication to engagement with the project. Hereby, by pre-existing contacts from different industries and by social media channels of the project, an announcement was published to invite them to EnerMan Stakeholder Community.

Low Engagement Level: With little interest or influence on research results, stakeholders need to be informed that there is less needed to consider or interact with them in more detail. .

Medium Engagement Level: Those in the **consult** mode have high interest but low influence and although by definition they are supportive of the research, they lack the capacity to significantly help

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

the project and deliver impact; however, they may become influential by forming alliances with other more influential stakeholders. Those in the **involve** mode are highly influential but have little interest in the research or low capacity/ resources to engage.

High Engagement Level: Stakeholders in the **collaborate** mode (high interest – high influence) are those with which it is likely to be most beneficial to engage. They may be able to supply relevant information, permissions, and resources, or may be markedly impacted by the eventual outcomes.

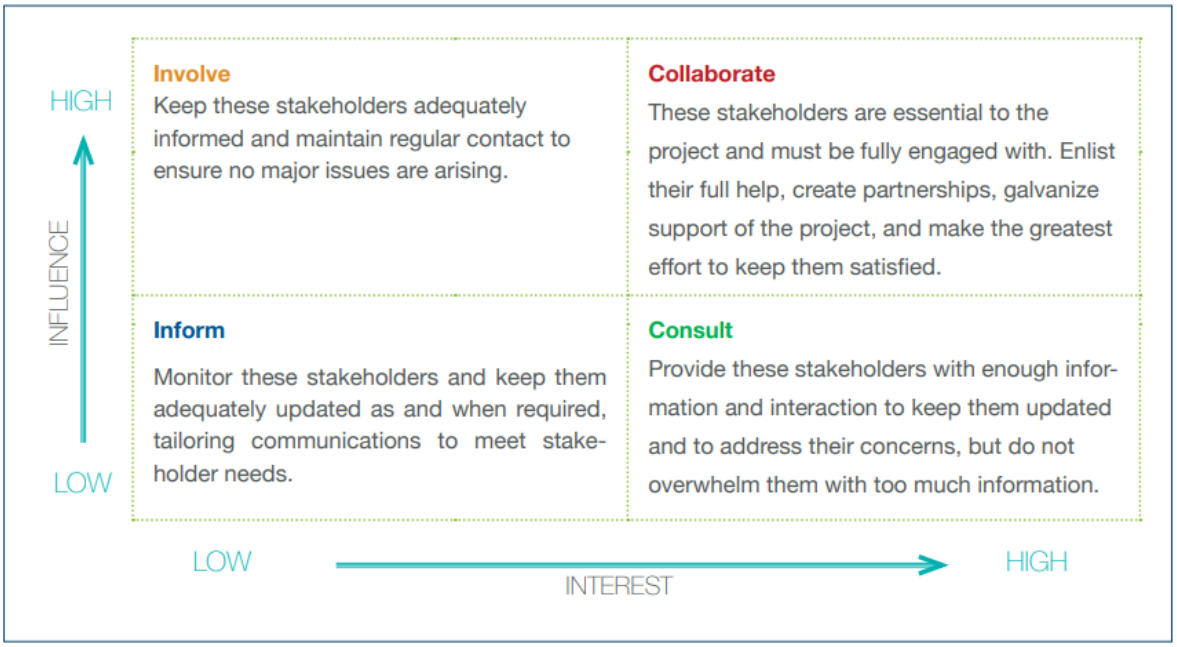

Figure 5 shows the influence and interest levels from low to high impact. Plotting stakeholder influence against interest. Stakeholders are assigned to a category according to their likely contribution and interest in the project. The boxes provide details of the levels of engagement (Durham E., 2014).

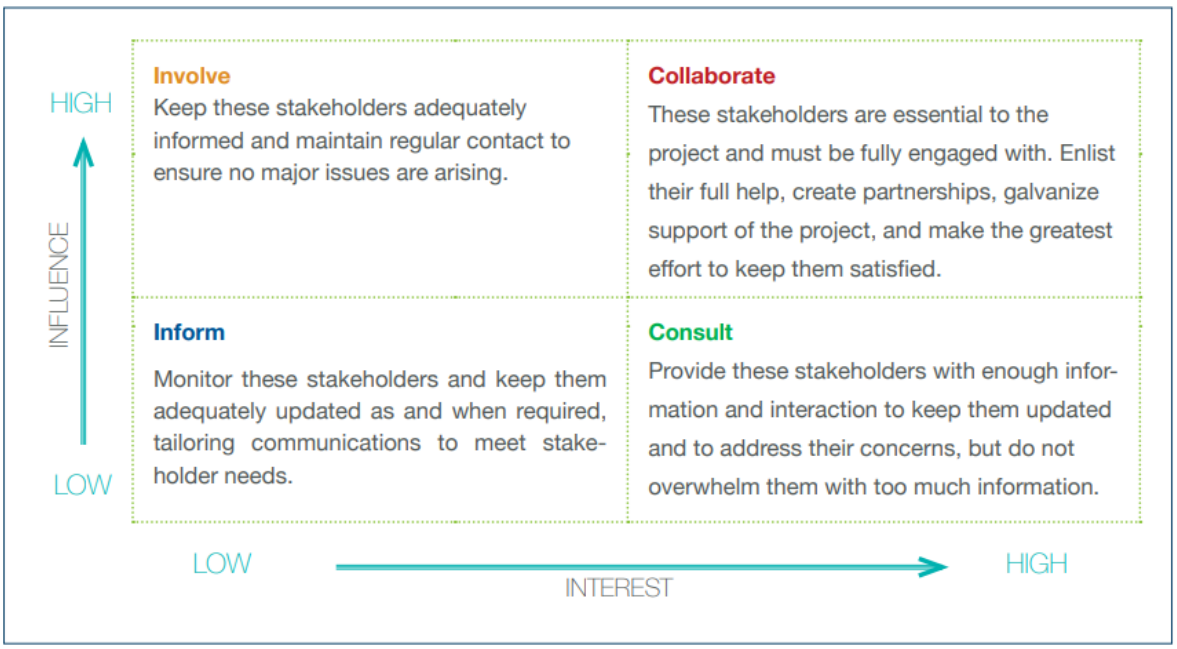

Figure 5 Influence and Interest Levels of Stakeholders (Durham E., 2014)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

Table 3 below shows the stakeholder types according to their engagement level (low, medium, high). The type of participation of the stakeholder is determined according to their low-medium-high level engagement. Those in medium and high level are active stakeholders of the project either by involving or collaborating in the project. Low & Low-Medium stakeholder are the active passive stakeholders of the project either by being informed or consulted. In some cases, EnerMan consortium also will be get informed and consulted by those stakeholders, since this is the nature of the engagement (Durham E., 2014).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

Table 3 EnerMan Stakeholder Information

Stakeholder Type	Type of participation	Level of Engagement (High, Medium, Low*)	Reasons to Involve	Approx. effort/Year	Indicative timing
Distribution system operators (DSOs)	Passive + anonymous survey	Low: Inform	Strengthen science policy interface and ensure relevance of research outputs	2 hours	Q2 2022 Q4 2023
End-user (Industry companies)	Active	Medium-High: Involve & Collaborate	Sharing technical expertise and potential contribution of resources to project.	5 hours	Q2 2022 Q4 2023
Energy Service Company	Passive + anonymous survey	Low-Medium: Inform &Consult	Strengthen science policy interface and ensure relevance of research outputs	2 hours	Q2 2022 Q4 2023
Energy Management hardware & software developer/provider	Active	Medium - High: Involve Collaborate	Better access to available data, potential contribution of resources and expertise to project.	5 hours	Q2 2022 Q4 2023
Energy Storage System Provider	Active	Medium - High: Involve Collaborate	Better access to available data, potential contribution of resources and expertise to project.	5 hours	Q2 2022 Q4 2023
European Commission	Passive	Low-Medium: Inform &Consult	Strengthen science policy interface and ensure relevance of research outputs	2 hours	Q2 2022 Q4 2023
Standardization Bodies	Active	Low-Medium: Inform &Consult	Strengthen science policy interface and ensure relevance of research outputs	5 hours	Q4 2021 Q4 2023
Governmental Bodies (auditor)	Passive + anonymous survey	Low-Medium: Inform &Consult	Strengthen science policy interface and ensure relevance of research outputs.	2 hours	Q2 2022 Q4 2023
Associations	Passive + anonymous survey	Low: Inform	Better access to available data, potential contribution of resources and expertise to project.	2 hours	Q2 2022 Q4 2023
Academicians	Active	Low-Medium: Inform &Consult	Better access to available data, potential contribution of resources and expertise to project.	5 hours	Q2 2022 Q4 2023
Incubator/ Start-up Accelerators/ Investor Platforms	Active	Low-Medium: Inform &Consult	Strengthen science policy interface and ensure relevance of research outputs	2 hours	Q2 2022 Q4 2023

*Low: Inform, Medium: Consult & Involve, High: Collaborate

3.1.2. *Stakeholder advisory board*

After engagement strategy is defended, it is planned to generate a Stakeholder Advisory Board. Where it is considered appropriate to give stakeholders power to influence the course of the research project; embed them where suitable in the project team (e.g., via stakeholder advisory panels). Stakeholders were canalized to the webpage of EnerMan to be registered into the community.

Stakeholder Community Registration Link: https://enerman-h2020.eu/stakeholder-community/

3.1.3. *Survey*

The Joint Questionnaire of ENGINE Initiative is a venture aiming at strengthening connections among digital initiatives at the European level, working on strategic topics addressing the constitution, population or regulation of the European Digital Single Market.

The questionnaire is focusing on "Digital Readiness. The stakeholder community of EnerMan was subjected to an assessment with this questionnaire to evaluate the status of each stakeholder depending on the type of stakeholder.

This survey aims at supporting the analysis within the EnerMan EU project of the end staleholders' requirements in order to identify the EnerMan Platform features and characteristics, and to understand its potential extrapolation to different stakeholders. The goal is to collect specific information about the most interesting industries in order to identify a list of sectors, processes and stakeholders with potential for energy efficiency, sustainable process/product design and manufacturing management optimization, as well as a list of challenges, requirements and potential solutions that can overcome those barriers. The results of this survey will contribute to mapping the possible manufacturing sectors for EnerMan application in order to understand the exploitation and replication possibilities.

This Survey was developed with EU Survey, the European Commission's official survey management tool. The results of the survey are listed below. In total 46 stakeholders were registered to the EnerMan Stakeholder community and all of the questionnaire was sent to all of them to be participated. Figure 6 shows the distribution of the countries and type of stakeholders registered. Out of 46 stakeholders, 11 stakeholders answered the questionnaire.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

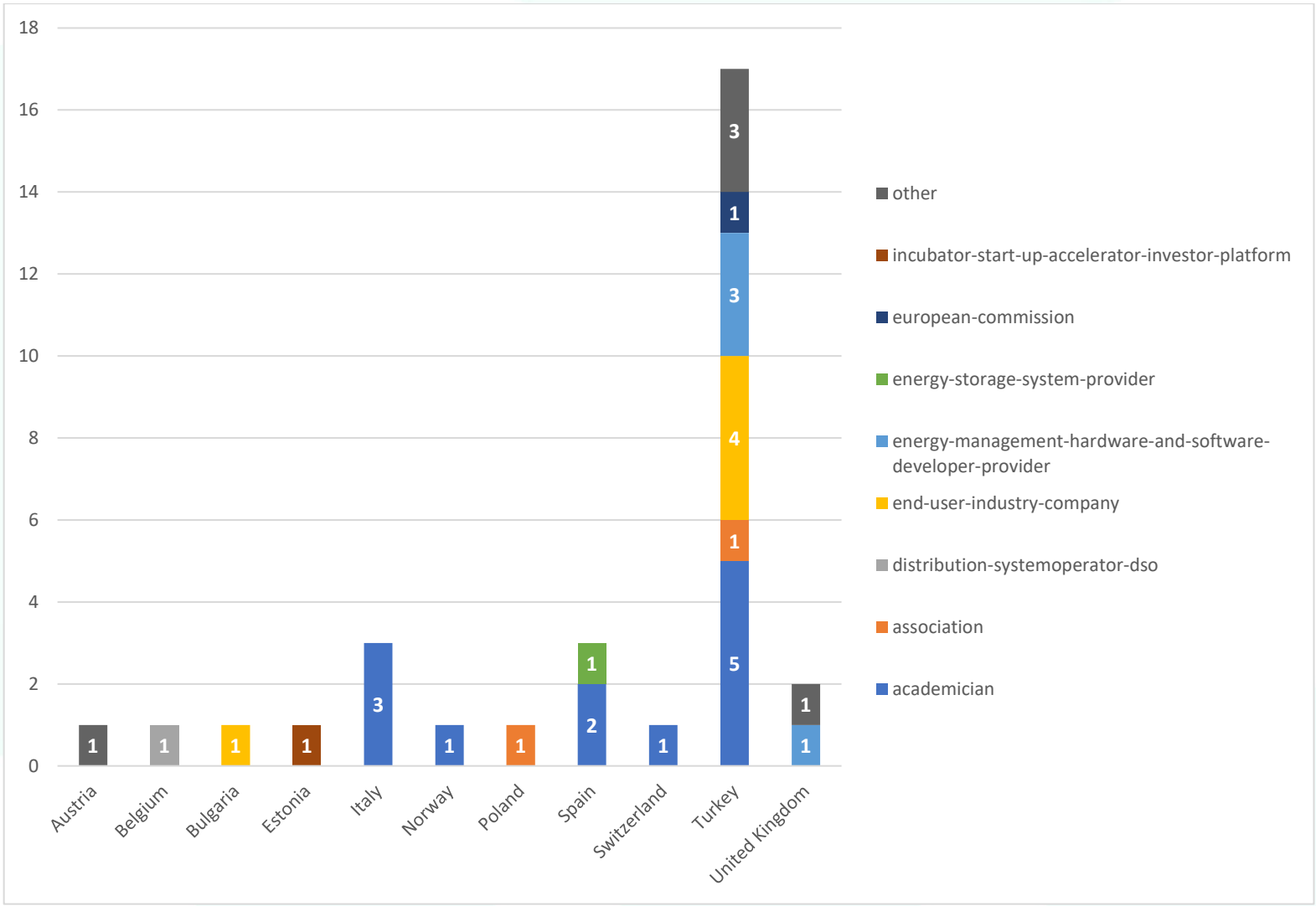

Figure 6 EnerMan stakeholders profile

4. STAKEHOLDER ANALYSIS

The respondents were first asked to identify to which type of organization they belong to. Approximately 45% of them from end users, 36% academicians, 10% standardization bodies and 10% associations. Figure 7 shows the number of respondents from stakeholders.

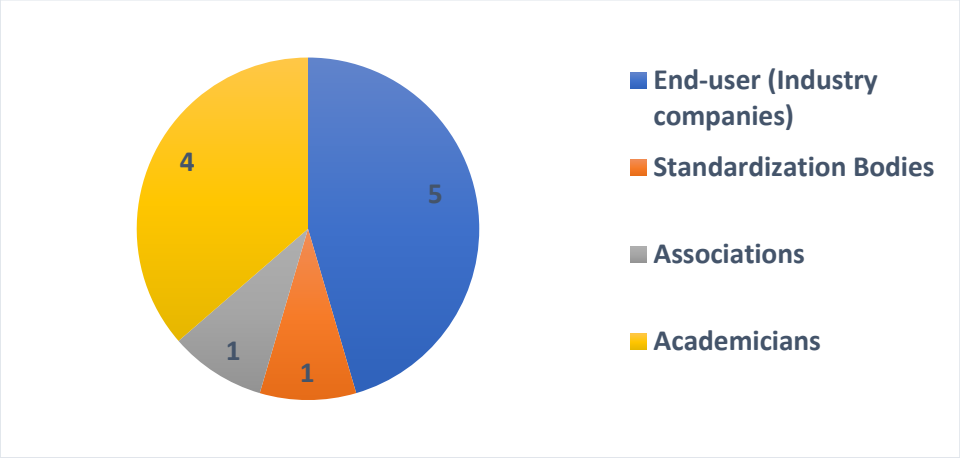

Figure 7 Survey respondents' distribution

The country distribution of the survey participants is shown in Figure 8. According to the data, 45% of the respondents are from Turkey, followed by Austria with 18%, and Greece, Norway, Poland, Spain with the same percentage (10%).

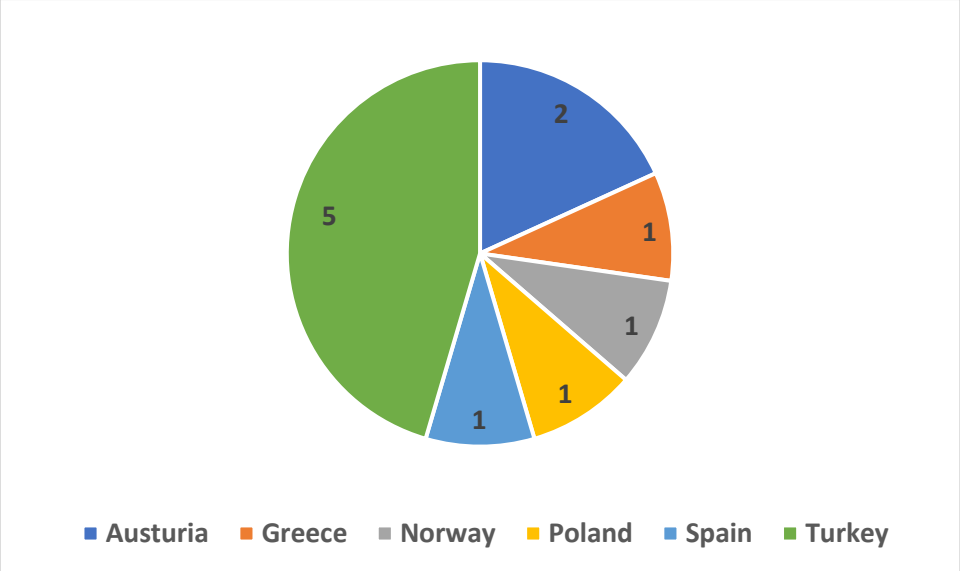

Figure 8 Country distributions of survey participants

Figure 9 shows that approximately 73% of respondents comes from large company, whereas the 27% from small and medium-sized enterprises (SMEs).

(3) Which is the size of your organization?

		Answers	Ratio
Small/Medium Enterprise		3	27.27 %
Large Company		8	72.73 %

Figure 9 Organization type of the respondents

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

According to the role of participants in their organizations, the 55% were researchers, 27% were from top management; energy management, data analytics and others were 10%.

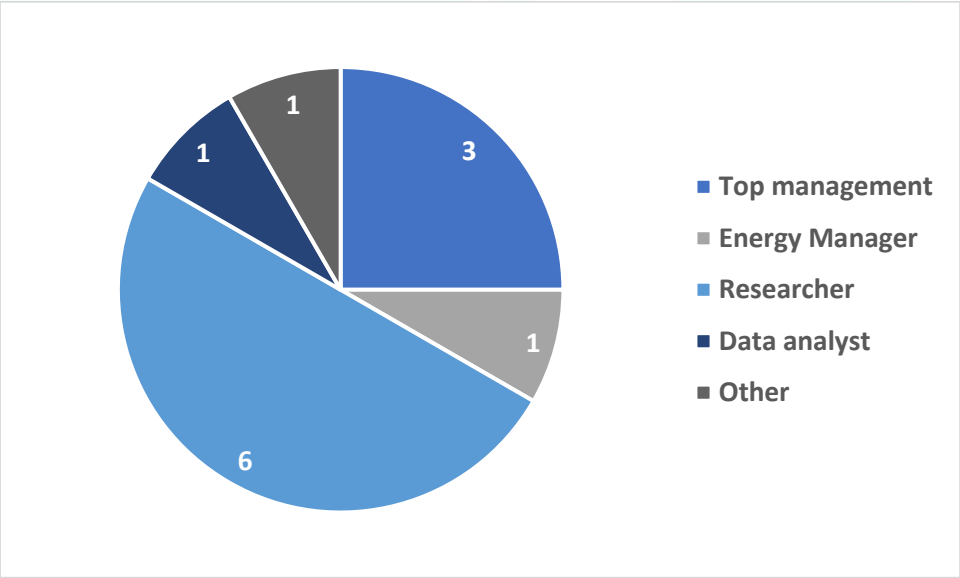

Figure 10 Role of the respondents in their organization

Respondents were asked if their organisation has a clear strategy for digitalisation. Approximately 62% adopted digitalization strategy. On the other hand, to implement and execute the digital strategy the expected timeframe is from 2 to 5 years for 55%, and less than 2 years for 36%. 9% of them think that it will require more than 5 years.

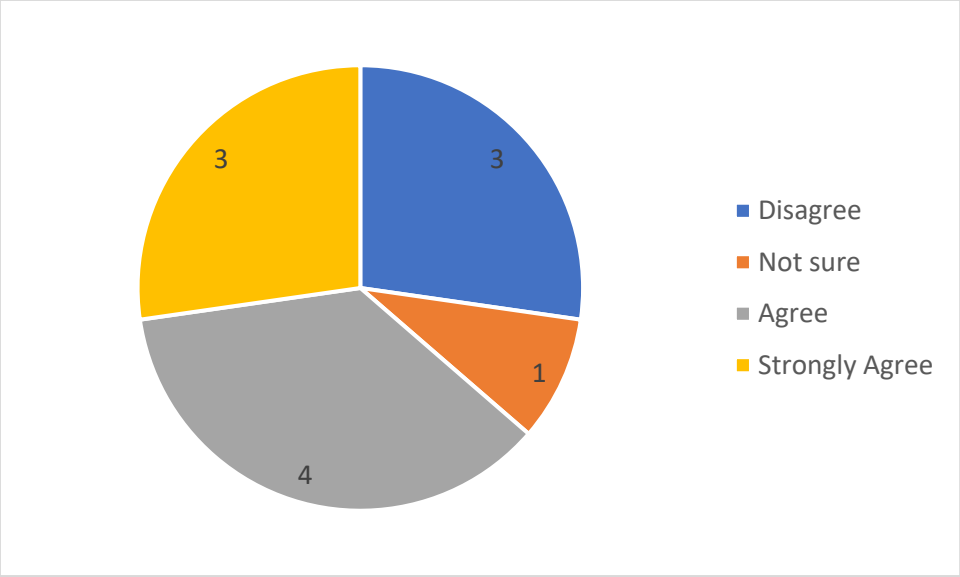

Figure 11 Existence of organizations' clear strategy for digitalization

The biggest driving factors to motivate uptake of digital solutions are shown in Figure 12. "Increase operational efficiency" is the most voted factor by 82% and followed by "Increase automation" and "Be more sustainable and greener" by 64%. Furthermore, 18% of the respondents think that COVID 19 is being a driving force to uptake a digital solution since pandemic directed the technology to digital platforms rather than face to face applications, this an expected factor.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

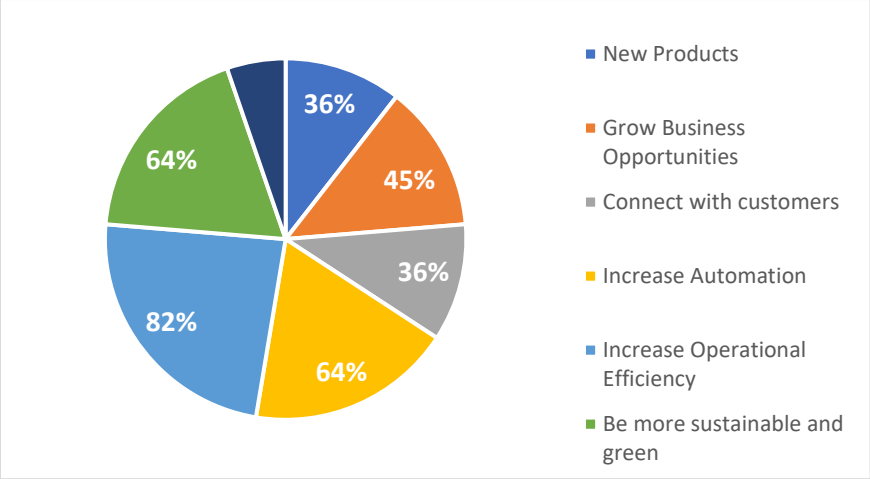

Figure 12 Factors motivating the digital solution uptake

Stakeholders answered the following question: "What are the business areas where digital technologies can provide added value?"; 91% answered "Production management", 73% think that "Energy management" and "Product development" are the aforementioned areas. 45% thinks that "Facilities management" and "Sales management" is also in consideration. 81% of respondents are actively seeking new opportunities that can support their digital development.

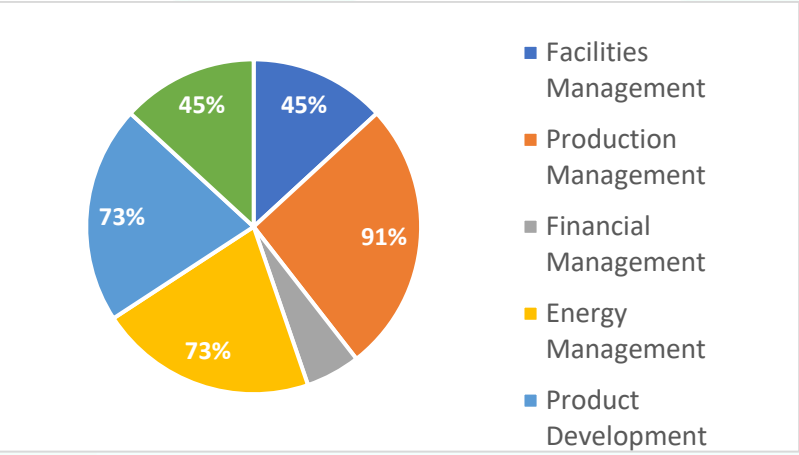

Figure 13 the business areas where digital technologies can provide added value

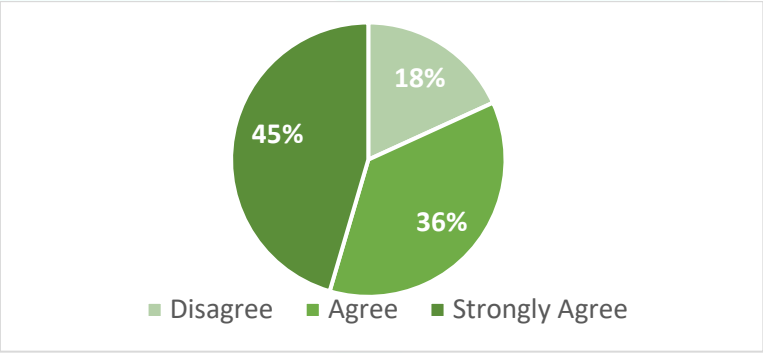

Figure 14 Actively seek new technologies that can support their digital development

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

Figure 15 shows the organizations' route to be prepared for (more) digitalization. Majority focuses on identification and alignment of digitalization needs with business objectives (67%).

(9) Which of the following best describes ways is your organisation prepared for (more) digitalisation?

		Answers	Ratio
Digitalisation needs are identified and are aligned with business objectives		8	66.67 %
Business departments and their staff are ready to support digitalisation plans		6	50.00 %
IT infrastructures are ready to support digitalisation plans		5	41.67 %
Enterprise's management is ready to lead the necessary organisational changes		5	41.67 %
Business architecture and operational processes can be adapted if required by digitalisation		3	25.00 %
Financial resources (own, loans, subsidies) are identified to secure digitalisation		2	16.67 %
ICT specialists are employed/sub-contracted (or hiring/subcontracting needs have been identified)		2	16.67 %
Clients' and partners' satisfaction with online services/interactions is monitored regularly		2	16.67 %
Risks of digitalisation (e.g. non-planned effects over other business areas) are considered		2	16.67 %
None of the above		1	8.33 %

Figure 15 Ways of your organisation prepared for (more) digitalisation

The 45% of respondents require to involve external third parties in process improvement projects. On the other hand, 36% of enterprises use remote business collaboration tools and IMS (Figure 16), followed by connectivity infrastructure & internal web portal (27%). When it comes to organizations, (Figure 17) majority is computer aided design (64%), IoT-IIoT (45%), digital twin – simulations – blockchain technology (36%).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

Information Management Systems (ERP, Product Lifecycle Management, CRM, Supply Chain Management, e-invoicing)	5	41.67 %
Remote business collaboration tools (e.g. teleworking, videoconferencing, virtual learning)	4	33.33 %
Internal web portal (Intranet)	4	33.33 %
Connectivity infrastructure (high speed internet, cloud computing services, remote access to office systems)	3	25.00 %
other options - relating to manufacturing processes	1	8.33 %

Figure 16 Technologies already used in enterprise

(12) Which of the following advanced digital technologies are already used by your organisation?

	Answers	Ratio
Computer-aided design (CAD) & manufacturing (CAM)	8	66.67 %
Internet of Things (IoT) and Industrial Internet of Things (I-IoT)	6	50.00 %
Simulation & digital twins (i.e. real-time digital representations of physical objects/processes)	4	33.33 %
Manufacturing execution systems	4	33.33 %
Blockchain technology	4	33.33 %
Additive manufacturing (e.g. 3D printers)	2	16.67 %
None of the above	2	16.67 %
Virtual reality, augmented reality	1	8.33 %

Figure 17 Technologies already used in enterprise

Figure 18 shows data management methods adopted by enterprises, and Figure 19 shows data management methods used by organization. In enterprises, relevant data are stored digitally, properly integrated and accessible in real time. In organizational level, the contribution of the digital technology used to environmental sustainability is investigated. Sustainable services provision, sustainable products are the top priority.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

(13) How is your enterprise data managed (i.e. stored, organised, accessed and exploited)?

		Answers	Ratio
Relevant data is stored digitally (e.g., office applications, email folders, stand-alone applications, CRM or ERP system, etc.)		5	41.67 %
Data is properly integrated (e.g. interoperable systems, application programming interfaces)		4	33.33 %
Data is accessible in real-time from different devices and locations		4	33.33 %
Collected data is systematically analysed and reported for decision-making		3	25.00 %
Data is not collected digitally		2	16.67 %
Data analytics are accessible without need of expert assistance (e.g. through dashboards)		2	16.67 %
Data analytics are enriched by combining external sources with own data		1	8.33 %

Figure 18 Enterprise' data management

		Answers	Ratio
Sustainable service provision (e.g. usage tracking for further reuse by other users)		7	58.33 %
Sustainable products (e.g. eco-design, end-to-end product lifecycle planning, end-of-life & extension of useful life)		6	50.00 %
Emissions, pollution and/or waste management		5	41.67 %
Optimisation of raw material consumption/cost		5	41.67 %
Paperless administrative processes		5	41.67 %
Sustainable business model (e.g. circular economy model, product-as-a-service)		4	33.33 %
Sustainable production and manufacturing methods, materials and components (incl. end-of-life management)		4	33.33 %
Sustainable energy generation in own facility		3	25.00 %
None of the above		2	16.67 %
Reduction of transport and packaging costs		1	8.33 %

Figure 19 Organizations' data management

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

About 55% of the respondents have chosen "Environmental concerns, and standards are embedded int business model and strategy" & "Energy consumption of digital Technologies and data storage are monitored and optimised" for environmental impacts consideration choosing in digital practices (Figure 20).

(15) How is your organisation taking into account environmental impacts in its digital choices and practices?

		Answers	Ratio
Environmental concerns and standards are embedded in the enterprise's business model and strategy		7	58.33 %
Energy consumption of digital technologies and data storage are monitored and optimised		6	50.00 %
Environmental aspects are part of digital technologies/suppliers' procurement criteria		5	41.67 %
Recycling/re-use of old technological equipment is actively practised by the enterprise		5	41.67 %
There is an Environmental Management System/certification implemented		4	33.33 %
None of the above		0	0.00 %

Figure 20 Environmental impacts consideration in digital choices

The rest of the questions asked in this survey were only compulsory for the stakeholders from "industry companies" because they are specifically designed to investigate the energy management system of the industry. From Question 21 onwards together with industry companies "Energy service company" and "Management HW&SW developers" were included.

In Figure 21, constraints that affect the performance of an industrial production system were evaluated; the top constrains are "Resource management" and "Equipment". 25% of the respondents indicate that "energy and environmental performances" is a decision-making asset into their production. Those who involve energy and environmental performance, mainly are using Electricity or Thermal generation for self-consumption (25%). Electricity generation to sell to the grid (feeding-tariff) (16%), Energy consumptions and bills are the following ones with 25%.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

(16) In your opinion, which is the constraint that affects the performance of an industrial production systems the most? (multiple choice)

	Answers	Ratio
Resources management	6	50.00 %
Equipment	5	41.67 %
Process Management	4	33.33 %
Time	3	25.00 %
Economic reasons	2	16.67 %

(17) Are data related to energy and environmental performances a decision-making asset into your production?

	Answers	Ratio
Yes	3	25.00 %
No	2	16.67 %
Not applicable	1	8.33 %

(17a) If Yes, which of the following data are considered?

	Answers	Ratio
Electricity or Thermal generation for self-consumption	3	25.00 %
Electricity generation to sell to the grid (feed-in-tariff)	2	16.67 %
Energy consumptions and bills	3	25.00 %
GHG Emission values	1	8.33 %
Other	2	16.67 %

Figure 21 Constraints that affect the performance of an industrial production System & data related to energy and environmental performances a decision-making asset into production

27% is considering investing/already installed renewable energy sources, 18% is not.

The answers to "High-level layer (as a set of Apps & Services) in a multi-service approach providing an innovative combination of functionalities for advanced energy-efficient, sustainable process/product design and manufacturing management. Have you ever used a software tool similar to the aforementioned one?" are shown in Figure 22. The ones who answered "yes" are those who used Control of the energy consumption in different process lines as software, represent the27%. Followed by Control of the environmental impacts, Facilitation of remote working and collaboration, Control of

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

warehouse movements and resources management, costs, and budget management with 18%, 18%, 18%, 9%, 9% respectively.

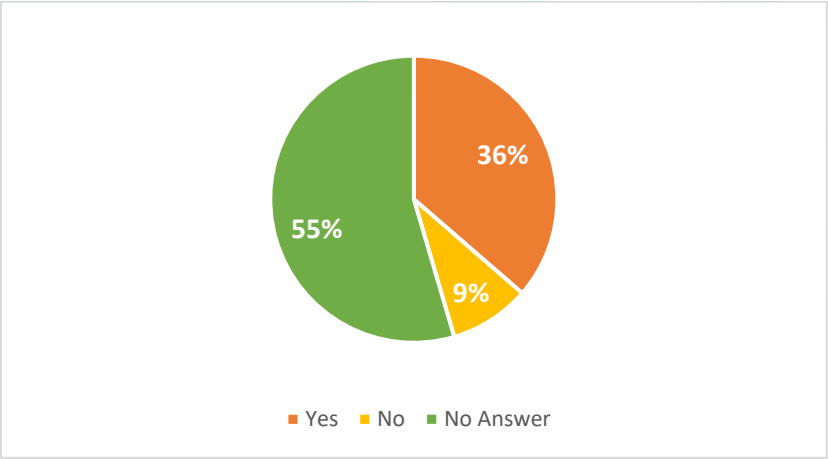

Figure 22 Software tools used for multiservice approach

The functionality misses due to the software tool used are shown in Figure 23, mostly encountered for control of warehouse movements and resource management.

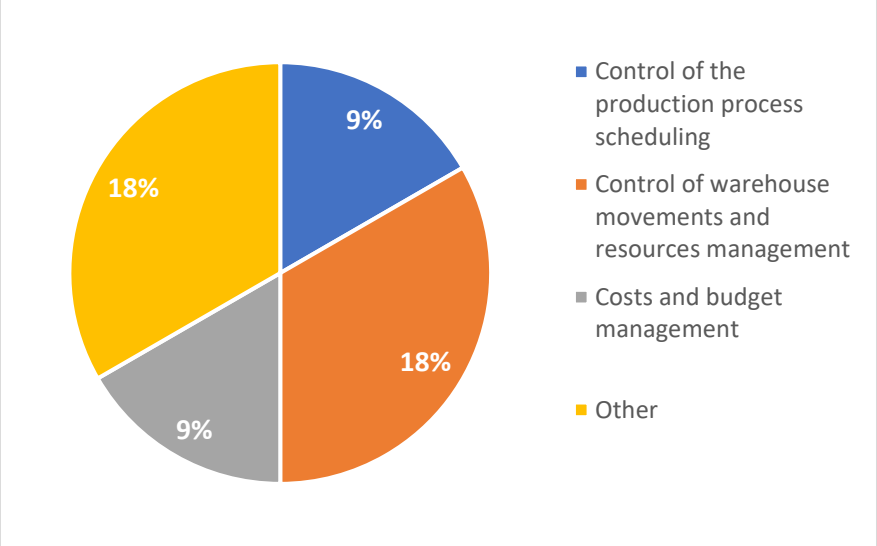

Figure 23 functionality miss from the tool used by your organization

Most of the stakeholders expect improvement in the manufacturing process planning and management by means of a software tool (42%). Another expectation is to save money and/or reduce the environmental footprint and improve the energy costs split among the different processes/departments (25%). The described software tool can particularly help the industrial processes "Measure sustainability indexes on the different steps of the process" (42%) and "Integrate heterogeneous data sources for better decision making" (25%).

Figure 25 lists the barriers for the software tool installation. Lack of digitalization of the detailed production information is highly prioritised.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

(21) What would you expect from a kind of software tool as the one mentioned in the previous question? To provide useful information to…

…improve the manufacturing process planning and management	5	41.67 %
…save money and/or reduce the environmental footprint	3	25.00 %
…improve the energy costs split among the different processes/departments	3	25.00 %
…to improve the social reputation of the manufacturing company and/or its products	3	25.00 %
…to improve the company/factory competitiveness	3	25.00 %
Other	1	8.33 %

(22) In your opinion, how the software tool described can particularly help the industrial processes?

Measure sustainability indexes on the different steps of the process	5	41.67 %
Integrate heterogeneous data sources for better decision making	3	25.00 %
Help to detect and correct minor inefficiencies in the processes	2	16.67 %
Help to stablish a fair split of energy/resources economic costs among the different process lines within the factory	2	16.67 %
Help to reduce the production waste	2	16.67 %

Figure 24 Expectations from software tools

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

(23) Which can be the barriers for the software tool installation?

Lack of digitalization of the detailed production information	5	41.67 %
Lack of individualized energy and resources metering and recording	3	25.00 %
Interoperability with existing software tools (SCADA, MES, ERP, LCA, GMAO…)	2	16.67 %
Staff not sufficiently trained to manage a new software tool	2	16.67 %
Energy does not represent a big share of the manufacturing costs	1	8.33 %

(24) Who are, in your opinion, the potential clients for this tool?

Factories highly dependent on energy costs	5	41.67 %
Factories whose energy consumption is widely fragmented in different lines and processes	4	33.33 %
Companies whose products are purchased by customers highly aware of the environmental impact associated with their manufacture	4	33.33 %
Factories whose energy consumption is focused on a specific energy-intensive process	3	25.00 %
Factories with complex requirements regarding production planning involving several restrictions of resources	2	16.67 %

(24) Who are, in your opinion, the potential clients for this tool?

Factories highly dependent on energy costs	5	41.67 %
Factories whose energy consumption is widely fragmented in different lines and processes	4	33.33 %
Companies whose products are purchased by customers highly aware of the environmental impact associated with their manufacture	4	33.33 %
Factories whose energy consumption is focused on a specific energy-intensive process	3	25.00 %
Factories with complex requirements regarding production planning involving several restrictions of resources	2	16.67 %

Figure 25 Barriers for the software tool installation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

Figure 26 shows that, according to the stakeholders' responses, the software tools that are adopted by the company should be used by energy managers (36%) or manufacturing production managers (27%).

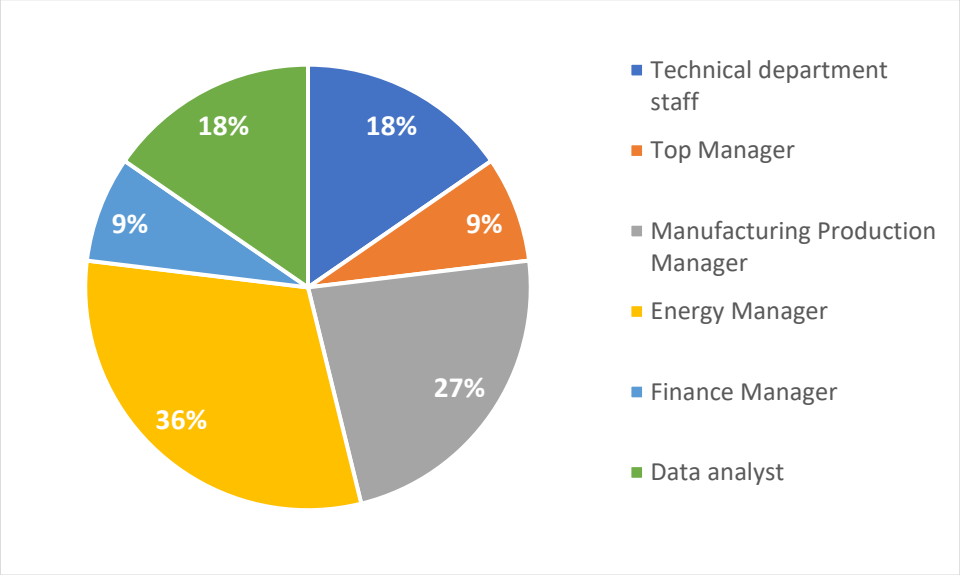

Figure 26 In your opinion, which professional profile should use this tool

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

5. KEY EXPLOITABLE RESULTS

The core EnerMan value proposition aims to provide an intelligent and autonomous energy management and cost optimization framework 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. An analysis and characterization of the KERs from a set of topics are reported in the tables below.

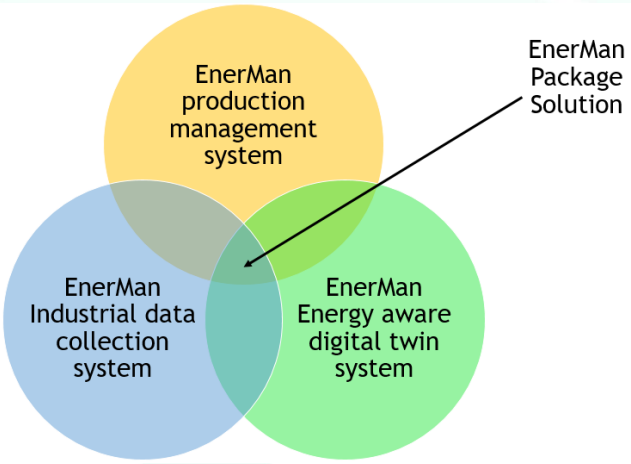

Figure 27 The Key Exploitable Results of EnerMan

EnerMan industrial data collection system is shown in Table 4.

Table 4 EnerMan industrial data collection system

Technical Description	Using Industrial Internet of Things (IIoT) approaches, deployed industrial sensors are collecting data from various sources inside a factory and aggregating them in data aggregation points. In EnerMan, heterogeneous data pre-processed locally and using sensor multimodal fusioning, aiming to provide accurate energy status results at the edge/fog IIoT level. Those results will be fed at near real time to the EnerMan IIoT cloud level (consisting of the EnerMan Management System plane and the System Analysis and prediction plane) in order to extract holistic, systemic energy consumption results across the whole production line chain. In this plane, the control loop IIoT actuator processes have also been included.
Innovation, benefits, and technical outcomes.	This KER provides an intelligent, holistic, secure and trustworthy sensor data collection and analysis mechanism to extract accurate energy sustainability metrics. It has a possibility to develop and improve research activities in data and machine learning as well as improve the granularity of data captured in all applied systems. Further technical outcomes are considered as a high connectivity between the Digital Twin and the data collection system, enabling the management of big amounts of data in a structured and systematic fashion. Additionally, as a feed in and a necessity for the further EnerMan package solution, it provides a shorter path to required input data for further digital twins and indirectly improves the Electrical Energy Forecasting tool.
Commercial and economic outcomes	The commercial outcomes are, for the large part, the way the KER provides the possibility of energy consumption analysis further reducing operating and energy costs. This KER specifically stand-alone is not considered to have a significant economic impact but used as a data collection tool further and when analysing

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

	energy utilization data, it is considered to help greatly with analysing and eventually decreasing energy costs by optimized energy planning. Further commercial outcomes need to be considered in a future stage of the project.
Process management impact	The process management impact is considered to be intermediate to high. This because a more frictionless opportunity to collect large amounts of data increases the possibility to analyse, make well-grounded decisions and more easily control of the processes where it is applied. This is directly related to the proper data management and pre-processing. It should, however, be noted that it performs the largest positive impact on process management when combined with further KERs.
Employee management impact	Employee management impact is considered low because this specific KER is more about the technical data and the increased amount of data points, and it is run in an atomized fashion.
Environmental impact	The environmental impact is considered intermediate. Through providing real-time holistic data to the digital twin this KER may provide substantial sustainable improvements through a better load consumption and a possible greener production. However, the KER alone is not enough to have tangible environmental impacts, it must for that goal be linked to further KERs.
Possible tangible or intangible outcomes of the KER	• PhD thesis on the topic: A possibility through topics related to ex advanced IoT techniques, data pre-processing, data filtration etc. • Further research: A possibility due to IoT being an emerging area of research strictly linked to multiple research fields. • Further new products developed: yes • Scientific publications
If any IPR included in the outputs	• Potentially for scientific publications.

EnerMan Energy aware digital twin system is shown in Table 5.

Table 5 EnerMan Energy aware digital twin system

Technical Description	This plane collects data from various sources and, using big data analytics, processes them and visualizes them to structure a unified energy consumption viewpoint. Additionally, by collecting predicted values from the System Analysis and Prediction plane, the Management System plane assesses the overall energy footprint of a factory. More specifically, in this plane, the administrators able to orchestrate the industrial control loop based on energy patterns scenarios and considering energy pattern predictions coming from the EnerMan digital twin. They also have the ability to use Extended Reality based human interfaces that visualizes the current and future predicted energy consumption in various, factory production lines and equipment.
Innovation, benefits and technical outcomes	This KER provides a visual tool and framework that suggests and implements control strategies that optimize the production efficiency, product quality and energy consumption. Further technical outcomes of the KER are specifically optimization of the production processes and energy consumption through providing multiple scenarios as to achieve production planning with the minimum possible energy cost and/or the maximum degree of green energy. It decreases and improves the energy usage based on demand for different industrial scenarios.
Commercial outcomes	This would increase the demand for Digital Twins and therefore a further support of the Digital Twin EnerMan KER. Additionally, the economic impact on industry and end-users is considered high due to this KER being directly related to the proper production management and planning for reducing energy and operating costs and therefore

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

	helping industries to choose the most proper production and process planning that would lead to the minimum possible energy cost.
Process management impact	The process management impact is strongly linked to the development of more energy aware operations and the management of energy consumption and proper production and planning for minimizing energy footprint and cost. However, as a tool and an aid the processes themselves won't be interfered with unless changes are made in accordance with the results presented. The significant energy consuming process parts can be modified considerable in accordance with process needs.
Employee management impact	The Employee management impact is considered low since the KER operates as automatic as possible and therefore the day-to-day process employees should not be affected unless significant modifications on physical process is made.
Environmental impact	The environmental impact is high when considering the goal of this KER being to achieve a production process planning utilizing a minimum amount of energy and with the maximum degree of green energy.
Possible tangible or intangible outcomes of the KER	• PhD thesis, for example on topics related to advanced techniques for achieving energy-cost aware production planning. Also, the possibility to do it in cooperation with industry. • Further research, for example a possibility to characterize the KER and validate it in industrial contexts together with industrial partners. Further research, for example a possibility to characterize and validate the KER in industrial contexts together with industrial partners and continuous research and improvements of production management systems. • Further new products developed. • Scientific publications. • Requirements and use cases for Digital Twin KER.
If any IPR included in the outputs	• Potentially for scientific publications.

EnerMan Package Solution is shown in Table 6.

Table 6 EnerMan Package Solution

Technical Description	With the three planes previously mentioned the EnerMan package solution envisions the factory as a living organism that manages the energy consumption in an autonomous way.
Innovation and benefits	As a package solution consisting of the three aforementioned parts the innovation and benefits of the three planes play a large role and therefore, please be referred to the previous three parts. Apart from that, the complete platform for energy management and prediction optimize processes, understands base loads, and allows for potential control to improve energy performance. The EnerMan package solution could additionally offer possibility of further innovation as it raises from the mutual interaction and integration between the three planes.
Commercial and economic outcomes	Please be referred to previous KERs.
Process management impact	Please be referred to previous KERs.
Employee management impact	Please be referred to previous KERs.
Environmental impact	Please be referred to previous KERs.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

Possible tangible or intangible outcomes of the KER	• PhD thesis on the topic of Industry 4.0-5.0 and energy aware production planning. It can additionally be done in cooperation with industrial partners to characterize and validate it in industrial contexts. • Further research on the EnerMan package solution could focus on the specialization of this type of digital solution to facilitate additional high energy demand units. • Further new products could be developed. For example, results of EnerMan project could promote the European Commission economic support aimed to new industrial PhD courses addressing the characterization and validation of EnerMan package solution within new industrial contexts. • Requirements and use cases for Digital Twin KER. • Scientific publications.
If any IPR included in the outputs	• Delimitation of IPR, intellectual property rights, between package solution and other KERs needs to be addressed.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

6. CONCLUSION

The current deliverable provides an enhanced stakeholder analysis in which the roadmap was determined in preliminary stakeholder report. Therefore, in this report more in-depth information about the stakeholder community of EnerMan was provided. According to the stakeholder's analysis, stakeholder's mapping, and engagement strategy the key beneficiaries of EnerMan were determined. The survey that has been sent to the stakeholder for stakeholder analysis purpose to get more information about their interest, knowledge and other specifications was examined. Additionally, the refined and updated Key Exploitable Results (KERs) of EnerMan project were presented in this report.

A stakeholder advisory board will be established from the current stakeholders who will actively direct the projects' outputs pathways. INTRACT has been actively contacting to own network to reach more professionals to be on board for EnerMan stakeholder community. A tab for stakeholder registration in the official website was established. Due to the importance of maintaining the webpage updated, the project consortium has been feeding the website and being near the stakeholders. Also, from the social media accounts the announcement of the stakeholder community was done. By using these platforms in combination, the digital footprint of the project has been increased and helped maximise online awareness of it.

To conclude, all partners should keep on actively contributing to the stakeholder engagement activities through the exploitation of the defined dissemination tools and channels, promoting and multiplying publicity of the project's aims and achievements, and disseminating targeted messages to all relevant stakeholders. All the relevant activity of the stakeholders will be updated in a final report "Communication activities and stakeholders' engagement" final report that will be delivered in December 2023 (M36).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

7. REFERENCES

Durham E., B. H. (2014). The BiodivERsA Stakeholder Engagement Handbook. Paris.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

Energy Efficient Manufacturing System Management

enerman-H2020.eu

EnerMan

enermanh2020 | enermanh2020 | enermanh2020

HORIZON 2020
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **No 958478**

EnerMan