CSA-Industry4.E

Grant agreement No 830845 – ECSEL-2018-3-CSA-Industry4E

Coordination & Support action for Lighthouse Initiative Industry4.E

Deliverable 3.1

Industry4.E dissemination and exploitation strategy

June 2019

Lead parties for Deliverable: S2i
Deliverable due date: M9
Actual submission date: M9
Dissemination level: Public

Abbreviations

BEP	Break Even Point
CI	Competitive Intelligence
CNC	Computer Numerical Control
CPS	Cyber Physical Systems
CSA	Coordinating and Support Action
ECS	Electronic Components and Systems
IPC	International Patent Classification
IPR	Intellectual Property Rights
KERs	Key Exploitable Results
KPI	Key Performance Indicators
LED	Light Emitting Diode
NDA	Non-Disclosure Agreement
PESTL	Political, Economic, Social, Technological, Legal
RDI	Research Development and Innovation
ROI	Return on Investment
SWOT	Strengths, Weaknesses, Opportunities, Threats
TRL	Technology Readiness Level

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Summary

The Deliverable at hand describes the design of a comprehensive Industry4.E '**Dissemination and Exploitation Strategy**', detailing the approach, measures and tools to develop tailored dissemination and exploitation plans for Industry4.E Lighthouse Projects. This template is available to current and future Lighthouse projects. The projects can adapt the strategy to suit their needs and increase their impact, while delivering a consistent message. The strategy describes the targeted **dissemination and exploitation activities, methodologies, tools and channels** suitable for the Industry 4.E Lighthouse Initiative as well as the impacts of these. It entails a **dissemination and exploitation roadmap** as well as an assessment **of relevant stakeholders**.

The CSA Industry4.E partners have:

- Evaluated **existing tools and methodologies** including stakeholder analysis, technology assessment, identification and prioritisation of the most promising key exploitable results (KER), IPR management along the whole project life cycle, as well as business model development and commercialisation strategies.
- Assessed how Industry 4.E Lighthouse Projects can build upon what exists and exploit synergies and complementarities between the projects in terms of cross-cutting topics.
- Performed an **analysis of the initiatives common themes** regarding 'exploitable results' and the overall Industry4.E Lighthouse technology and product offer.
- Detailed the exploitation strategy with a **number of research projects**, by holding a joint workshop on project dissemination and exploitation and deriving questionnaires for further in-depth analysis to feed into D1.1 (Project mapping).

The activities have shown that many suitable methods and tools exist, that can easily be applied and integrated into the various projects' dissemination and exploitation strategies at different stages of their project lifecycles. As the Industry4.E Lighthouse projects vary in terms of focus, starting date, size, duration, composition of the consortium, among other things, there is no 'one size fits all' approach. Hence, providing a toolbox with a comprehensive set of methodologies offers a useful guide for all the Industry4.E lighthouse projects on best practice options suitable to their specific project needs.

As the Lighthouse 4.E projects are all targeting 'Digital Industry', synergies and complementarities can be found and common aims and target groups identified. Main topics include platforms, modelling and simulation, digital twins, predictive maintenance, Cyber Physical Systems & Internet of Things and cybersecurity and future projects aim to build upon the results expanding them into the direction of AI enabled manufacturing.

By discussing and exchanging on their results, the projects can learn from each other and even build on each other's outcomes (e.g. Arrowhead platform). The provision of guidance regarding dissemination and exploitation activities is appreciated by the Lighthouse Projects. Moreover, further in-depth exchanges on projects outcomes, especially exploitable results are seen as key and should be continued on a regular basis.

1 Introduction

ECSEL Joint Undertaking (ECSEL-JU) is an EU-driven public-private partnership, funding innovation in electronic components and systems (www.ecsel.eu). Through the ECSEL-JU, European industry, SMEs and Research and Technology Organisations are supported and co-financed by ECSEL participating states and the European Union. ECSEL-JU has created "Lighthouse Initiatives" as they identified the need to better coordinate and link Research, Development and Innovation (RDI) activities taking place in order to help European industry achieve digital transition and strengthen Europe's competitiveness and leadership. Three Lighthouses have been launched to date; **Industry4.E**, Mobility.E and Health.E.

The **Industry4.E Lighthouse** has a special focus on all means of microelectronics and ICT for Digital Industry. Operating across project, funding, and national boundaries, Industry4.E is expected to bring together relevant RDI projects funded across various funding programmes helping them to connect with each other and the end-user/stakeholder community.

To support the implementation of activities in relation to the Industry4.E Lighthouse, ECSEL JU via Horizon 2020 have funded a Coordination and Support Action (CSA) with the following aims:

1. Support the LIASE in establishing the Lighthouse
2. Actively assist in enabling successful execution of the Digital Industry roadmap
3. Engage research communities - coordinate the relevant stakeholders, project consortia and policy-makers
4. **Facilitate, support and assist Industry4.E projects in effectively disseminating and exploiting project results**
5. Promote the Lighthouse visibility
6. Develop and implement a public engagement and outreach strategy to raise the visibility of Industry4.E to the broader public and related initiatives

The document at hand specifically contributes to objective No. 4, supporting the Industry 4.E Lighthouse projects' dissemination and exploitation activities. It represents the first of a series of three tasks and associated Deliverables. Within this first Deliverable D3.1 existing methods and tools for Industry 4.E Lighthouse projects for building a tailored Dissemination and Exploitation strategy are evaluated. Moreover D3.1 assesses synergies between the projects to leverage from and enhance the impacts through a joint approach. The second task and related Deliverable will develop targeted trainings for the Industry 4.E Lighthouse Projects, taking the proposed methods and tools as well as the individual Lighthouse projects needs into account. Three trainings for Industry4.E Lighthouse projects will be held to deepen knowledge and give hands-on support for efficient dissemination and exploitation planning, technology transfer and related methodologies and tools. From the feedback and lessons learnt, comprehensive guidelines for Communication, Dissemination and Exploitation will be developed, to serve current and future projects in efficiently enhancing their projects impacts.

This Deliverable builds on the vast experience of the consortium partners, especially S2i and AquaTT, who regularly act as Communication, Dissemination and Exploitation managers in European funded projects and have been doing so for many years also on previous related projects, like Focus, FoF Impact, IPR Helpdesk and many more.

2   Developing a Dissemination and Exploitation Plan

A well-defined Dissemination and Exploitation Strategy and Plan is crucial to effectively raising awareness of the projects aims and objectives, disseminating its scientific results as well as facilitating the uptake of new technologies. This chapter gives an overview on some definitions and describes the main elements to build a dissemination and exploitation strategy and plan.

2.1   Communication, Dissemination and Exploitation activities

Communication, dissemination and exploitation are closely intertwined. **Communication activities** aim to give visibility to the project and its results to a broad, general audience, including the interested public. The target groups of communication activities are therefore not only the scientific and industrial community, but include potential end-users, local authorities, policy makers and the general public. Communication activities complement the dissemination efforts as they add a public value to the achievements of the project by 'translating' the, sometimes, complex scientific results into easy to understand media resources emphasising more on the impacts and benefit. Communication includes the mass media and general public to inform and engage with citizens and society showing the benefit and potential social impacts of leading-edge research projects. Communication activities for Industry4.E Lighthouse projects are covered in WP4 (Public Engagement and Outreach).

Dissemination activities aim at sharing the project results with specialist audiences, once they are available. Dissemination can be performed through scientific publications, conferences or briefings to transfer knowledge and results to enable their take up.
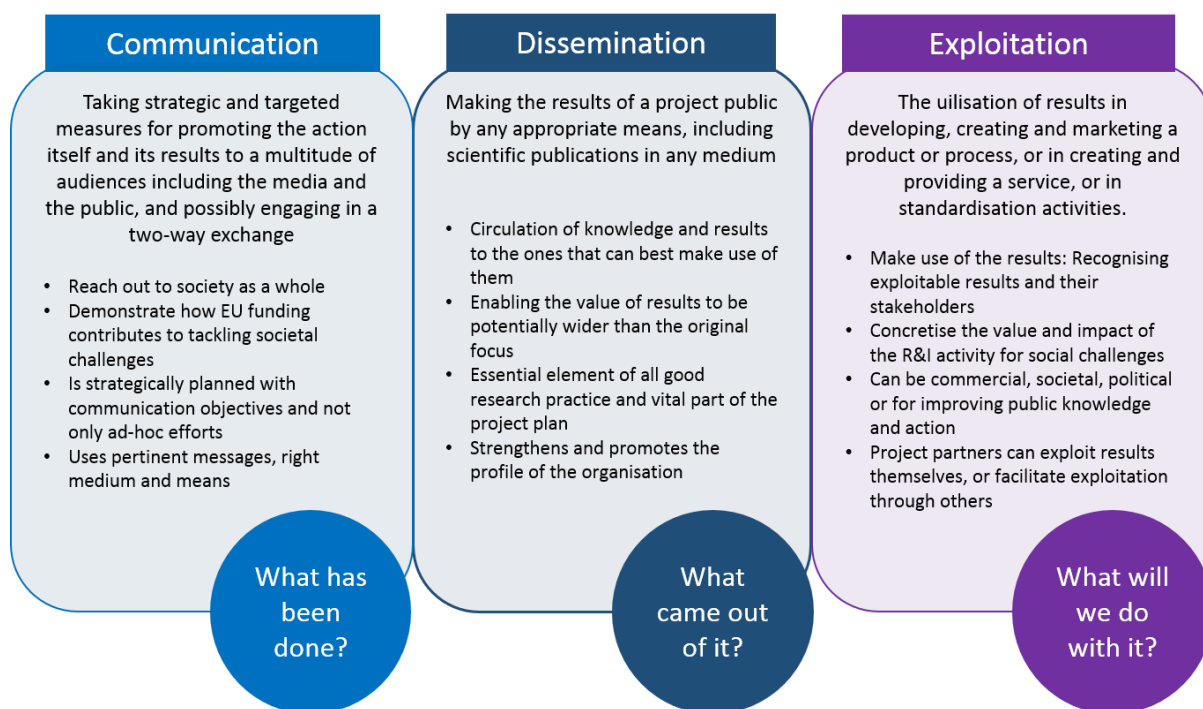

Figure 1: Overview Communication, Dissemination, Exploitation

The dissemination workflow aims mainly at informing researchers, industry, potential customers and other professional stakeholders (e.g. devices end-users) on the technical project achievements, and

in particular on the benefits from the implementation of new technologies/products/services for different applications.

Exploitation and market uptake measures target knowledge transfer, with the aim to exploit the project results to potential technology adopters at a scientific level. Dissemination activities foresee to include the project relevant scientific and economic groups in order to add value to the project's development and deployment. Exploitation activities aim at successfully implementing the project results in the research and industry, whereas the market uptake measures have to ensure the market adoption of the products developed in the project.

2.2 Development of a Project Dissemination and Exploitation Plan

A project dissemination and exploitation plan serves the purpose to jointly plan, monitor, assess and report on dissemination and exploitation activities. It represents a living document, evolving during the project lifetime. The graph below shows activities and interconnections between communication, dissemination and exploitation activities along an exemplary timeline of three project years.
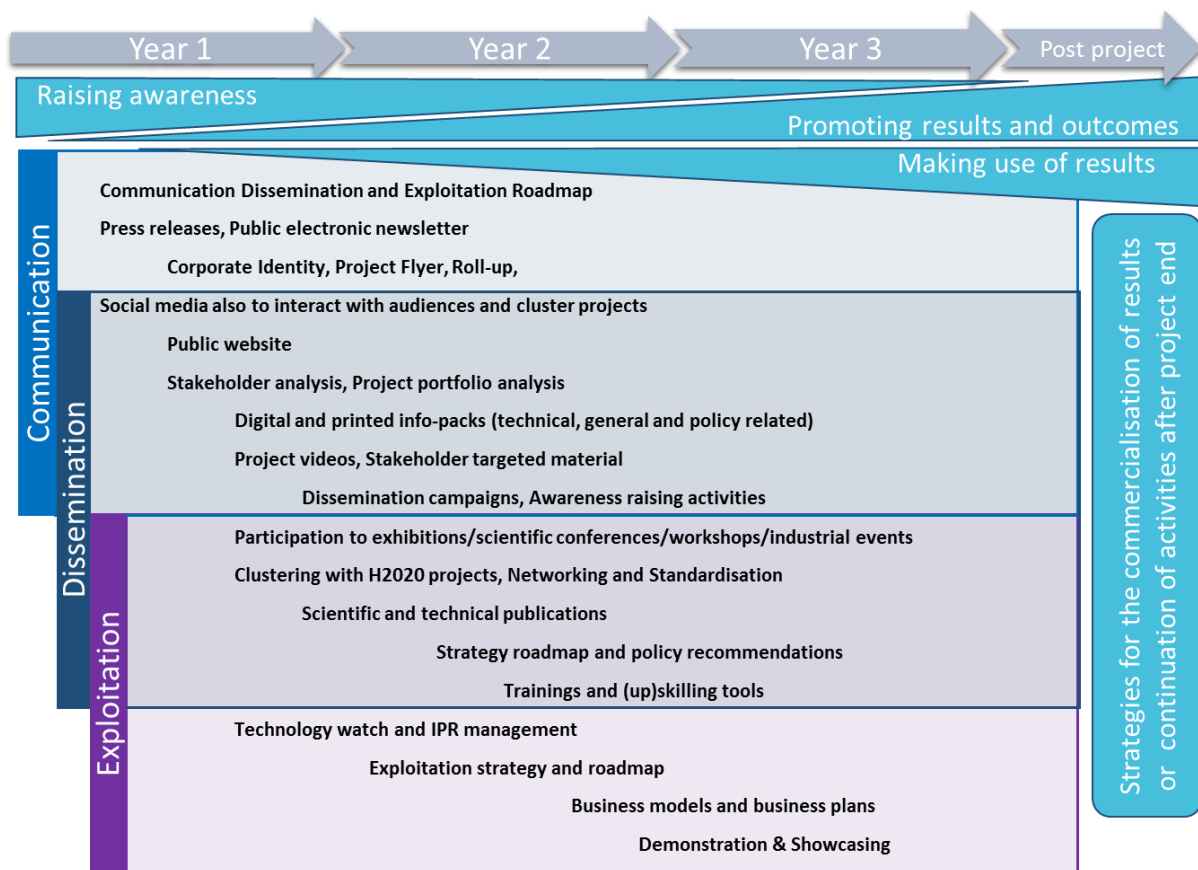
Figure 2: Content Matrix of a Communication, Dissemination and Exploitation Plan

The development of the project communication, dissemination and exploitation plan should be seen as an integrated approach, where strategic aims, activities and applied tools work hand in hand to support each other. While communication activities are performed from the very start of the project, to raise awareness on its objectives and aims, build up the relevant target audience, network with

related communities above others, dissemination and exploitation activities come into play when project results become available. With this, target groups will evolve during the project's lifetime and optimal channels may vary, as well as communication and dissemination materials need to be constantly adapted. Moreover, it is highly advisable to collect feedback and analyse the outcomes of activities (hits on website and page views, followers on social media, feedback to workshops, referencing publications, etc.), to flexibly adapt and fine-tune the approach during the project duration.

All project partners should be actively involved in the creation of a **dissemination and exploitation plan**. A first draft is usually described within the proposal and then updated early in the project. For the early phase of the project, the overall objective of communication and dissemination will be to raise awareness on project aims and expected results within the public, scientific community and the manufacturing industry. This dissemination and exploitation plan is supposed to be a living document, which will be updated regularly taking into account the assessment of activities performed and planning for the upcoming period. For an effective dissemination and exploitation plan, it is essential to get a clear picture of the dissemination aims and messages, identify the suitable dissemination **channels**, analyse the project's **target groups** and tailor the communication and dissemination material to them. Moreover, the expected impacts of the activities should be clear and measurable.

The development of the **exploitation strategy** is a flexible process that has to be tailored to the need of the project and project partners. In order to build the strategy efficiently the projects' exploitation strategy and the partners' individual strategies have to be considered in parallel. It is highly recommended to build the exploitation strategy and plan together with the partners in the frame of exploitation workshops to be organised by the exploitation manager. This will provide the **necessary transparency** to allow partners to get the understanding about each other expectations.

The individual methodologies and tools to create the overall dissemination and exploitation plan are described in more detail within the coming chapters.

3   Description of Methods and Tools

With respect to project aims, size, duration and consortium composition among other factors, the dissemination and exploitation plans can vary enormously from one project to the next. It is of utmost importance to tailor the strategy to the projects needs and the possible users of the project results. Nevertheless, there are a number of useful methodologies and tools, which can be applied in a varying composition to best suit a project. Some of the methodologies and tools are described within this deliverable. An extended and more detailed description will be available in the 'Guidelines for communication, dissemination and exploitation in the frame of the LI4.E' to be published in September 2020.

3.1   Methods and Tools for Project Dissemination

To ensure the highest success of a project, a **concerted dissemination strategy** is considered an essential factor. It is essential to clearly define the dissemination **aims and messages**, analyse the projects audience and **target groups** and identify the suitable dissemination **channels**, to approach them with tailored materials and information. To constantly improve activities, their impact should be monitored and feedback integrated in updates of the strategy and dissemination plan.

3.1.1   Definition of aims and messages dissemination

The project will have to define the aims and focus of their communication and dissemination activities first. Possible goals of communication and dissemination activities include:

Communication activities aim to:

- Inform a general audience about the project and its results to increase the project's visibility, in terms of objectives, activities and benefits;
- Raise interest in the project concept from potential stakeholders in Europe, and beyond, to promote the project's aims, evolution and results;
- Show how the outcomes are relevant for our everyday lives;
- Show potential users and customers that they can integrate the project results in future applications and commercial products;
- Strengthen the partner's reputation on regional, national and international level;
- Support the European Commission in demonstrating the success of European collaboration projects. That these successes will help to strengthen Europe's competitiveness in this area, maintaining or bringing back industry to Europe.

Dissemination/exploitation activities aim to:

- Involve stakeholders, the relevant scientific and economical groups and experts to initiate their contribution to the project in a research-oriented (further development and scientific exploitation of project results) or commercial way (exploitation of results and market implementation) at European level and worldwide;
- Ensure a broad dissemination of the project results and improve the transfer of technical, scientific achievements and knowledge outside the core consortium to other European projects and into European industry -;

- Generate market demand for the products or services developed and thereby facilitate exploitation of the products and services generated;
- Determine market uptake measures and to achieve an early uptake of the project results;
- Identify business opportunities and develop feasible business models;
- Provide regulatory recommendations;
- Contribute to the development of standards.

Key Messages should answer the following questions:

- What are the main project outcomes
- Which are the main problems that the projects' outcomes will solve
- What is the wider impact the project will generate?

3.1.2   Tools and Channels for Project Dissemination

Several tools and channels can be employed by the consortia to promote the project, increase its visibility, and support the exploitation of the final results of the project including:

Digital dissemination media
- a public project website
- social media channels (e.g. Twitter and LinkedIn)
- press releases
- project newsletters
- online publications
- online trainings
- project videos
- virtual demo sites

Printed dissemination material
- a project flyer, leaflets, brochure (possibly updated with evolving results)
- a project roll-up, posters, templates, gadgets (dissemination kit)
- publications in peer reviewed journals
- publications in magazines and annual reports
- project book

Face-to-face dissemination
- contributions to conferences
- presentations on fairs
- organisation of workshops (for industry)
- large dissemination events targeting broad public / end-users
- demonstration / showcase events / roadshow
- dissemination campaigns
- company visits
- clustering & networking activities / interaction with other related projects
- standardisation activities
- training & teaching activities

- technology transfer events / brokerage events / investors pitches
- …

While some of these tools are used in most Lighthouse projects already (project website, social media, flyer, conferences, publications), other might proof useful to integrate in the dissemination approach. As Communication activities are handled in more detail in WP4 and the associated D4.1, only dissemination activities are described in more detail below.

The **dissemination** targeting **essentially the transfer of knowledge to** scientific and industrial audiences can contain the following activities and tools:

- Participation in **scientific conferences** to present the scientific/technical breakthroughs of the project (presentations and posters), assuring thus a swift technology transfer through making generated knowledge available before specialised audiences.
- Participation in **industrial fairs**, to present the project industrial achievements / demonstrate the project developed technologies on a common booth. This is of prime importance to reach potential end-users of the developed technologies. The fairs can be national and international.
- Publication of cross-thematic **peer-reviewed scientific/industrial articles** in international journals. This will assure the general knowledge transfer among the specialised audiences (scientific, industrial…).
- **Participation in experts groups,** blogs for specific experts within the related scientific / technical community.
- Final publication summarising all project results will be prepared by partners and printed for publication in form of a **project book**.
- Development of **standards**, participation in standardisation working groups and committees
- Organisation of **thematic training workshops** targeting mainly potential end-users and industry.
- Develop on-line **training material** to be used for take-up activities and further exploitation of the project results.
- Integration of project results into **university courses** in the field of manufacturing. This will enable future use of the technologies through the immediate involvement of the next generation of engineers, PhDs as well as managers.
- Organisation of a **final conference** to present technical achievements of the project. In order to maximise its impact, the possibility to join forces with a related high-level event (ECSEL symposium, EFECS, EFFRA, Manufuture) will be considered, potentially reaching a large audience coming from both academic and industrial areas.
- **Networking** with other similar R&D projects (common events) and networks (e.g. Enterprise Europe Network, European Technology Platforms, ECSEL, EFECS, ARTEMIS events, EFFRA events, Manufuture).
- **Clustering activities** with European networks should also be implemented in order to maximise the impact of the project on the potential technology adopters and end-users.
- Clustering activities with regional and national SMEs networks on related technologies.
- **Technology Transfer Workshops, Brokerage Events** and **Investors Pitches** to evaluate opportunities for commercialisation or further funding after the project end.
- …

Within the projects, all partners typically organise and participate in a great range of events that contribute to the dissemination and exploitation of the project itself and its results. For a detailed planning along the project, the following table can serve to collect dissemination activities among the partners on planned events, dates and locations.

Dissemination and Communication Activities							
No.	Type of Activity[1]	Main lead	Title, Description	Date/Period Start date/ end date	Place (City, Country)	Type of audience[2]	Size of audience
1	Participation to a cluster event / workshop						
2	Participation to conference						

Table 1: Dissemination and Communication Activities

Moreover, within the Lighthouse Industry 4.E projects a number of scientific / technical publications can be expected. The table below is provided by the EC to collect and categorise publications.

Scientific and other publications													
No.	Type of publication	DOI	ISSN or eSSN	Authors	Title of the journal or equivalent	Number date	Publisher	Place of publication	Year of publication	Relevant pages	Public & private participation YES/NO	Peer review Yes / No	Open access yes/no
1													
2													
3													

Table 2: Scientific and other publications

Activities funded under the Europeans Unions H2020 Programme can 'pay back' to the overall community by publishing and sharing their results. Publications have to be open access (green or gold)

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[1]Please list only activities directly linked to the Action: A) [Organisation of a Conference]; B) [Organisation of a workshop]; C) [Press release]; D) [Non-scientific and non-peer reviewed publications (popularised publications)]; E) [Exhibition]; F) [Flyers training]; G) [Social media]; H) [Web-site]; I) [Communication campaign (e.g. radio, TV)]; J) [Participation to a conference]; K) [Participation to a workshop]; L) [Participation to an event other than a conference or workshop]; M) [Video/film]; N) [Brokerage event]; O) [Pitch event]; P) [Trade fair]; Q)[Participation in activities organised jointly with other H2020 project(s)]; R)[Other];

[2]A) [Scientific Community (higher education, Research)]; B) [Industry]; C)[Civil Society]; D) [General Public]; E)[Policy makers]; F) [Medias]; G)[Investors]; H) [Customers]; I) [Other]; ('multiple choices' possible)

and meta-data associated to the publications are suggested to be shared in open access repositories like 'OpenAire'.

3.1.3   Development of the dissemination strategy and approach

As not all data can be disseminated and shared, as some innovations should rather be protected and exploited commercially, the consortium is recommended to include a Data Management Plan (DMP) into its strategy. Such a DMP defines what data the project will generate, whether and how it will be exploited or made accessible for verification and re-use, and how it will be curated and preserved. The Communication, Dissemination and Exploitation as well as the Data Management Plan detail which results should be disseminated and where protection is needed to exploit them commercially.
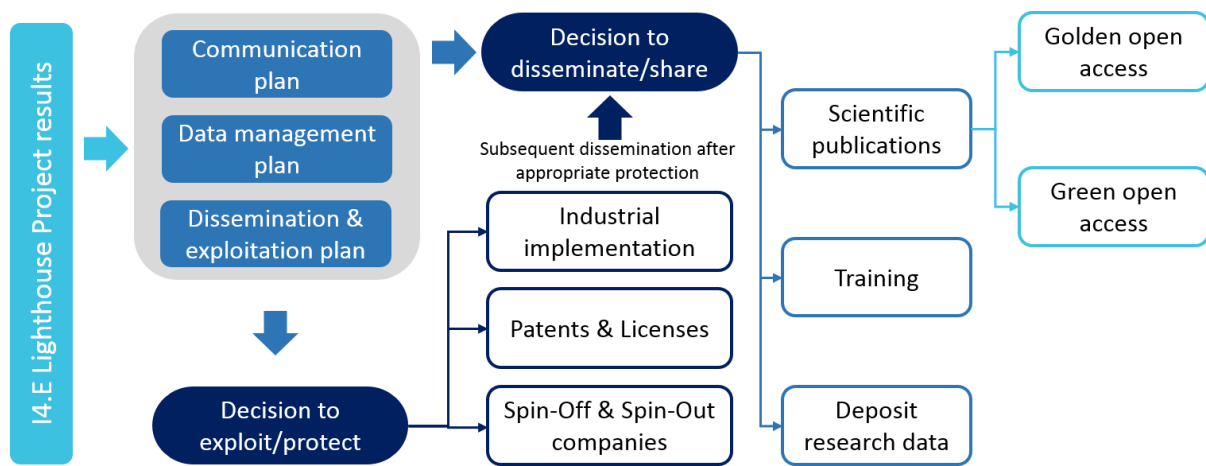

Figure 3: General results management plan

For the results to be disseminated, it is essential to identify the aims of such dissemination, analyse the projects target groups and tailor the communication and dissemination material and messages to them. The **aims of dissemination** (*WHY* are we performing dissemination activities?), should be brought in line with the planned **activities** (*WHAT* dissemination activities do we perform?) and the planned **implementation** (*HOW* and *WHEN* do we implement these dissemination activities?). Activities should already be planned having specific **Key Performance Indicators** (KPIs) in mind (e.g. number of peer reviewed publications, number of participants in events, European coverage, and number of investors addressed …). Some examples are shown below:

Aim (= WHY?)	Target Group (= WHO?)	Dissemination Tools / Channel (= WHAT?)	Implementation and partners involved (= HOW?)	Timeline (=WHEN?)	Impact (=KPI?)
Disseminate scientific/ technical results	Scientific community	Peer reviewed publications	Academic partners xx, yy, …	When results become available	minimum 10 peer reviewed publications, referenced

Disseminate scientific results	Scientific community	Give presentation at conference	Academic partners xx, yy, …	When results become available	minimum 20 conference talks
Demonstrate prototype	Industrial community	International fair	Partners xx, yy	After year 2	Minimum 5 fairs
Engage end-users	End-users	Workshop	Partners xx, yy	After year 2	Minimum xx end-users reached
Promote standards	Standardisation bodies	Working group meeting	Partners xx, yy	Continuous	Number of standards
xxx					

Table 3: Key questions for strategy development

The **target groups** can include a variety of stakeholders. It is important to check who exactly should be addressed according to the project needs. Projects on lower Technology Readiness Level (TRL) scales typically will disseminate their disruptive findings to the scientific community. Projects working on higher TRLs might already address the manufacturing industry or investors with their newly developed products or services. It is very helpful to already define contact points within the consortium at an early stage. Target groups may include any person or group who can affect or be affected by the achievements of the project objectives or influence these objectives:

Target groups of dissemination activities	Contact points within a consortium
Scientific community, research community, academia	
Industry including potential end-users	
SMEs and midcaps (suppliers and users of digital technologies)	
Related projects (ECSEL, FoF, Eureka…)	
Clusters, associations, platforms, networks	
Multipliers (e.g. Enterprise Europe Network)	
Related EU, national and regional initiatives	
Open source community / ecosystem	
Standardisation and regulation bodies	
Skills initiatives, training providers, higher and lower education	
EC, policy-makers at European, national and regional levels	
Local authorities	
Private investors, venture capitalists, business angels, banks	
General public, media	

Table 4: Target groups of dissemination activities

3.2 Methods and Tools for Project Exploitation

Following a successful project development including a well-received communication and dissemination plan, there is the equally important step of designing an exploitation plan. This can be developed along a three-step-analysis starting with the following questions:

Which project results have high exploitation potential?	Is there an accessible market for our exploitable results?	How are we going to implement the exploitation?

- The first step is the identification of **Key Exploitable Results** (KERs). In this phase, the collective input of all project partners is required. Apart from jointly defining, characterising and prioritising the exploitable results, it is suggested possibly group some of these into clusters. This promotes the formation of synergies boosting exploitability of the project as a whole.
- Subsequently, an analysis of the **macro-economic landscape** has to be conducted to evaluate the strategic fit of the suggested KERs to the market. The main objective of this step is the analysis of the attainability of a successful exploitation including all of its various influences.
- The third step involves **strategic implementation** tools to maximise the impact of the project results. This might be achieved by a number of methods including further research, licensing, new services/products, joint ventures or standards.
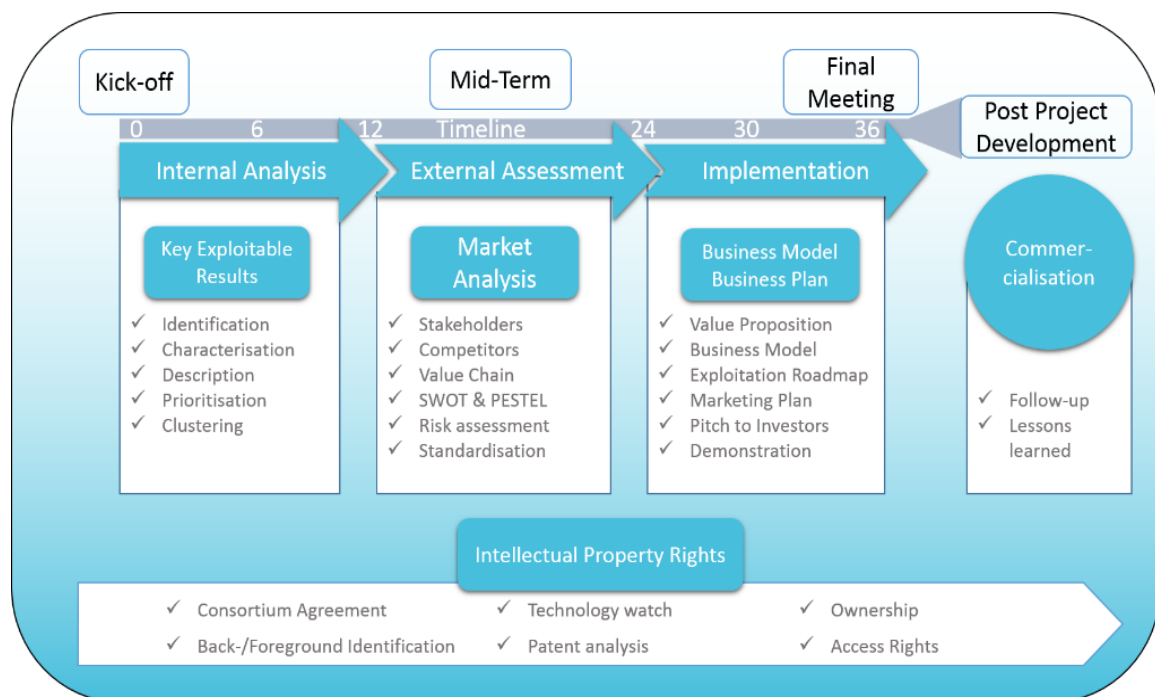

Figure 4: Exploitation overview

A certain set of activities will be performed throughout the entire duration of the project, namely the '**Intellectual Property Rights Management**'. Figure 4 presents a general overview containing some of

the key elements to develop a tailored exploitation strategy and plan. The following pages will depict a more detailed insight into the most important tools.

3.2.1 Management of Intellectual Property Rights

A first step is to clarify and define IPR related definitions and processes. An extract of definitions as can be found within the EC H2020 guidelines is presented below:

Exploitation (Use): Direct or indirect utilisation of foreground in further research activities (other than those covered by the project), or for developing, creating and marketing a product or process or services. An exploitable result is defined as an outcome of the project that meets two conditions:

- It has commercial/social/academic relevance
- It can be commercialised/exploited as a stand-alone result

These results might need further R&D, prototyping, engineering, validation, etc. before they become commercially exploitable. Exploitable results are generally defined as products, processes, methods, services, which are new, improved or more efficient.

Background: Information held by beneficiaries, owned or controlled by project partners and brought to the project; may come from existing knowledge as well as copyright or other IPR. Background information has to be: relevant to the project result, needed to carry out the project or for using the foreground, and somehow embedded in the result.

Foreground = Results: Results, including information, being protectable or not, which are generated under the project. Belongs to the beneficiary generating it. Can be jointly generated (joint ownership).

Moreover, different means and mechanisms apply for different kinds of results. It is important to clearly identify the exploitable results, and the appropriate means of protection.
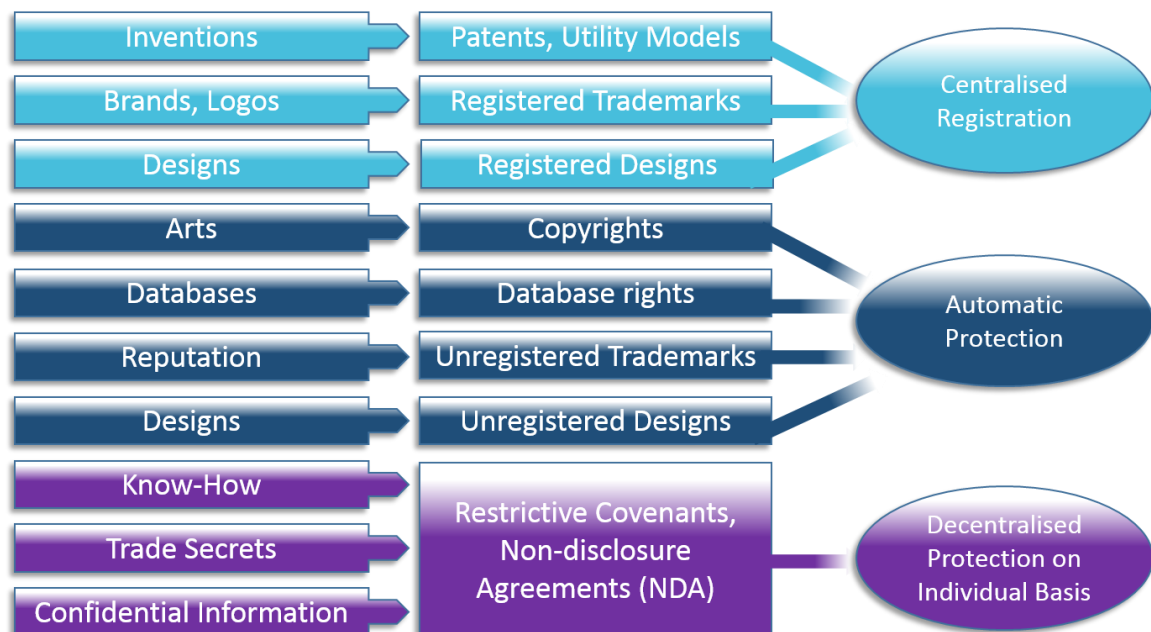

Figure 5: Types of exploitable results and means of protection

It is highly recommended to handle exploitation activities as well as IPR Management in a participative and transparent way ideally conducting a series of webinars and face-to-face IPR and exploitation workshops. Within European R&I projects a number of complementary partners from research, small and large industry come together. Therefore, it is important to set common grounds and learn about each other's expectations, aims and needs from an early stage. While participants from academia often aim on publishing their findings at conferences or in journals, industry focuses on protecting and commercialising results.

Exploitation workshops will help to clearly define the Key Exploitable Results, characterise them and prioritise them jointly with the project partners. Exploitable results can be of scientific or commercial relevance and with this might rather be published or protected. For commercial KER various workshop based methodologies can support the elaboration of suitable business models and strategies around them. A series of IPR and exploitation workshops will help to get a clear picture on background and foreground of each partner, and with this the related ownership to foster discussions on access rights.

Exploitation Workshops can combine the assessment of Intellectual Property Rights in parallel with elaborating on the roadmap for the exploitation of results. IPR basics will be handled in an early workshop along with the identification of the Key Exploitable Results (KERs), while access rights and technology transfer will be included in a workshop at a late stage.

Intellectual Property Rights Management			
IPR Basics	**Protection of Results**	**Ownership / Access Rights**	**Technology Transfer**
• IPR - Definitions • Back- /Foreground • Identification of KERs	• Technology watch • Patent analysis • Characterisation of KERs	• Identification of ownership • Prioritisation of KERs	• Definition of access rights, licensing • Commercialisation • Business model & plan • Exploitation Roadmap
Identification	Characterisation	Prioritisation	Investors Pitch
Exploitation			

Figure 6: IPR management and Exploitation Workshops

3.2.2   Patent analysis

Assuming your project introduces a new product / innovation to the market landscape it is crucial to assess the current state-of-the-art and demonstrate how your project's exploitable output strives beyond this. Therefore, it is vital to screen the following areas

- Concurrent project landscape
- Published scientific literature
- Already granted patents

Available patents can be researched using e.g. the openly accessible database Espacenet (http://worldwide.espacenet.com) provided by the European Patent Office (http://www.epo.org). Consequently, there are two important factors for a successful patent research:

- Understanding the structure of patents
- Conducting an efficient research

Structure of patents

The information contained in patent documents is generally structured in three parts:

- The first part provides general information about the patent: The title, a summary, the invention, the names of the inventors, dates and numbers and the status of the patent document.
- The second part of a patent describes the problems being solved by the invention, the state-of-the-art today and a technical description.
- The third part concludes with drawings, the claims and a research report.

Efficient Patent research

When researching a patent, choosing the right key words is crucial. These should be selected according to the geographic area, the time period and inventor's company and most importantly the type of and fitting description for your invention. Additionally, it is advised to combine the textual search with patent classification codes. The most widely used codes are found under the International Patent Classification (http://www.wipo.int/ipcpub).
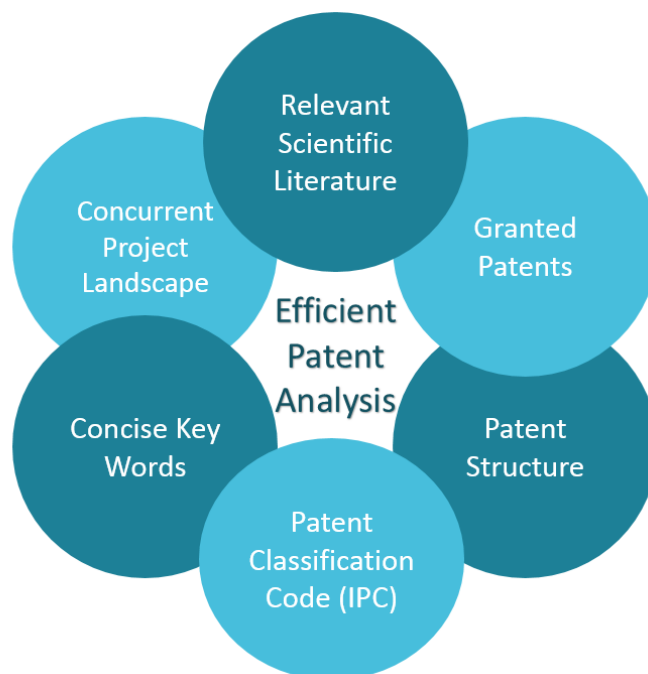

Figure 7: Summary of the key areas of an efficient patent analysis

3.2.3 Market Research

The objective of Market Research is the gathering, analysing and interpreting of exploitable relevant market information to perform a feasibility study for your KERs. This comprises but is not limited to market segmentation, supply and demand, past, present and potential spending habits of target customers, the economic environment in the industry sector, key competitors in the field, barriers to entry and regulations. A market research follows a path paved with questions leading you to a comprehensive understanding about product placement.
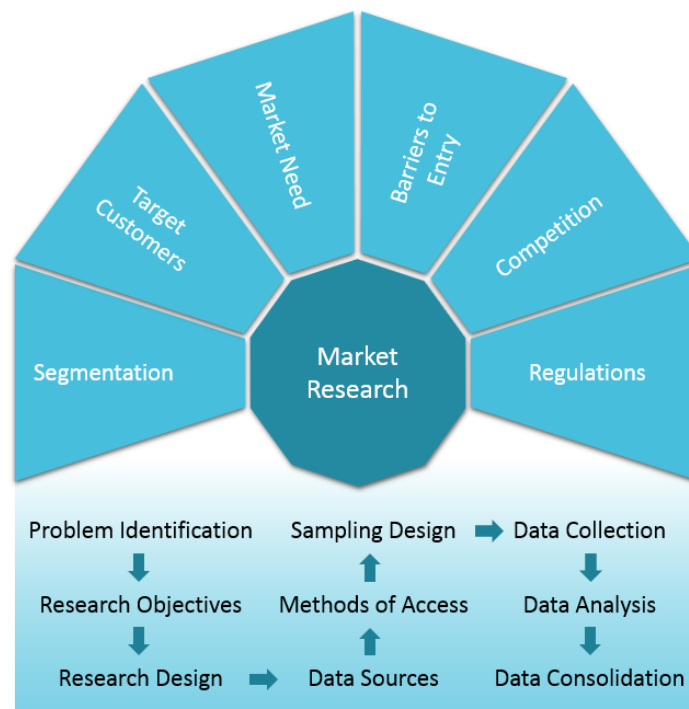

Figure 8: Aspects and process of market research

In the pursuit of answers two types of information can and should be accessed:

Primary information gathered from first-hand accounts through surveys, observation or experimentation.
Secondary information is compiled through other sources, like company records, research studies or books related to the topic.

Whichever way is applied to conduct a market research, it will prove immensely time saving to define the research process as precise as possible. The following questions support the creation of an organised market research plan:

- What market will be analysed?
- Which problem will be solved?
- What questions is the research trying to answer?
- What type of investigation proves most efficient in answering those?
- Which type of information will help?
- How will this data be obtained?

The accurate definition of a research strategy to answer questions about the above mentioned topics regarding the outside world is a valuable tool to understand one's place in the grand scheme of things and to establish an effective exploitation strategy.

3.2.4   Competitive Intelligence

An addition or rather an alternative to market research is Competitive Intelligence (CI). It describes the mechanism of understanding and learning what's happening in the world outside your business with the aim to maximise your competitiveness. In an increasingly digital environment, this method makes increasing use of Big Data and analysis algorithms to maximise the impact of research results. This means learning as much as possible as early as possible about your industry and your competitors to a point at which it is essentially possible to anticipate changes and adapt your strategies accordingly. As CI is an ongoing action, the data collection process is better described as surveillance rather than research and can be summarised with the following four steps:

- Definition of information surveillance strategies
- Regular information collection
- Transfer from collected information to intelligence by the application of "Know-How"
- Dissemination of gained intelligent insights to the decision makers

For further information regarding CI "The Manager's Guide to Competitive Intelligence" is a good place to start.

3.2.5   PESTEL and SWOT Analysis

To optimise the chances of successful project completion it is crucial to understand one's own organisation as well as the surrounding macro-economic landscape. For this purpose, **P**olitical, **E**conomic, **S**ocial, **T**echnological, **E**nvironmental and **L**egal (PESTEL) and **S**trength, **W**eaknesses, **O**pportunities and **T**hreats (SWOT) analysis are often combined conceptual tools to create a comprehensive evaluation of projects and organisations. Both give valuable inspiration helping to better understand your current standpoint from which to go forward.

Figure 9: PESTEL Analysis

The PESTEL Analysis is exclusively externally focussed. The following table offers a range of possible considerations to evaluate the existing market conditions. The analysis of these factors will help in gaining a comprehensive understanding of the macro environment that may positively or negatively affect your strategic planning process. After gathering substantial information, the different results of the PESTEL Analysis can be evaluated and synthesised into actual opportunities and threats for the project. This consolidating process leads to the SWOT Analysis, which can be used in combination to produce a strategic matching between internal characteristics and external circumstances.
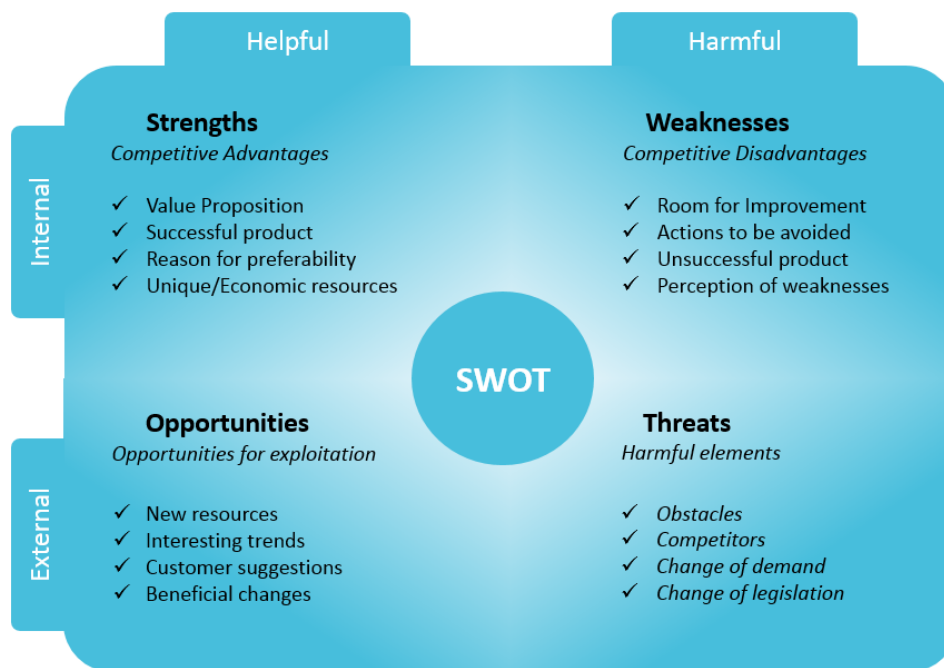

Figure 10: SWOT Matrix

The SWOT matrix is designed to help build an understanding of your own organisation and its current standpoint. This analysis is split into internal and external factors also described as:

Strengths and Weaknesses comprised of the 4 Ps, i.e. Product, Price, Place and Promotion as well as other resource and manufacturing capabilities. The content of these fields can be found within the organisational structure.

Opportunities and Threats relate to macroeconomic, technological, legal or sociocultural changes that might be either beneficial or hindering to a project's objective, as discovered in the PESTEL analysis.

These factors are collected to deduce the obtainability of an objective and hence the best strategy of achieving it. Subsequently, the strength and weaknesses can be matched to the identified opportunities and threats to seize or circumvent them respectively.

This said, it should be noted, that neither PESTEL nor SWOT analysis leave you with a strategy on how to improve your project. They are tools to better understand one's current standpoint and potential direction and thus present a versatile starting point for further discussions.

3.2.6 Business Model Canvas

A business venture requires varying areas of focus throughout its lifetime for a successful implementation. One of the tools to direct activities to where attention is most urgently needed is the well-known and widely applied Business Model Canvas, initially proposed by Alexander Osterwalder in 2008. Its main advantages are the simple use, the comprehensiveness and the flexibility.
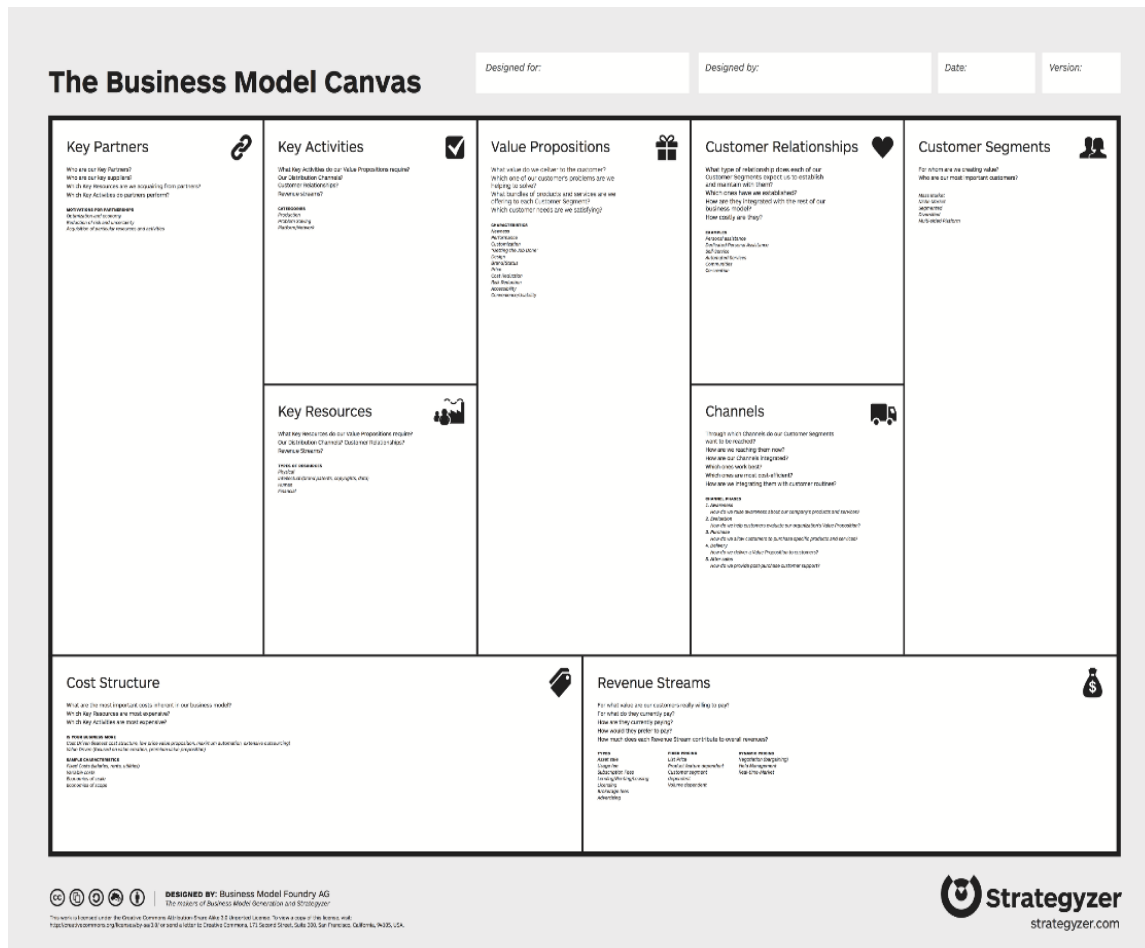

Figure 11: Business Model Canvas (Source: www.strategyzer.com)

All canvas models include building blocks covering crucial topics of business development such as:

1. Customer Segments
   Who are you creating values for?

2. Value Propositions
   What core value do you deliver to the customer?

   Which Value do they expect?

3. Channels
   Which channels are most effective to reach your customers?

   Which are most convenient for them?

4. Customer Relationships
   What relationship expects the target customer to establish with you?

5. Revenue Streams
   For which values are your customers willing to pay?

   How is the payment most convenient?

6. Cost Structure
   Which infrastructure bears the most cost?

   Which has the highest cost-benefit ratio?

7. Key Resources
   Which key resources do your value propositions require?

8. Key Activities
   What key activities do your value propositions require?

9. Key Partnerships
   Who are your key partners/suppliers?

   What are their motivations?

Alternative versions might have space for ´Social and Environmental Costs and Benefits´ or other relevant topics to choose from. This might represent a strong influence on all of the above mentioned areas of a business venture, especially in the social and environmental sector.

There is also a lighter version called a ´Lean Canvas´ focussing more directly on your product and its proposed value (e.g. https://canvanizer.com/new/lean-canvas). This canvas allows a fast access to the product without the necessity of a complete business plan.

The Business Model Canvas is usually printed out on a large surface so groups of people can jointly start brainstorming and discussing business model elements with pots-it notes or board markers. It enables you to understand your business and to go through the process of making connections between your idea and how to turn it into a business.

3.2.7 Risk Assessment

The type of risk and its subsequent impact multiplied by the probability of it occurring provides your project with a Risk Index which represents the base of any Risk Assessment. By nature, this Index is qualitative, though enabling you to prioritise threats and prepare measures accordingly. To do this, risks are separated into segments, each of which require different preparations. Then probability of occurrence and impact are added in numbers from 1 to 5 and the index is calculated.

3.2.8 Standardisation

To promote an effective introduction of a new product or service it is crucial to integrate it with the existing technological environment. Standardisation helps in creating interoperability and compatibility across varying countries and industries. There are three European Standardisation Organisations (ESO) CEN (https://www.cen.eu), CENELEC (http://www.cencenelec.eu), and ETSI (http://www.etsi.org) which will readily support your efforts when thinking about standardisation.

For further information on Risk Assessment and Standardisation read the FOCUS document

"Methodology for industrial exploitation & take-up"
(https://www.focusonfof.eu/downloads/results/exploitt-dossier.pdf).

3.2.9 Business Plan

A Business Plan consolidates all the evaluated information forming a comprehensive outlook of how and where your business is headed. A financial projection is added as a measure of allowing your venture to be summarised into hard numbers. To translate all collected information into numbers a couple of tools are used.

Break-Even-Analysis

To analyse the EU-independent sustainability of your project it is important to understand how much and for how long you have to rely on subsidisation. This analysis delivers a qualitative approach to this subject by simply comparing fixed and variable costs of the units sold to the expected revenue. The Break-Even-Point (BEP) marks the moment your business turns profitable.
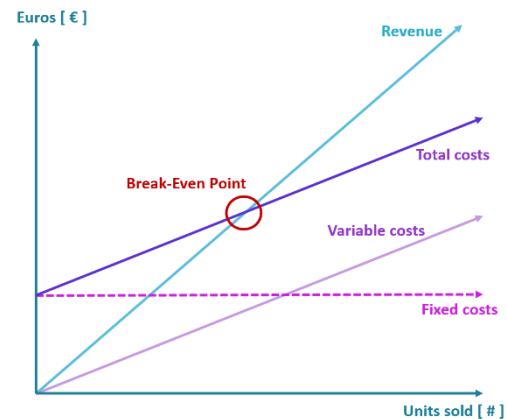

Figure 12: Break-Even-Analysis

Return of Investment

This graphical representation of your BEP can be emphasised by the quantitative representation through your Return of Investment (ROI). The ROI produces a percentage by dividing the difference between your revenue and your investment by your investment.

$$ROI = \frac{Revenue - Investment}{Investment} \times 100$$

Before you reach the BEP the investment will be greater than the revenue leaving you with losses and hence with a negative ROI. Passing the BEP your ROI will turn positive and hence predict sustainability while the height of percentage provides an indication on how much so.

3.2.10 Implementation Roadmap

After having gone through the above described tools it is time to fill in a roadmap and organise the exploitation of your project into a specific action plan. To fill in a Roadmap efficiently the high-level strategy on how to propel this project's idea into reality has to be in place. The Roadmap puts everything together and should leave you with a comprehensive list of actions to be undertaken throughout the project life cycle and beyond. It acts as a navigation chart, guiding you from where you are to where you want to go and how to get there. A well created road map accompanies the project development as a touchstone, telling you what you should be doing and how well you are doing it.
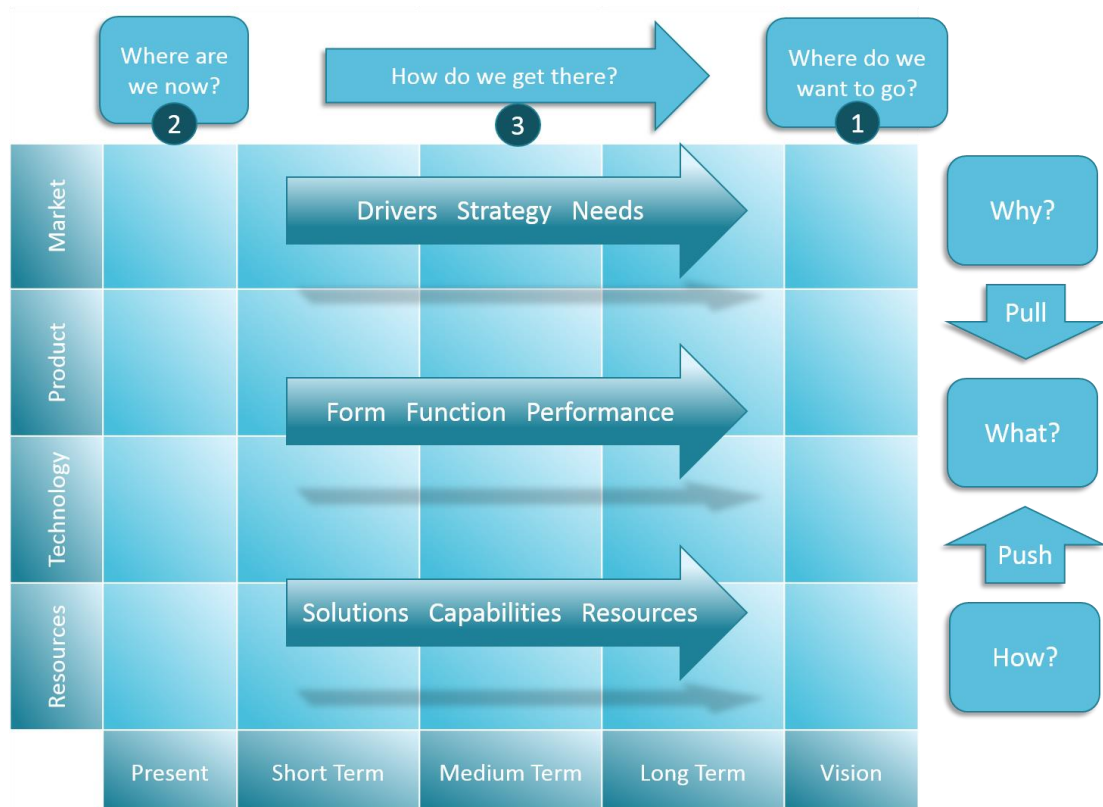

Figure 13: Schema of an exploitation roadmap

4 Tailoring to / Synergies between I4.E Lighthouse Projects

The ECSEL projects currently included in the 'Digital Industry Lighthouse' typically run for 3 years and range from 30 - 100 partners and €10 to €100 million. The current projects have starting dates from May 2015 to date.
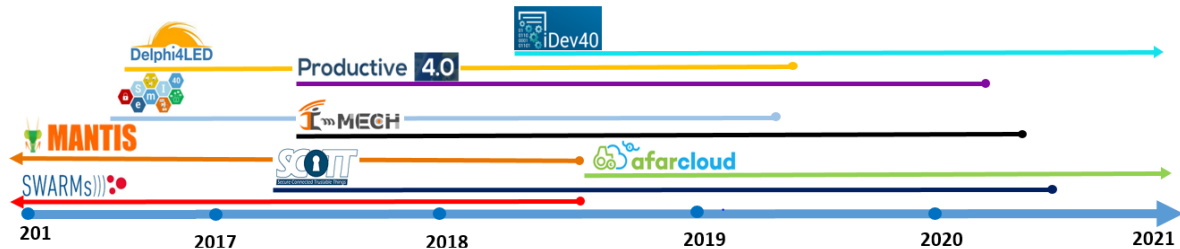

Figure 14: Project time lines

Projects have targeted main topics of the Smart Manufacturing or Digital Industry chapters of the related ECSEL Strategic Research Agendas (SRA).

ECSEL SRA challenges and topics from calls before 2018 focussed on:

Challenges:
- Digital and highly automated production
- Flexible sustainable production with customisation capabilities
- Collaborative production in efficient supply chain networks
- Coverage of the entire product life-cycle
- Safe and secure production
- Improved Overall Equipment Efficiency (OEE)

Roadmap Topics:
- Instant access to virtual dynamic factory
- Increased Information transparency between field devices and ERP
- Real-time sensing & networking in challenging environments
- Process Industry as an agile part of the energy system
- Management of critical Knowledge to support maintenance decision-making
- Automation service and function development process
- Open simulator platform
- Automation system for distributed manufacturing
- Balancing of system security and production flexibility

Thereafter, major challenges were defined, and the 2018 and 2019 ECS SRA included:

- **Major Challenge 1:** Developing digital twins, simulation models for the evaluation of industrial assets at all factory levels and over system or product life-cycles
- **Major Challenge 2:** Implementing AI and machine learning to detect anomalies or similarities and to optimise parameters

28 (**45**)

- **Major challenge 3:** Generalising condition monitoring, to pre-damage warning online decision-making support and standardisation of communication scenarios to enable big data collection across huge (remote) sites
- **Major challenge 4:** Developing digital platforms, application development frameworks that integrate sensors/actuators and systems

A short analysis of the Lighthouse Projects' objectives and exploitable results is performed within the next chapter. An in-depth analysis and mapping of the projects will be performed in D1.1.

4.1   Examples of Industry 4.E Lighthouse Objectives and Results

In the Industry 4.E Lighthouse, Key Exploitable Results have been uncovered through a few different methods. First, public deliverables published on the websites of all Industry4.E Lighthouse projects were scanned in order to identify key findings within these projects. Next, these results were clustered into a variety of common Industry4.0 and Electronic Components and Systems domains present within the ECSEL JU's focus areas. Next, these identified results were then compared with presentations given at the in-person workshop held by the Industry4.E CSA in Bucharest, Romania in June 2019. As a final step, the CSA cross-referenced what Lighthouse Project leaders identified themselves as their main exploitable results with that the CSA had found, and re-clustered them into main focus areas. The Industry4.E Lighthouse Projects are described in the order of their starting date.

4.1.1   MANTIS

MANTIS – **Cyber Physical System based Proactive Collaborative Maintenance** was a 47 partner strong consortium funded by ECSEL-JU. The overall concept of MANTIS was to provide a **proactive maintenance service platform architecture** based on **Cyber Physical Systems** that allows estimation of future performance, prediction and prevention of imminent failures and scheduling of proactive maintenance. MANTIS' **Proactive Maintenance** Service Platform Architecture is based on Cyber Physical Systems that enable "Collaborative Maintenance Ecosystems". The scope of technical innovation developed by MANTIS includes, **smart sensors, actuators and cyber physical systems** capable of local pre-processing, as well as robust **communication systems** for harsh environments.

More specifically, the technologies addressed in the MANTIS project related to predictive maintenance include new sensing CPS to capture maintenance relevant/critical information, virtual Plug & Play, secure wireless solutions, remote access to new geographic markets networks, distributed (local) decision making, cloud connection for data aggregation and complex computing and distributed Big Data analysis.

Since the close of the MANTIS project, several exploitable results can be seen. These consist of a unique MANTIS **open reference architecture**, a selection of **optimal sensors** for intelligent functions, new **AI algorithms** that have been validated and tested in 11 use cases, and 36 new products, 13 processes, 16 methods (consists of algorithms, HMI, sensors, and software platforms). The research addressed in MANTIS will continue to contribute to companies' assets availability, competitiveness, growth and sustainability. More details at **www.mantis-project.eu**

4.1.2   SWARMs

SWARMs -Smart and Networking Underwater Robots in Cooperation Meshes, was an industry-led ECSEL-JU project, where large technology companies collaborate with SMEs specialised in **the subsea, robotics and communication sectors**, and universities together with research institution. SWARMs designed, developed and successfully demonstrated a platform for a new generation of **autonomous maritime and underwater operations.** The project's **integrated platform** includes a set of **software/hardware components**, adopted and incorporated into the current generation of maritime and underwater vehicles in order to improve autonomy, robustness, cost-effectiveness, and reliability of offshore operations, namely through vehicles cooperation. The SWARMs platform consists of technologies that (unlike other manufactures), to share integrated robot functionalities in a transparent way.

SWARMs technology also resulted in a distributed set of **intelligent components for perception, decision-making and environment recognition** capable of assisting the vehicles in characterising the working environment, including artefacts, and i**mproved communication technologies** as well as **sensing (vision and acoustic) technologies.** The project's underwater vehicles were proved to enhance **control and management services**, hardware, assisting in the execution of mission's tasks, and creating, monitoring, controlling and managing the mission's activities **autonomously in real-time.** Overall, the SWARMs project resulted in reduced operational costs, increased safety of tasks assigned to divers and contributed to dealing with factors that threaten the offshore sector's expansion. More information at **www.swarms.eu**

4.1.3   SemI40

SemI40 - Power Semiconductor and Electronics Manufacturing 4.0 was a project consisting of an international 37 partner team of leading industry partners with small- and medium sized companies as well as research institutes and well-established universities. The project's ambition was to enhance sustainable competitiveness in European electronics and semiconductor production, adopting recent innovations in electronic systems and ICT technologies. SemI40 particularly concentrated on developing essential manufacturing capabilities. By advancing European electronic components and systems manufacturing to "Smart Sustainable and Integrated Production", Semi40 focused on two domains of key enabling technologies, "production" and **"semiconductor technologies"** made in Europe.

The project included a well-focused approach of **automation and smart production system integration in the domains of technologies, tools and methodologies**, which are complemented by innovations in the area of **secure communication, knowledge management, automated decision-making and smart agile production execution**, will ensure the competitive production in Europe. **In particular,** specific technologies and methods included **data safety and security** in manufacturing environment, integration of legacy equipment, **and agility** in ECS production for fast **adaptability**, **automated decision making** in manufacturing shop floor, and v**irtualisation** and digitalisation for advanced simulation. Through applying holistic, complex and challenging approaches, SemI40 will further pave the way for highly innovative microelectronics "Made in Europe." For more information, visit **www.semi40.eu**

4.1.4   Delphi4LED

Delphi4LED - From Measurements to Standardised Multi-Domain Compact Models of LEDs is Europe's leading thermal research world-wide in terms of thermal measurement and modelling techniques. The aim of the H2020 Delphi4LED project was to help maintain this leadership in the specific field of LEDs. The European lighting industry aims at reducing cost, at continuously improving product performance while reducing time to market and enlarging the product. The main objective of Delphi4LED was to develop a standardised method to create multi-domain (thermal-optical-electrical) LED based **design and simulation tools** for the solid-state lighting industry. As part of the Delphi4LED project, **tools and standards** were developed on various levels to enable the design and manufacturing of more **reliable and cost-effective LED based lighting solutions** to bring to the market much faster than today.

Delphi4LED's main results consist of a multi-domain **LED compact model** and a proposed **new LED-based product digital flow.** Other results from the research have been **virtual prototyping** and simulation for lighting design, as well as an LED compact towards international standards committees (CIE and JEDEC). The researchers also obtain exploitable results through optical measurement methods of LED packages and thermal characterisation techniques for semiconductor packages. Overall, the consortium also established recommendations on LED test package reporting, which will also be brought before standardisation bodies. For more info, visit **www.delphi4led.eu**

4.1.5   Productive4.0

Productive4.0 – Electronics and ICT as an enabler for digital industry and optimised supply chain management covering the entire product lifecycle. Producive4.0 is Europe´s biggest research project in the field of Digital Industry. It is an ECSEL-JU project, with 108 partners, and is the cornerstone project of the Industry4.E Lighthouse. The project addresses all domains of the Digital Industry, thus comprising the complete range of Industry 4.0. One of the project's main aims is to create a **user platform** across value chains and industries, thus promoting the **digital networking of manufacturing companies, production machines and products**. The participating partners have examined methods, concepts and technologies for **service-oriented architecture** as well as for components and infrastructure in the Internet of Things. Other aspects are **standardisation and process virtualisation, in other words, simulating manufacturing processes to optimise real workflows**. The platform can be used in the three interlocked process pillars for managing the **supply chains, the product life cycle and digital production**.

Productive4.0 will furnish companies with fundamental tools necessary for the digital transformation. The results such as **IoT components modelling and simulation methods** as well as **tool chains for cross-lifecycle and cross-domain digitalisation** are suitable means for linking all stages of a **product lifecycle** in a sustainable way. In establishing a Semantic Web, they have created a digital reference platform that also creates a common language for semiconductor supply chains. The project's work has also resulted in **SoS-based system architecture platforms to supporting automation and digitalisation** for industry, which includes technologies such as **real-time performance, safety and security, engineering and scalability** as well as support of plant capturing. The Productive4.0 consortium is working to make production more predictable and flexible, and to change business models for the upcoming digital revolution into business success. More information at **www.productive40.eu**

4.1.6 SCOTT

SCOTT– Secure COnnected Trustable Things is an ECSEL-JU project with 57 key partners from 12 countries (EU and Brazil), that will provide comprehensive cost-efficient solutions for wireless, end-to-end secure, trustworthy connectivity and interoperability. SCOTT uses **a standardised multi-domain reference architecture,** created in a predecessor project (DEWI and its "Bubble concept") and being fully compliant with ISO 29182 – Sensor Network Reference Architecture, which fosters reusability, scalability, and interoperability of SCOTT solutions.

SCOTT's main results are the anticipated development of **building blocks for security & safety**, **distributed cloud integration**, energy efficiency, autonomy of devices, and reference architecture/implementation. SCOTT aims to extend the **Internet of Things,** and is working with various technologies, including wirelessly connected devices, smart sensors and actuators, and smart infrastructure in home, mobility, health domains. Integrated into SCOTT's use cases are systems also focusing on privacy and trustability. SCOTT has been testing various products in use cases across several domains, which include IOT systems for focus areas such as assisted living facilities and automobile security. The project anticipates that its results will help define models of evaluation of safety and security. For more details, visit **www.scottproject.eu**

4.1.7 I-MECH

I-MECH - Intelligent Motion Control Platform for Smart Mechatronic: I-MECH is a 31 partner ECSEL-JU project that aims to bridge the gap between the latest research results and best industrial practice in intelligent motion control for smart mechatronic systems. The project works with Software and Hardware building blocks, featuring standardised interfaces, will be developed to deliver a complete **I-MECH reference** motion control platform. The project's main objectives are to develop techniques for employment of advanced **model-based methods for the design, real-time control and self-diagnosis of cyber-physical systems.** It will also develop a smart Instrumentation layer gathering visual and sensor information to enhance the achievable performance of the system, and will develop modular unified, Software motion control building blocks for a service-oriented architecture paradigm, i.e. Smart Control Layer.

I-MECH will lead to improved machine performance and reliability as measured by a whole variety of parameters including response time, reliability, control bandwidth, control accuracy and error. The developed technologies in will have a significant impact on industrial printing, semiconductor production, high speed packaging, **smart machining tools** and high precision CNC milling machines, and healthcare robotics. In terms of results, so far, I-MECH has successfully established a **reference platform**, which consists of both hardware and software building blocks, as well as CPS methodologies. Some examples include medical manipulators, printing devices, semiconductors, packaging, and big CNC machining. Other anticipated future results as the project carries forward **are full machine digital twins** living parallel live used for predictive maintenance, edge computing, new principle actuators, and collaborative robots. For more information, visit **www.i-mech.eu.**

4.1.8 iDev40

iDev40 – Integrated Development 4.0: a 38 partner ECSEL-JU project, with a main objective to achieve a disruptive or "breakthrough change" step towards speedup in time-to-market by digitalising

European industry. iDev40 introduces seamlessly integrated **ECS development processes, safe and secure digital automation workflows, interoperable and inter-organisational network solutions as well as an enhanced transparency of data and intelligence** that will lead to a reduction in the time to market (T2M) race for ECS solutions. This project will take the **human factor** seriously throughout all planned industrial use cases and will increase people excellence by identifying **human-centric** complexity drivers for integrated development and production, defining the right **skill profiles** of the employee in the factory of the future to cope with digitalisation challenges and thereby scale digital technology adoption.

iDev40 has produced several exploitable results. So far, these consist of successes in reaching their goal to implement AI approaches in the ECS Domain. The consortium has been able to **virtualise the entire IFX fab cluster**, and is also developing visualisation tools for multi-factory planning. The project has also produced new automated sorter scenarios and simulation models for development lots. The research work has also been able to effectively digitise to **automate administration processes** and begin the development of **standardisation for digital twin**. Overall, their simulation work to create **frameworks for complex socio-technical systems** will create a large impact in the industry. iDev40 will lead to a new role of Europe in digital culture, leadership, skill sets and capabilities of the human workforce to implement the digital change. More information at **www.idev40.eu.**

4.1.9   AFarCloud

AFarCloud - Aggregate Farming in the Cloud, is an ECSEL-JU project with 60 partners that will provide a distributed platform for autonomous farming that will allow the integration and cooperation of **agriculture Cyber Physical Systems** in real-time in order to increase efficiency, productivity, animal health, food quality and reduce farm labour costs. AFarCloud will provide a **distributed platform for autonomous farming**, which will allow the platform to be integrated with farm management software and will support **monitoring and decision-making**, based on **big data and real time data mining techniques**.

AFarCloud also aims to make **farming robots** accessible to more users by enabling farming vehicles to **work in a cooperative mesh**, opening up new applications and ensuring re-usability, as various standard vehicles can combine their capabilities in order to boost farming efficiency. The consortium represents the whole ICT-based farming solutions' value chain, including all key actors needed for the development, demonstration and future market uptake of the precision farming framework targeted in the project. More details at **www.afarcloud.eu**

4.1.10   MADEin4

MADEin4- Metrology Advances for Digitised ECS Industry 4.0, is a new ECSEL JU project that is a joint action of nearly 50 manufactures and R&D organisations from 10 countries. The project will focus on developing **advanced and highly connected cyber physical systems** using a novel Industry 4.0 approach that combines metrology data analysis and design with **machine learning** methodologies and digital twinning. MADEin4 will facilitate manufacturers' pre-commercial access to test samples by connecting them with large RTOs, in order to reach its overall goal of driving European **semiconductor** industry growth. So far, results of the MADEin4 project have been the development of next generation metrology inspection tools, as well as the development of systems of electronic design automation,

product lifecycle management, machine learning, and digital twinning for **predictive maintenance**. Further in the project, the consortium expects it will have a production-line demonstrator.

4.1.11 Arrowhead Tools

Arrowhead Tools is another new ECSEL JU project that aims for digitalisation and automation solutions for the European industry, which will close the gaps that hinder the **IT/OT integration**. Arrowhead Tools will introduce new technologies in an open source platform for the design and run-time engineering of IoT and System of Systems. Overall, the projects' expected results are to provide new engineering processes, **an integration platform**, and new tools for the cost-efficient development of digitalisation, connectivity and automation system solutions.

Further Industry4.E Lighthouse projects – a number of other projects will join the Industry4.E Lighthouse as it evolves. These projects will all have access to the guidelines to help them to increase the social impact and uptake of their results.

Within the ECS-SRA and book of projects, the projects have been classified according to the following categories:
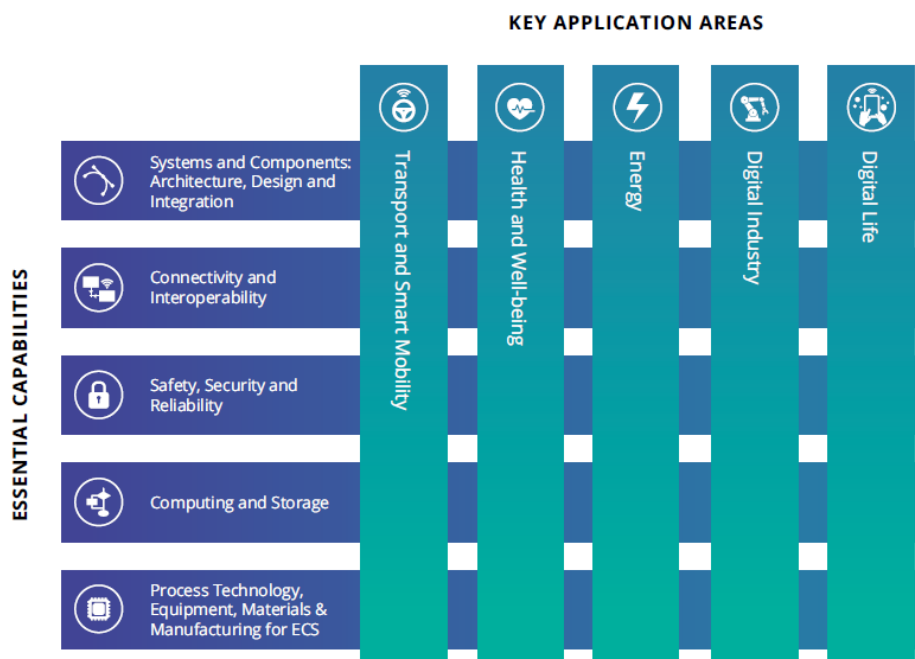
Figure 15: Key application areas and essential capabilities of ECSEL SRA

The Following table categorises the Lighthouse projects into their contribution regarding essential capabilities, the major challenges of the SRA 2019 and future challenges foreseen for SRA updates.

4.2 Analysis of synergies

To analyse synergies, complementarities and cross-cutting themes, a matrix for the current Lighthouse projects and themes has been elaborated:

Domain		SWARMs	MANTIS	(Arrowhead)	Delphi4LED	SCOTT	I-MECH	Productive 4.0	iDev40	afarcloud
Systems and Components Architecture, Design, Integration		■	■	■	■	■	■	■	■	■
Connectivity and Interoperability		■	■	■		■	■			■
Safety, security and Reliability				■		■		■	■	
Computing and Storage								■	■	■
ECS Process Technology, Equipment, Materials and Manufacturing				■			■	■	■	■
ECS SRA 2018 and 2019										

Digital Twins Modelling & Simulation				●	●			●	●	
Artificial Intelligence, Machine learning		●	●	●			●	●		●
Condition Monitoring, Predictive Maintenance			●				●			
Digital Platforms Application Development Frameworks		●	●			●	●	●	●	●
ECS SRA emerging themes										
Human centered Manufacturing									●	
Sustainable Manufacturing, Circular Economy										

Figure 16: Project Domain Matrix

The Industry4.E Lighthouse themes and topics focus on the digitisation of manufacturing, including systems engineering, architectures and platforms, data analytics, condition monitoring and predictive maintenance, modelling and simulation, digital twin, connectivity and interoperability, reliability, safety and cybersecurity, CPS and IoT above others. Emerging themes include AI enabled, human centred manufacturing, and sustainable manufacturing in a circular economy. The projects complement each other well and can build upon each other's results. Moreover, there are other programmes and initiatives on European (e.g. H2020 Factories of the Future / FoF) and national or regional level (see graph below). Lighthouse Projects are recommended to exchange results with these relevant initiatives. As the projects are quite large, with a big number of partners they cover many countries across Europe within the project ecosystem. To enhance interaction especially with the much related FoF projects, the EFFRA Innovation portal will be used to collect and categorise the projects outcomes, to enhance collaboration and exploitation for the overall achievements.
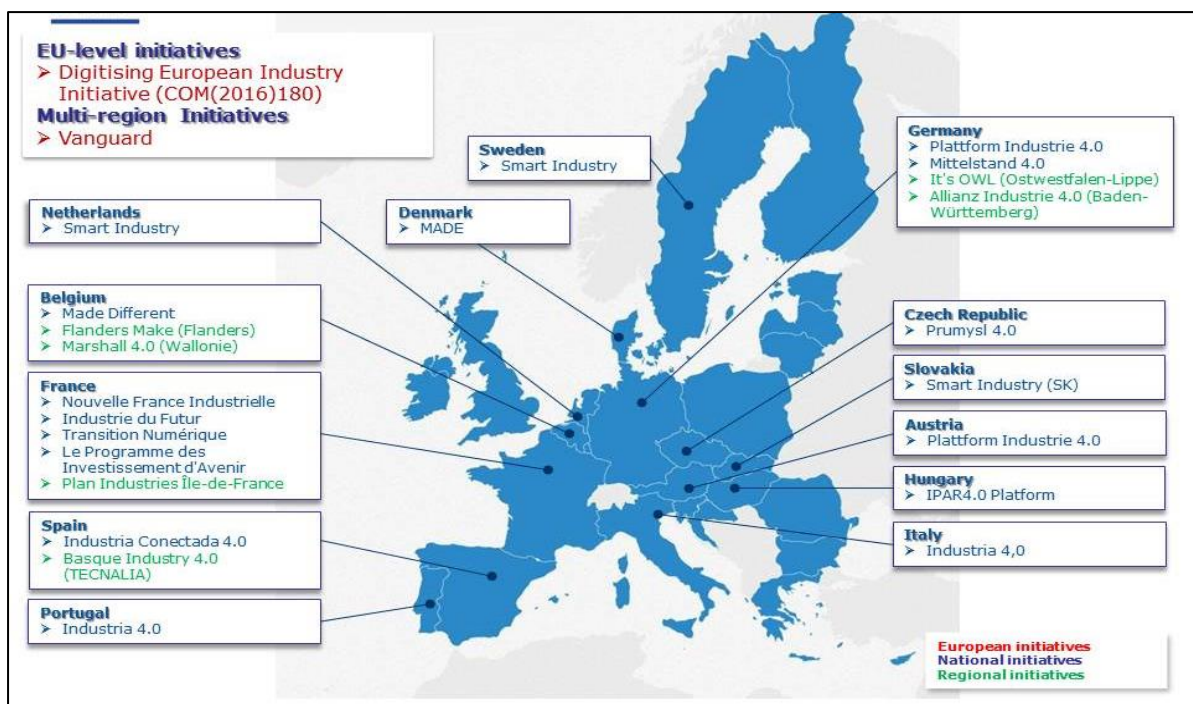

Figure 17: Related EU, national and regional initiatives

4.3 Assessment of projects needs

To assess how the CSA Industry 4.E can best support the Lighthouse Projects in their Dissemination and Exploitation efforts, ideas had already been detailed within the Description of Action, including supporting the development of the Dissemination and Exploitation Plans, providing trainings on methods and tools and elaborating guidelines for current and future Lighthouse Projects.

To verify the ideas and adapt them to the most suitable approach, the Lighthouse Projects were asked for their feedback in the Collaboration Meetings (Bucharest, June 19th 2019) and through questionnaires (see annex). The outcomes of this will directly feed into the design of the trainings offered to the Lighthouse Projects and the Guidelines for Dissemination and Communication.

5 Checklist

The below checklist gives an overview on key questions to be checked for your dissemination and exploitation approach. As projects vary in size, focus, duration etc. not all the points have to apply to your project, but they could give you guidance on what to consider.

Checklist	Yes / No	Need for training	Comment
Dissemination			
Is a strategic plan for Dissemination and Exploitation in place (and regularly updated)?			
Is a Data Management Plan in place, detailing how you will exploit and/or share and preserve your data?			
Is the consortium aware of Dissemination and Exploitation funding rules? (in the Grant Agreement and/or Consortium Agreement)			
Does the project have a dedicated work package on Dissemination and Exploitation? Is a Dissemination, Exploitation and / or Innovation Manager or Committee appointed?			
Are dissemination and communication messages elaborated? Is the project portfolio analysed and promoted?			
Are the target group analysed and defined well?			
Are the partners networks exploited and multipliers involved? Is networking with related projects and clusters performed? Are there own community building efforts?			
Are the Communication and Dissemination materials adapted to scientific, industrial, end-users and general audiences?			
Are Communication and Dissemination tools and channels established and efficiently used. Are KPIs defined and assessed?			
Is feedback collected and a statistical analysis performed? (e.g. web visits, social media followers, participants in workshops,…)?			
Is there a detailed planning and high activity regarding project related publications, conferences, fairs, workshops, trainings, … Are KPIs defined and assessed?			
Are own dissemination or demonstration events, roadshow or dissemination campaigns planned?			
Are trainings planned? Are you providing skills training – skilling, upskilling, reskilling?			
Exploitation			
Have you elaborated a preliminary business plan (in the proposal)?			
Is continuous technology watch performed?			
Is a patent analysis performed (FTO - freedom to operate checked)?			
Are IPR issues handled well and transparently e.g. within project internal exploitation workshops (Consortium Agreement, background, foreground, ownership, access rights)?			

Are exploitable results identified, described well and prioritised?			
Are exploitation opportunities and risks well assessed?			
Has a stakeholder analysis been performed and adapted to the projects outcomes?			
Is a value chain analysis and competitors analysis performed?			
Is a SWOT, PESTEL performed?			
Is a market analysis performed?			
Is a risk analysis performed?			
Are business models elaborated for key / high potential exploitable results?			
Are business plans elaborated within the project lifetime?			
Is an exploitation / commercialisation roadmap elaborated?			
Are prototypes, use cases, pilots or demonstrators planned?			
Will you address investors? Do you know how to pitch?			
Are standardisation efforts undertaken?			

6 Next Steps: Trainings and Guidelines

After the assessment of suitable methodologies and tools as well as feedback from the lighthouse projects, targeted trainings will be elaborated and 3 training sessions will be held (1st at EFFECS 2019). Thereafter, CSA-Industry4.E will develop a comprehensive Guideline document tailored to Industry4.E (D3.3) for current and future lighthouse associated projects to help them in communicating, disseminating and exploiting their results.

Next to the trainings and guidelines targeted at Dissemination and Exploitation (derived from WP3 activities), the final guidelines will include a chapter on Communication activities (derived from WP4 activities) to help them in communicating their story to the general public to increase the social impact and uptake of project results.

7 References

Azkarate, Ander. *Methodology for Clustering, Industrial Exploitation & Take-up. D2.2 Methodology for Industrial Exploitation & Take-Up*. FOCUS on FoF, 2016, pp. 1–14.

FoF-Impact. *D1.3 Use and Impact of Existing Technology Transfer Services within the Context of Factories of the Future*. EFFRA, 2016, pp. 1–33.

FoF-Impact. *D2.2 Formats for public workshops and events*. EFFRA, 2016, pp. 1–37.

FoF-Impact. *D2.3 Formats for first and second line assistance to individual organisations or project consortia*. EFFRA, 2016, pp. 1–20.

Herlitschka, de Colvenaer et al. *ECSEL JU Book of Projects: Calls 2016 & 2017*. Vol. 2, European Commission, 2018.

Nowak, Foster et al. *ECSEL JU Book of Projects: Calls 2014 & 2015*. Vol. 1, European Commission, 2016.

Participant Portal H2020 Online Manual. European Commission, 2019. <ec.europa.eu/research/participants/docs/h2020-funding-guide/grants/grant-management_en.htm>.

Steinbeis Europa Zentrum. "Exploitation Workshops" *Steinbeis-Europa-Zentrum*

8 Useful Links

Business Model Canvas	http://www.strategyzer.com
European Patent Office	http://www.epo.org
European Standardisation Organisation CEN	https://www.cen.eu
CENELEC	http://www.cencenelec.eu
ETSI	http://www.etsi.org
International Patent Classification	http://www.wipo.int/ipcpub
Patent research	http://worldwide.espacenet.com
Lighthouse Projects	
MANTIS	http://www.mantis-project.eu
SWARMs	http://www.swarms.eu
SemI40	http://www.semi40.eu
Delphi4led	http://www.delphi4led.eu
Productive40	http://www.productive40.eu
SCOTT	http://www.scottproject.eu
I-MECH	http://www.i-mech.eu
iDev40	http://www.idev40.eu

9 History of Changes

This Deliverable has been developed by the CSA-Industry4.E WP3 leader S2i, in collaboration with the CSA-Industry4.E partners.

Industry4.E Public Engagement and Outreach Strategy	
Version - Date	**Comments & Recommendations**
V0 – 15.05.2019	D3.1 document structured, draft created; Meike Reimann (S2i)
V1 – 29.05.2019	D3.1 draft enriched with descriptions of tools and methodologies (S2i)
V2 – 07.06.2019	D3.1 draft adapted with summary, introduction, definitions (S2i)
V3 – 12.06.2019	D3.1 draft updated with Projects Exploitable Results and Check-list (S2i)
V4 – 27.06.2019	D3.1 finalisation (S2i)
V5 – 28.06.2019	D3.1 submission (IMR)

10 Annex

10.1 Questionnaire on methods and tools used and support needed

Exploitation Checklist

Lighthouse Project: _____   Contact: _____

Methods/Tools	Yes/No	Training need	Comment
Key Exploitable Results (KER)			
Key Exploitable Results (KER) clearly defined			
Characterisation by innovation, exploitability, impact in industry			
Prioritisation of KERs			
Clustering of KERs			
Intellectual Property Management			
Consortium Agreement			
Background/Foreground			
Ownership			
Access rights			
Patent Analysis			
Technology Watch			
Market Research			
Stakeholder & Competitor analysis			
Value chain analysis			
SWOT/PESTEL			
Risk assessment			
Standardisation			
Business Models and Business Plans			
Value Proposition			
Business Model Design			
Business Plan			
Exploitation Roadmap			
Pitch to Investors			

General Comments

Dissemination Checklist

Lighthouse Project:_____   **Contact:**_____

Methods/Tools	Yes/No	Training need	Comment
Dissemination and Exploitation Plan / Data Management			
Dissemination and Exploitation Plan in place			
D & E Plan regularly updated (KPIs?)			
Data Management Plan in place			
Dissemination / Communication Channels, Materials & Activities			
Website, dissemination kit, social media channels			
Project portfolio analysed and promoted			
Project messages clear, target group specific material developed			
Dissemination on fairs, conferences, workshops			
Scientific and technical publications / patents			
Own dissemination / demonstration event			
Dissemination campaigns			
Training activities			
Stakeholders Analysis and Engagement			
Stakeholders / target groups analysed			
Clustering activities / networking			
End-user involvement			
General Comments			
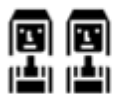
10.2 Questionnaire on Key Exploitable Results

Project Name: _____ **Contact:** _____

Domain	TRL	Rank	Key Exploitable Results	Comments
ECSEL – Digital Industry Topics 2018 / 2019				
Digital Platforms Application Developm. Frameworks			•	
Digital Twins Modelling & Simulation			•	
Condition Monitoring, Predictive Maintenance			•	
Artificial Intelligence, Machine learning			•	
Human centered Manufacturing			•	
Sustainable Manufacturing, Circular Economy			•	
?			•	
ECSEL Roadmap Industry Related technological Topics 2018				
System & Components: Architecture, Design and Integration			•	
Connectivity and interoperability			•	
Safety, security and Reliability			•	
Computing and Storage			•	•
ECS Process Technology, Equipment, Materials and Manufacturing			•	
?			•	
ECSEL – Application Domains in addition to Digital Industry				
Transport			•	
Health			•	
Energy			•	
Digital Life			•	
?			•	

Results Involvement Key:

0= Not applicable   + = Low   ++ = Medium   +++ = High

General Overview of Lighthouse Project Results

Domain		Rank	Results	Comments
Digital Platform				
Modular factory for distributed and automated production				
Live virtual twins of raw-materials, process and products				
Advanced sensors				
Real-time data analytics				
Hardware components				
Software components				
Robotic and Cobot Systems				
Management of critical knowledge				
Semi-autonomous automation engineering				
Integrated operational & cybersecurity management				
Other	?			

Results Involvement Key:

0= Not applicable	+ = Low	++ = Medium	+++ = High