# Open-Digital-Industrial and Networking pilot lines using modular components for scalable production

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**Summary**: The purpose of this document is to report the final exploitation strategies of ODIN partners, promoting the Key Exploitable Results (KER) in further commercial and research applications. Specifically, compared to the previous exploitation deliverables of the project, it presents the final Results Ownership List (ROL) of the project, it includes an updated market analysis with detailed market niches for each KER and an IP landscape analysis, it presents the final exploitation strategies of ODIN's partners, and it further elaborates on the commercialisation plans per KER. All the exploitation activities of the project have been also benefited from the Horizon Results Booster (HRB) service. A dedicated HRB expert reviewed our go-to-market strategy and business plans and validated their feasibility and potential.

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## GLOSSARY

| Acronym | Definition |
|---|---|
| **BG** | Background IP |
| **CA** | Consortium Agreement |
| **EA** | Exploitable Asset |
| **ER** | Exploitable Result |
| **FG** | Foreground IP |
| **GA** | Grant Agreement |
| **HRC** | Human Robot Collaboration |
| **HW** | Hardware |
| **IP** | Intellectual Property |
| **IPR** | Intellectual Property Rights |
| **KER** | Key Exploitable Result |
| **ROL** | Results Ownership List |
| **SW** | Software |
| **SWOT** | Strengths, Weaknesses, Opportunities, and Threats |

# LEGAL DISCLAIMER

The ODIN project is co-funded by the European Union's Horizon 2020 research and innovation programme under the Grant Agreement No 101017141. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the granting authority can be held responsible for them.

## EXECUTIVE SUMMARY

The ODIN exploitation plan, spanning six phases, exhibited progress up to M48, since it has been constantly followed and several exploitation activities have been implemented. The final exploitation strategies per project partner and per Key Exploitable Result (KER) are presented in this report. Detailed sections delve into the exploitation plan and the IPR Strategy, presenting the project's efforts from M37 – M48. Key activities so far encompass the creation of the ODIN innovation management log, updating ER specifications, analysing target markets, and refining exploitation paths. The comprehensive IPR analysis extends to individual ERs and the broader landscape, providing insights for efficient commercialization. To enhance our exploitation activities, ODIN has applied and received services from the Horizon Results Booster initiative, which is supported by the EC. The project has also uploaded most of its KER to the Horizon Results Platform, to increase their visibility and get access to potentially new end-users and/or collaborators.

More specifically, the key activities described in this report include:

- the presentation of the final Results Ownership List (ROL) of ODIN,
- IPR management endeavours, represented by the re-validation of the project's Background IP and Foreground IP,
- final and detailed market research, which includes presentation of ODIN's target markets and market niches, EU dynamics and regulatory framework (especially in manufacturing digitalization and robotics), updated SWOT analysis and IP landscape analysis,
- detailed presentation of the exploitation activities done in collaboration with the Horizon Results Booster service, along with their outcomes,
- a Business Model Canvas (BMC) for the project as a whole, to highlight key value propositions, distribution channels, revenue streams and costs, among others,
- individual exploitation plans describing in detail how the ODIN partners intend to use the project results in further commercial and/or research activities,
- 7 commercialization plans which were designed and updated based on feedback received from the HRB services, one for each of the KER, and
- 8 exploitation cases and tailored market entry plans for the next years, based on the work done in the commercialization plans.

In total, the updated list includes **27 Exploitable Results**, out of which, and based on partners' exploitation views and business strategies, **7 of them have been highlighted as Key Exploitable Results** (and therefore, final commercialisation plans and a tailored go-to-market strategy has also been developed for them). The final list of the ODIN KER is presented below:

| # | Key Exploitable Result | Owner(s) | Target Market |
|---|---|---|---|
| 1 | Perception skill library for flexible robotics | ROBOCEPTION and TAU | Manufacturing companies that use robotic systems, robotics software providers, training and maintenance service providers |
| 2 | Digital twin protection framework and threat analysis toolkit | S21Sec | • Companies that use digital twin systems, including manufacturing, construction, and logistics companies<br>• Cybersecurity and data privacy service providers |

| | | | |
|---|---|---|---|
| 3 | Risk assessment, virtual safety components and safety validation methods for industrial deployment | PILZ | • End users such as manufacturing, construction, and logistics companies that want a cost-efficient way to validate their HRC applications.<br>• Industrial safety service providers, to optimize the design time of the safety concepts.<br>• Machine builders, system integrators that focus that apply HRC technologies in their solutions and OEMs, optimize the design time of the safety concepts and they also want to validate in simulation that the proposed designs comply with the standard. |
| 4 | OpenFlow Platform (previously Open flexible orchestration of workplaces) | INTRA | • Large manufacturing companies with automated production lines.<br>• Technology integrators in manufacturing. |
| 5 | Autonomous mobile manipulators for collaborative operations (2 distinct solutions, one owned by COMAU, the other owned by AIC which are bundled into one KER) | COMAU and AIC | • Manufacturing companies that your manufacturing process consist on serial operations and flexibility on operations positioning in traceability of product is needed.<br>• Manufacturing companies needs flexible production for to produce a lot of versions of product. |
| 6 | ML Solution for inspection of automotive engines | DGH | • Automotive manufacturing companies with automated production lines requiring advanced objects and defect detection.<br>• Automotive manufacturing companies working with robotic systems that align well with the project's develops done.<br>• All the levels of industries OEMs, and TIER 1 and TIER 2 suppliers. Manufacturing companies working in these types of industries. |
| 7 | AR Suite for collaborative assembly operations | LMS and INTRA | • Manufacturing companies interested in human-robot collaborative operations to ensure the effective and safely co-existence of human operators and robot.<br>• Robotic Integrators in case of Human-Robot Collaborative workstations.<br>• Assembly line operators without background knowledge on the assembly procedure.<br>• Manufacturing companies interested to inform human operators on demand regarding corrective actions on products (e.g. quality inspection results, corrective actions)<br>• Training providers to train in a more efficient way new employees. |

## Final ODIN Market analysis

ODIN targets three main markets: Manufacturing Automation and Robotics, Industrial IoT (IIoT), and Industrial Safety & Security. These markets are experiencing robust growth driven by technological advancements, digitalization, and regulatory requirements.

- **Manufacturing automation and robotics**: valued at $205.86 billion in 2022, this market is projected to reach $351.78 billion by 2029 due to Industry 4.0 adoption and labour shortages. Key applications include assembly, quality control, and human-robot collaboration.
- **Industrial IoT (IIoT)**: Growing from $544 billion in 2022 to $3.3 trillion by 2030, IIoT is revolutionizing industrial operations with technologies like digital twins, predictive maintenance, and connected devices.
- **Industrial Safety & Security**: Estimated at $5.5 billion in 2022 and expected to hit $9.2 billion by 2028, growth is driven by workplace safety and cybersecurity needs.

In the EU, the manufacturing automation market accounts for €51.4 billion, led by Germany. EU regulatory frameworks, such as the Machinery Directive and the European Green Deal, emphasize digitalization, sustainability, and safety. These create significant opportunities for ODIN's solutions, including energy-efficient systems and safety-compliant automation.

## Summary of the ODIN Business Model

The ODIN business model focuses on delivering advanced Industry 4.0 automation solutions, targeting large manufacturers, OEMs, and smart manufacturing facilities undergoing digital transformation. Key partners include AI and robotics developers, regulatory bodies, and funding agencies, ensuring compliance and innovation support. Core activities involve refining ODIN’s exploitable results, customizing solutions for industries like automotive, and adhering to safety and cybersecurity standards. ODIN's value propositions emphasize enhanced operational efficiency, improved quality control, safer human-robot collaboration, and reduced downtime through predictive maintenance and AI-driven analytics. Customer relationships are encouraged through tailored training programs and co-development of solutions with key clients. Critical resources include a robust IP portfolio with 27 exploitable results, advanced AI and IoT frameworks, and skilled professionals. ODIN leverages channels like online marketing, Industry 4.0 events, and partner networks to reach its audience. Cost drivers encompass R&D, integration, and marketing expenses, while revenue streams are generated through licensing agreements, service contracts, and consulting fees.

## Summary of the ODIN Exploitation Cases

The exploitation cases for ODIN’s KER outline diverse pathways to ensure their industrial adoption, commercialization, and long-term impact. LMS plans to integrate its reconfigurable tools and advanced applications into EU projects and real-world factory settings, leveraging its leadership in EIT-Manufacturing to refine technologies. INTRA’s OpenFlow platform offers modular digitization tools for Industry 4.0, available via licensing agreements, while being positioned as Background IP for new collaborations. COMAU and AIC promote autonomous mobile manipulators for flexible production tasks, showcasing the technology in exhibitions and targeting niche customer applications. KTH and S21Sec enhance manufacturing automation with digital twins, focusing on academic research and cybersecurity services, respectively. DGH demonstrates its AI-driven quality inspection software for automotive engines through training and client demonstrations, integrating it into its portfolio for OEMs. PILZ's HRC Risk Assessment Tool aims to standardize collaboration safety, with pilot testing and market launch planned by 2025. ODIN pilot use cases in manufacturing sectors like automotive and aeronautics act as initial adopters, refining the solutions for operational workflows. Furthermore, ODIN results are promoted via the Horizon Results Platform and international conferences to attract industry stakeholders, ensuring broader visibility, adoption, and continuity in research and innovation.

# 1. INTRODUCTION

The exploitation strategy and business plan of ODIN is meticulously crafted to define methodologies, processes, and tools that transcend the immediate project outcomes, spreading their scientific, societal, technological, and economic value. We adhere to and implement the ODIN exploitation plan and Intellectual Property Rights (IPR) management strategy, defined at earlier stages, to nurture the identification of the project's Exploitable Results (ER) and help their commercial/academic/political exploitation. This is the last exploitation deliverable of the ODIN project, where we lay over the plans for effective use of the project's exploitable results in further commercial and/ or academic pathways. We identify and present the project's final list of ER along with their leaders, which are in total 27. Out of them, we have selected in the project 7 Key Exploitable Results (KER)who stand as the most prominent exploitation opportunities. We also analyzed in detail the business aspects on how these KER could be viable after the end of the project, and we present in Section 5.4 tailored commercialization plans for this purpose (7 commercialization plans). Moreover, this is facilitated by a market analysis, where we delve into the details about the market size, trends, regulatory frameworks and we also analyzed the competition and make a SWOT analysis. A Business Model Canvas (BMC) for the project as a whole is also part of this deliverable, as an exercise to see where we stand and what are the various business drivers and initiators. Moreover, we also discuss about how the knowledge gained in ODIN could support standardization endeavors. All the final exploitation activities that are reported in this deliverable, where also validated and in consultation with an expert from the EC-backed Horizon Results Booster (HRB) Service. Also, the exploitation cases stemming out of ODIN, are presented in detail in Section 5.5 (8 sub-cases in total).

## 1.1. Deliverable Objectives

The scope and objectives of this deliverable are to:

- **Report progress of the exploitation activities** (up to M48) towards the continuous refinement and implementation of the exploitation plan and IPR management strategy of the project.
- **Update the ODIN list of ER and KER** based on the latest technical developments of the project, and provide ODIN's Final Results Ownership List (ROL).
- **Update and present the Final ODIN Exploitation Strategies** of partners (individual/joint), based on partners' latest exploitation views, and business goals.
- Update the initial **market analysis** and analyse the ODIN IP landscape to support and inform the commercialization of the KER.
- **Manage the BG and FG IP knowledge** of the project and define the respective access rights, licenses and potential protection measures that could be employed.
- Design and fine-tune the final **commercialistion plans** for the KER to facilitate their go-to-market strategy and support impact creation of the ODIN project.

## 1.2. ODIN exploitation plan and status of the new exploitation activities included in D6.6 up to M48

As a reminder the ODIN exploitation plan is comprised of six different phases to facilitate the identification, management, and further utilisation of the project's innovations, as presented below.

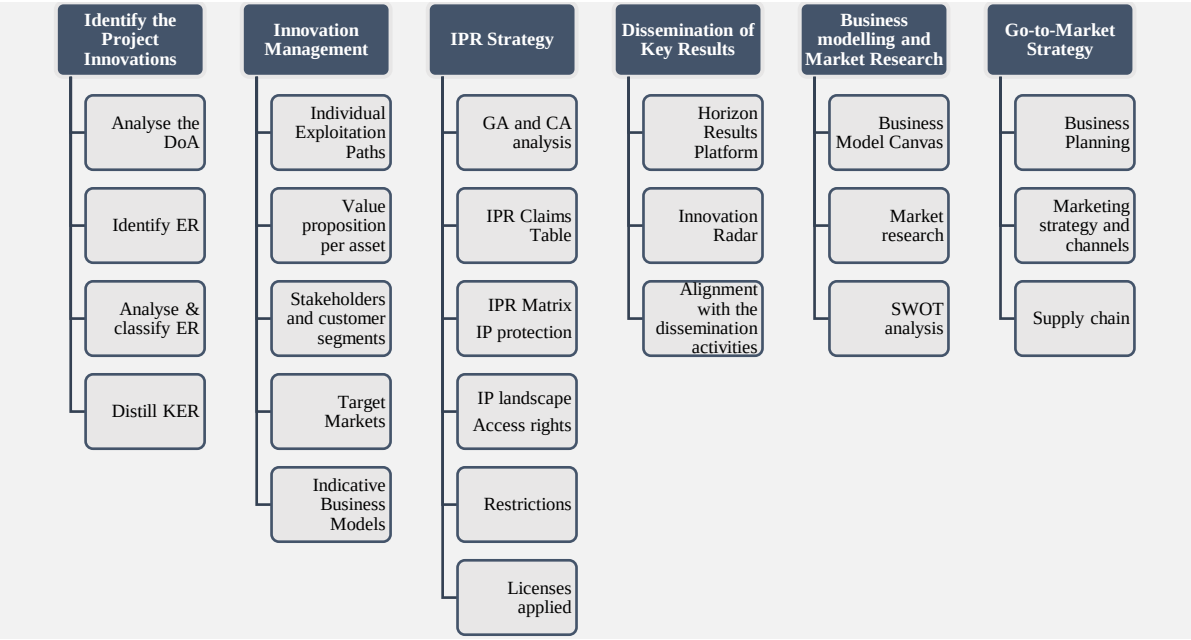



**Figure 1: ODIN Exploitation and Innovation Management Plan**

INTRA, as the lead partner, developed and maintained the project's innovation management log and managed the IP aspects of the ER/KER, adhering to the European IP helpdesk guidelines and best practices on IPR for H2020 (and Horizon Europe) projects, along with the active participation and support of all project partners.

Building on this scheme, compared to D6.4 (the interim deliverable reporting the ODIN exploitation activities), the following actions have been implemented:

- The final Results Ownership List (ROL) of ODIN has been included in this report. This list has been validated by all consortium partners and it presents a final list of 27 ER along with their owners.
- Out of the overall ODIN list of 27 ER, 7 of them have been selected as KER, based on their exploitation potential, impact and business feasibility.
- The final exploitation strategies of all consortium partners have been collected and presented in this report. They provide partners views on what results there are interested in exploiting, via what channels and monetization strategies, and also which customers segments they will target.
- In addition to the above, the target markets per KER have been made more practical/concrete and market niches are now identified, pending on partners' latest exploitation views and – in parallel – the value propositions have been adjusted accordingly.
- Based on the identifies target market per KER, the market analysis and the competition analysis have been extended and updated in this final report.
- **Seven (7) initial business plans** have been designed collaboratively by involved partners and the exploitation manager, following a pre-defined structure.
- One **physical exploitation workshop** and one **survey** have been implemented to support the exploitation activities.
- The final **Background IP** of the project, as well as the **Foreground IP**, have been validated and presented.
- The ODIN project has applied and been accepted to receive support services from the **Horizon Results Booster** in order to validate and improve the go-to-market strategies created.

- 3 exploitation sessions have been organized with the experts from the HRB service. The goal of these sessions where to validate and improve the exploitation strategy of ODIN and more specifically, to improve the business plans per KER.
- The suggestions of the HRB experts have been considered and addressed, resulting in updated business plans and exploitation strategies for the 7 KER. Specifically, the business plan updates include:
    - More specific market niches per KER
    - Management team per KER (who will manage and exploit the results?)
    - Key resources needed to exploit the KER (e.g., infrastructure, modules from other partners, etc.)
    - Exploitation roadmap per KER
    - Quantification of the financial estimations
    - Marketing plans, meaning how to better engage stakeholders/ customers
    - The above aspects are investigated in this report on top of the already investigated business plan elements.
- The final KER list of the project has been uploaded on the Horizon Results Platform. This will help significantly increase the sustainability of the project results, via outreach to potential customers, collaborators and investment opportunities.
- Online exploitation templates created by the exploitation leader have been used to facilitate the management of the exploitation task and to perform all the abovementioned activities.

## 1.3. Document structure

This deliverable covers important aspects of the project's objectives, exploitable results, exploitation paths, innovation management, and Intellectual Property Rights (IPR) strategy. The underlying structure is presented below.

- **Section 2**: This section outlines ODIN's exploitable results and key innovations and delves into the Intellectual Property Rights (IPR), Background, and Foreground IP. Moreover, the final exploitation strategies per ER and per partner are provided.
- **Section 3**: This section presents our final market research and competition analysis, introduces the market for ODIN innovations, and presents an updated SWOT analysis. An IP landscape analysis is also elaborated.
- **Section 4**: In this section we document the collaborative exploitation activities done between the HRB services and the ODIN exploitation team.
- **Section 5:** This section presents a full list of exploitation activities made to support the sustainability of the project results, namely the final commercialization plans per KER, the exploitation cases in ODIN and the future exploitation steps to be followed.
- **Section 6**: This section presents the standardization activities and suggestions of ODIN.
- **Section 7**: This concluding section summarizes the exploitation accomplishments of the ODIN project.
- **Annexes**: In the Annex, we present a table analysing the relevant IP that has been identified (having similarities to the ODIN technologies), with a list of relevant patents that have been scrutinized. This section contributes to the broader understanding of the project's intellectual property landscape and potential implications for ODIN's innovations.

# 2. ODIN FINAL EXPLOITABLE RESULTS' LIST, EXPLOITATION STRATEGIES, BACKGROUND AND FOREGROUND IP

This Section provides a taxonomy of ODIN's ER and KER, offering a view of their core business characteristics. Simultaneously, it outlines the mapping of their critical business features, identifies key stakeholders and customer segments, and underscores the benefits and value propositions they bring to the market. The primary objective of this exercise is to enhance our understanding of ODIN's primary offerings and services, thereby facilitating the development of tailored service positioning. Furthermore, the detailed taxonomy of ERs serves as the foundation for our market segmentation endeavours and plays a pivotal role in shaping our concrete marketing and distribution strategies for the project's KER in forthcoming update of this deliverable. This holistic approach ensures that ODIN is well-equipped to strategically position its innovations and capitalize on market opportunities effectively.

## 2.1. Final list of ODIN Exploitable Results – Results Ownership List (ROL)

Over the months of M37 – M48 we performed an exercise to identify and validate the final list of the ODIN ER. In further detail, ERs refer to the tangible or intangible outputs generated during a project that have the potential to create value. We consider the results that can be commercialized, used for further research, or contribute to societal, economic, or environmental impacts. They include technologies, processes, methodologies, software, patents, data sets, knowledge, or any innovation developed during the project, which can be leveraged by the project partners or external stakeholders.

The process to achieve this following the underlying steps: (i) exploitation manager, INTRA, prepared a template called innovation management log (.doc format) in order to facilitate identification and management of ER, (ii) each task leader analysed the technical activities of each task and updated the list of results accordingly, (iii) the updated list of the ER, namely the Results Ownership List, was presented to all partners and all partners agreed on the updated ER, their type, and their owners. The ODIN ROL, including a taxonomy of ODIN's exploitable results, is detailed in the table below, along with the partner(s) who contributed the result, the corresponding Work Package, and the type of each result. Based on feedback from partners, the taxonomy was further refined to reflect the latest project developments and their updated concepts for each result. The final column of the table indicates whether a result is classified as Key within the project. In Section 5, the final business plans and commercialisation strategies are developed for each KER.

**Table 1: ODIN Final Results Ownership List**

| ER# | ER Name | Lead partner(s) | Single (S) or Joint (J) Ownership | Will the results be exploited by the owner(s) | Is this a Key Exploitable Result? (Yes/No) |
|---|---|---|---|---|---|
| 1 | Mobile robot screwing on moving part | TECNALIA | S | Y | - |
| 2 | Autonomous mobile manipulators for collaborative operations | COMAU, AIC | J | Y | Yes (KER #5) |
| 3 | High payload robot in-line hand guiding system manipulation | COMAU | S | Y | - |
| 4 | Perception skill library for flexible robotics | ROBOCEPTION, TAU, KTH | J | Y | Yes (KER #1) |
| 5 | 3D-modeling based inspection of aeronautics parts | TECNALIA | S | Y | - |
| 6 | Flexible programming toolbox | TECNALIA | S | Y | - |
| 7 | Navigation with 3D sensor information to transport big parts on attached cart with full collision avoidance | TECNALIA | S | Y | - |
| 8 | Environment monitoring and robot control SW library | TAU | S | Y | - |
| 9 | Reconfigurable tools for parts' manipulation | LMS | S | Y | - |
| 10 | VR-based safety training | TAU | S | Y | - |

| ER# | ER Name | Lead partner(s) | Single (S) or Joint (J) Ownership | Will the results be exploited by the owner(s) | Is this a Key Exploitable Result? (Yes/No) |
|---|---|---|---|---|---|
| 11 | Data model of resource descriptions and web service | TAU | S | Y | - |
| 12 | Virtual commissioning module | VIS | S | Y | - |
| 13 | Risk assessment, virtual safety components and safety validation methods for industrial deployment | PILZ | S | Y | Yes (KER #3) |
| 14 | ODIN Simulation Library | VIS | S | Y | - |
| 15 | AR Suite for collaborative assembly operations | LMS, INTRA | J | Y | Yes (KER #7) |
| 16 | Digital twin using sensor data fusion | KTH | S | Y | - |
| 17 | Model based task planner | INTRA, LMS | J | Y | - |
| 18 | OpenFlow Platform (previously Open flexible orchestration of workplaces) | INTRA | S | Y | Yes (KER #4) |
| 19 | Digital twin protection framework and threat analysis toolkit | S21SEC | S | Y | Yes (KER #2) |
| 20 | ML solution for quality inspection of automotive engines | DGH | S | Y | Yes (KER #6) |

| ER# | ER Name | Lead partner(s) | Single (S) or Joint (J) Ownership | Will the results be exploited by the owner(s) | Is this a Key Exploitable Result? (Yes/No) |
|---|---|---|---|---|---|
| 21 | White goods industrial application | BEKO, LMS, TAU, ROBO, VIS, KTH, S21SEC, INTRA | J | Y | - |
| 22 | Automotive industrial application | STELLANTIS, LMS, DGH, COMAU, ROBO, TECNALIA, S21SEC, INTRA | J | Y | - |
| 23 | Aeronautics industrial application | AEROTECNIC, TECNALIA, VIS, ROBO, S21SEC, INTRA | J | Y | - |
| 24 | ODIN research papers | All involved partners | J | Y | - |
| 25 | ODIN web-portal and communication tools | INTRA, LMS | J | Y | - |
| 26 | Knowledge for standardisation frameworks | PILZ | S | Y | - |
| 27 | ODIN novel business models and exploitation plans | All partners | J | Y | - |

## 2.2. Exploitation Plans per ER

For each ER, we have also mapped and updated, as also reported in D6.4, the potential market that it could address, the end-users/ customers who could utilise the asset, as well as we have also performed a detailed exercise under which we identified the key benefits (value propositions) that each asset offers to the underlying end-users/ customers. This information in summarised in the Table below. Please note that we present the updated target markets and exploitation paths only for the tangible results that hold most innovation potential (namely, from ER1 – ER20), excluding the intangible ER and those related to pilot application.

**Table 2: Updated ODIN Target Markets and Exploitation Paths per Partner and Result**

| ER# | ER Name | Estimated Time-to Market | Target Market(s) (in the EU) | Short term exploitation Plans |
|---|---|---|---|---|
| 1 | Mobile Robot screwing on moving part | 1 – 2 years | • **System Integrators: (i)** These companies can use our mobile robot for automation in various applications. (ii) They require efficient and reliable robotic solutions to integrate into their systems.<br>• **Research organisations and Universities**: They can leverage this technology for educational purposes and research projects.<br>• **Industrial Manufacturers**: Manufacturers seeking automation solutions for their production lines. They need precise and adaptable robotic systems. | • Enhance the current product based on project developments, primarily targeting system integrators and end users.<br>• Explore collaboration opportunities with partners, aligning with the strategic goals of TECNALIA. |
| 2 | Autonomous mobile manipulator for collaborative operations | Within a year | • Manufacturing companies that your manufacturing process consist on serial operations and flexibility on operations positioning in traceability of product is needed.<br>• Manufacturing companies needs flexible production for to produce a lot of versions of product. | • Introduce new developments to the product and initiate research projects in various industrial sectors (automotive, white goods, logistics, manufacturing).<br>• Evaluate possible collaborations with partners for combined exploitation results (COMAU). |
| 3 | High payload robot in-line hand guiding system manipulation | Within a year | • **Manufacturing companies involved in heavy-duty and precision manufacturing processes:** These companies need high payload robots for precise and efficient manufacturing.<br>• **Logistics and warehousing companies dealing with the movement and handling of heavy goods**: Companies in logistics require efficient | • Enhanced new product for various industrial sectors, including automotive, white goods, logistics, and general industry.<br>• Explore collaboration opportunities with partners, aligning with strategic goals (COMAU). |

| ER# | ER Name | Estimated Time-to Market | Target Market(s) (in the EU) | Short term exploitation Plans |
|---|---|---|---|---|
| | | | and safe material handling solutions for heavy goods. | |
| 4 | Perception Skill Library for Flexible Robotics | 1 – 3 years | • **System Integrators**: These companies can enhance their robotic solutions with perception skills, improving their products and services.<br>• **Industrial Manufacturers**: Manufacturers in the automotive and white goods sectors can benefit from improved robotic perception for quality control and automation. | • Roboception will exploit the ER#4 by integrating the results into existing products as well as developing new products. This will benefit both existing customers and new prospects. Roboception is open to collaborating with other partners to exploit the results.<br>• New research project, utilisation in teaching, demonstrations to companies (TAU).<br>• Open to collaborate with other partners for combined exploitation efforts (WHEMAN). |
| 5 | 3D-modeling based inspection of aeronautic parts | 1 – 2 years | • **Aerospace manufacturers**: Aerospace companies require 3D modelling-based inspection for quality control and maintenance of their parts.<br>• **Aircraft maintenance, repair, and overhaul (MRO) facilities**: MRO facilities need efficient inspection tools for aircraft components.<br>• **Aeronautics regulatory authorities**: Authorities need reliable inspection methods to ensure compliance with safety standards. | • Launch improved product, targeting system integrators and end users.<br>• Explore collaboration opportunities with partners aligned with our strategy (TECNALIA). |
| 6 | Flexible Programming Toolbox | 1 – 2 years | • **Manufacturing companies that rely on automated machinery and robotics**: These companies can use the toolbox to streamline their operations and adapt robots to specific tasks.<br>• **Companies specializing in custom robotics and automation solutions**: Custom solution | • Launch improved product, targeting system integrators and end users.<br>• Explore collaboration opportunities with partners aligned with our strategy (TECNALIA). |

| ER# | ER Name | Estimated Time-to Market | Target Market(s) (in the EU) | Short term exploitation Plans |
|---|---|---|---|---|
| | | | providers require flexible programming tools to meet unique client needs. | |
| 7 | Navigation with 3D sensor information | 1 – 2 years | • **Manufacturing companies** that rely on automated machinery to streamline their operations.<br>• **Autonomous Vehicles and Robotics Companies**: Companies in the autonomous vehicle and robotics sector can leverage 3D sensor information for navigation purposes. | • Launch improved product, targeting system integrators and end users.<br>• Explore collaboration opportunities with partners aligned with our strategy (TECNALIA) |
| 8 | Environment Monitoring and Robot Control SW Library | Within a year | • Companies specializing in **custom robotics and automation solutions.** | • Utilize the technology in new research projects and offer it for teaching and demonstrations to companies. |
| 9 | Reconfigurable tools for parts' manipulation | 1 – 2 years | • Manufacturers interested in easily reconfigurable solutions towards agile production: Companies looking to adapt their production processes with reconfigurable tools.<br>• OEMs such as car and white goods builders: Original equipment manufacturers need flexible solutions for their production lines.<br>• System integrators: they can combine the provided service within their own custom based solutions. | • The developed robot tooling is intended to be exploited (by LMS) as an overall framework-based solution, including both the design as well as the control aspects.<br>• A new product/service will be targeted which will also include any required integration activities during the deployment phase. |
| 10 | VR/ AR based Safety Training | 1 – 2 years | • Manufacturing and Industrial Companies: Manufacturers, especially those in industries with potentially hazardous environments, can use VR/AR safety training to educate employees | • Implement the technology in new research projects and offer it for teaching and demonstrations to companies (TAU).<br>• Collaborate with partners (TAU). |

| ER# | ER Name | Estimated Time-to Market | Target Market(s) (in the EU) | Short term exploitation Plans |
|---|---|---|---|---|
| | | | on safety protocols and reduce workplace accidents and injuries. | |
| 11 | Data Model of Resource descriptions and web service | 1 – 2 years | • Companies in manufacturing.<br>• System integrators.<br>• Technology and component suppliers. | • Implement the technology in new research projects and offer it for teaching and demonstrations to companies (TAU).<br>• Collaborate with partners (TAU). |
| 12 | Virtual commissioning module | Within a year | • Automotive.<br>• Aerospace.<br>• Electronics.<br>• Food.<br>• Pharma. | • Launch the new product, offering consulting and dedicated integration services.<br>• Expect initial adopters from various verticals, including automotive, aeronautics, white goods, and other industries.<br>• Collaboration opportunities may arise with partners such as VIS. |
| 13 | Risk assessment, virtual safety components and safety validation methods for industrial deployment | 3 years or more | • that want a cost-efficient way to validate their HRC applications.<br>• Industrial safety service providers, to optimize the design time of the safety concepts.<br>• Machine builders, system integrators that focus that apply HRC technologies in their solutions and OEMs, optimize the design time of the safety concepts and they also want to validate in simulation that the proposed designs comply with the standard.<br>• PILZ consulting and engineering teams for internal use and all the subsidiaries globally. On the same terms as the safety service providers. | • Focus on internal adoption for providing competitive services.<br>• Update current methodologies and expand with new research projects.<br>• Collaboration opportunities with partners (PILZ). |

| ER# | ER Name | Estimated Time-to Market | Target Market(s) (in the EU) | Short term exploitation Plans |
|---|---|---|---|---|
| 14 | ODIN Simulation Library | 1 -2 years | • Automotive.<br>• Aerospace.<br>• Electronics.<br>• Food.<br>• Pharma. | • Launch the new product, offering consulting and dedicated integration services.<br>• Expect initial adopters from various verticals, including automotive, aeronautics, white goods, and other industries.<br>• Collaboration opportunities with partners (VIS). |
| 15 | AR Suite for collaborative assembly operations | 1 -2 years | • Manufacturing companies interested in human-robot collaborative operations to ensure the effective and safely co-existence of human operators and robot.<br>• Robotic Integrators in case of Human-Robot Collaborative workstations.<br>• Assembly line operators without background knowledge on the assembly procedure.<br>• Manufacturing companies interested to inform human operators on demand regarding corrective actions on products (e.g. quality inspection results, corrective actions)<br>• Training providers to train in a more efficient way new employees. | • Exploit the AR suite as an integrated service, including the AR application and data communication between human operators and robotic manipulators (LMS).<br>• Target manufacturing companies interested in operator support solutions.<br>• Collaboration opportunities with partners in the consortium. |
| 16 | Digital twin using sensor data fusion | 1 -2 years | • Manufacturing company and assembly lines. | • Use the result in new research projects under new use cases (KTH) |
| 17 | Model based task planner | 1 -2 years | • Manufacturing companies interested in production and task planning solutions that can robustly adapt to unexpected changes in existing | The Model based Task Planner will be exploited as a software module aiming to provide an innovative AI based decision making solution with task planning and dynamic reconfiguration capabilities. This could constitute either a |

| ER# | ER Name | Estimated Time-to Market | Target Market(s) (in the EU) | Short term exploitation Plans |
|---|---|---|---|---|
| | | | processes under the scope of agile production. Potential customers include various industries such as automotive, white goods, metal industry, food, and electronics.<br>• Industrial application's SW providers (EU); focus niches automotive, white goods, electronics. | standalone module or as a bundled package with the OpenFlow Platform, enhancing the functionalities of the OpenFlow platform (KER no 18).<br>The potential customers will be manufacturing companies interested in production and task planning solutions that can robustly adapt to unexpected changes in existing processes under the scope of agile production. |
| 18 | OpenFlow Platform | 1 -2 years | • Industrial application's SW providers; system integrators: focus niches automotive, white goods, electronics<br>• Research organisations and universities<br>• Manufacturing companies interested in production and task planning solutions that can robustly adapt to unexpected changes in existing processes under the scope of agile production. | INTRA aims to exploit this result via two exploitation paths:<br>(i) seek licensing agreements with manufacturing application providers, in order to use the OpenFlow platform as a middleware between their tool and the deployment in the plant/ premise of the end user, and<br>(ii) with manufacturing companies directly, who would like to use the OpenFlow platform to integrate tools from third-party application providers.<br>Also, further collaboration opportunities will be pursued to use the OpenFlow platform as background IP in new research projects in manufacturing and industry 4.0. |
| 19 | Digital twin protection framework and threat analysis toolkit | 3 years or more | • Companies that use digital twin systems, including manufacturing, construction, and logistics companies<br>• Cybersecurity and data privacy service providers | • Improving the products that S21Sec use internally for giving the services to the clients. |
| 20 | ML solution for quality inspection of automotive engines | Within a year | • Manufacturing companies that use robotic systems and require cybersecurity incident and detection capabilities to be able to overcome the possible cybersecurity attacks. | • Introduce a new software inspection product centralized on Stellantis automotive use cases (by DGH). |

| ER# | ER Name | Estimated Time-to Market | Target Market(s) (in the EU) | Short term exploitation Plans |
|---|---|---|---|---|
| | | | • Robotics software providers – system integrators could be interested in the inclusion of cybersecurity incident detection and response capabilities in their software stack<br>• Training and maintenance service providers. Companies involved in the training and maintenance of industrial systems may be interested in teaching about cybersecurity issues in their customers' environments, raising awareness of the need to protect these environments, and how they can do so with tools such as this KER. | • DGH is open to collaboration with partners and potential customers in various industries, including automotive, aeronautics, food, and beverages, among others. |

## 2.3. IPR Management in ODIN

This section provides an overview of the intellectual property (IP) landscape within the ODIN project, highlighting both the background (BG) IP utilized and the foreground (FG) IP generated during the project's lifecycle. An IPR directory has been used throughout the project called IPR Matrix to support the identification and management of the project's Background and Foreground IP. It documented both BG and FG IP assets, with active partner involvement and analysis of protection status, licensing, and confidentiality. For FG IP, partners conducted a preliminary assessment of results, linked them to relevant BG IP, and outlined protection strategies, restrictions, and conditions for post-project usage, all organized within an IPR matrix to guide decision-making. The following Tables of Background IP and Foreground IP were originally included in the interim version of this report in D6.4. In the current version of the deliverable, these Tables have been communicated with partners and re-validated (as of M48), aligned with the project's current developments and partners' views – delivering the final version of the ODIN Background and Foreground IP. No major changes compared to the previous version have been observed.

### 2.3.1. Background IP

| BG # | Background (Name) | Partner | Short Description of BG | Protection |
|---|---|---|---|---|
| BG1 | AR applications for HRC operations | LMS | LMS has background knowledge on how to build AR applications but also their integration with robotics systems. | Licensing |
| BG2 | Task planning algorithm | LMS | LMS has previous knowledge on task planning algorithms but also on their adaptation and integration for different assembly processes including human and robot resources. | Licensing |
| BG3 | Robotic end effectors | LMS | LMS has previous knowledge on designing, deploying and integrating mechanical grippers for robotic arms. | Licensing |
| BG4 | Flexbotics programming Framework | TECNALIA | Framework which provides a wide set of libraries and generic skills for robot programming | NDA/Confidentiality Agreement |
| BG5 | Flexbotics Dual-arm robot motion planning and control solution | TECNALIA | Robot skills which ease generation and execution of dual-arm trajectories for large object manipulation. | NDA/Confidentiality Agreement |
| BG6 | Flexbotics Mobile Robot control and Autonomous Navigation solution | TECNALIA | Localization and navigation software modules which allow map and autonomous navigation | NDA/Confidentiality Agreement |
| BG7 | Omnidirectional mobile dual-arm robot design and control | TECNALIA | Knowledge for new robot platform design, including not only hardware components but also the software. | NDA/Confidentiality Agreement |
| BG8 | Flexbotics 3D Perception solution for quality control and robot guiding | TECNALIA | Computer vision technology for object detection based on 3D sensors pointcloud and CAD matching techniques. | NDA/Confidentiality Agreement |
| BG9 | Concept, design and software for vision-based safety concept based on digital light processing (DLP) projector(s) and 2D/3D camera(s) | TAU | - Including dynamic (safety) zones and visualizing them<br>- Including dynamic buttons and information representation (i.e., user Interface) | Licensing |
| BG10 | Resource Description Concept | TAU | It has three abstraction levels for resource data modelling: Abstract Resource | Creative Commons OR |

| BG # | Background (Name) | Partner | Short Description of BG | Protection |
|---|---|---|---|---|
| | | | Description (ARD), Resource Description (RD), and Resource Instance Description (RID). | no protection (via publications) |
| BG11 | Example set of ARDs, RDs, and RIDs files | TAU | Formats: Schema of RD/ARD/RID and as RDs as resource pool ontology. | Creative Commons |
| BG12 | Resource Description editor software for creation of RDs. | TAU | Desktop SW application for making and editing Resource Descriptions. | Licensing OR Open-source License |
| BG13 | Resource Description Web Service for publishing, sharing and distributing; viewing, searching, and processing RDs associated to the Resource Description Concept. | TAU | This is a web server application including database, user interface, web service interface, and a few processing tools. | Online public service by registration and/or Open-source license |
| BG14 | Formal knowledge representation, Matchmaking Ontology, for describing the product, process, resources, and system related information models. | TAU | Including Process Taxonomy model, an information model which facilitates the matchmaking between product requirements and system capabilities:<br>- Including formal Capability Model for describing capabilities of production resources, and combined capabilities of multiple co-operating resources<br>- Including formal Resource Model and Resource Interface Model to represent production resource<br>- Including formal Product Model representing manufactured product, its parts, and manufacturing processes with their parameters. | Creative Commons |
| BG15 | Matchmaking web service (Database and server) | TAU | Software for storing and accessing to the information presented with the Matchmaking Ontology. | Online RESTful web service and/or Open-source license |
| BG16 | Know-how on automation systems and robot-based solutions. | COMAU | Support and integration of customized automation systems. | NDA/Confidentiality Agreement |
| BG17 | Robotics product including low and high payload Cobots and AGV (mobile platform) | COMAU | Use of robotics systems based on specific end-user requirements. | NDA/Confidentiality Agreement |
| BG18 | rc_visard 65 , rc_visard 160 HW/SW, rc_cube and accessories | ROBO | Sensors with onboard computing and IPCs external deployment. | Licensing + NDA (optional) |
| BG19 | rc_reason SW modules: Itempick, Boxpick, SilhouetteMatch, CADMatch, SLAM, TagDetect | ROBO | Software modules for object detection with and without model data. | Licensing + NDA (optional) |
| BG20 | Commercial simulation software in an object code format and accessible through VIS' standard API's only. | VIS | Under Visual Components license. | Licensing |

| BG # | Background (Name) | Partner | Short Description of BG | Protection |
|---|---|---|---|---|
| BG21 | Knowledge and expertise generated by employees | INTRA | Knowledge through employees' own internal research projects, within EU funded or national-funded R&D projects, knowledge generated within industry funded collaborations (research and services) and knowledge that is confidential due to other reasons. | NDA/Confidentiality Agreement |
| BG22 | Commercial simulation software | INTRA | Which is in an object code format and accessible through the intended user API's. | NDA/Confidentiality Agreement |
| BG23 | Software for the real-time orchestration, decision making and monitoring of manufacturing resources | INTRA | Openflow software. | NDA/Confidentiality Agreement |
| BG24 | Knowledge repository | INTRA | For the effective modelling, persistence and retrieval of the orchestration, execution and monitoring information. | NDA/Confidentiality Agreement |
| BG25 | Cybersecurity incident detection and response Security Operation Center (SOC) platform, and Threat Intelligence (TI) platform | S21SEC | Managed cybersecurity services provided by Security Operation Center (SOC) and covering a 360º approach of cybersecurity services (from initial prediction and prevention of security incidents, passing through detection until response and recovery). Also providing advanced cybersecurity services such as, Threat intelligence, Threat hunting, DFIR, etc. | Ad-hoc Confidentiality Agreement |
| BG26 | Secure DevOps platform | S21SEC | DevSecOps methodology for egrating security into the software development life cycle, specially including automating security testing and integrating security into the continuous integration/continuous delivery pipeline. | Ad-hoc Confidentiality Agreement |

### 2.3.2. Foreground IP

The table below presents the FG IP generated by the project.

| #FG | Project Result (FG) | Indicative Type of Protection | Restrictions? Conditions to use after the end of the project | Related BG Number used for the Foreground FG |
|---|---|---|---|---|
| **FG1** | Mobile robot screwing on moving part | License | Yes – To be negotiated | BG4, BG5, BG6, BG7, BG8 |
| **FG2** | Autonomous mobile manipulator for collaborative operations | License | Yes – paid proprietary | BG16, BG17 |
| **FG3** | High payload robot in-line hand guiding system manipulation | License | Yes – paid proprietary | BG16, BG17 |
| **FG4** | Perception Skill Library for Flexible Robotics | Trade Secret | Yes - paid proprietary | BG9 |

| #FG | Project Result (FG) | Indicative Type of Protection | Restrictions? Conditions to use after the end of the project | Related BG Number used for the Foreground FG |
|---|---|---|---|---|
| **FG5** | 3D-modeling based inspection of aeronautics parts | License | Yes – To be negotiated | BG4, BG8 |
| **FG6** | Flexible Programming Toolbox | License | Yes – To be negotiated | BG4, BG5, BG6, BG7, BG8 |
| **FG7** | Navigation with 3D sensor information to transport big parts on attached cart with full collision avoidance | License | Yes – To be negotiated | BG4, BG6, BG7 |
| **FG8** | Environment Monitoring and Robot Control SW Library | License | Yes – To be negotiated | BG9 |
| **FG9** | Reconfigurable tools for parts' manipulation | License | Yes – To be negotiated | BG3 |
| **FG10** | VR/ AR based Safety Training | Copyright | Yes - paid proprietary | - |
| **FG11** | Data model of resource descriptions and web service | Copyright | Yes - free without source | BG10, BG15 |
| **FG12** | Virtual commissioning module | License | Yes - paid proprietary | BG10, BG11, BG12, BG15 |
| **FG13** | Risk assessment, virtual safety components and safety validation methods for industrial deployment | Confidentiality Agreement | No - not for sale | - |
| **FG14** | ODIN Simulation Library | License | Yes - paid proprietary | - |
| **FG15** | AR suite For Collaborative Assembly Operations | License | Yes – To be negotiated | BG1 |
| **FG16** | Digital twin using sensor data fusion | Confidentiality Agreement | No - not for sale | BG14, BG23 |
| **FG17** | Model Based Task Planner | License | Yes – To be negotiated | BG2, BG21, BG22, BG23, BG24 |
| **FG18** | OpenFlow Platform | Confidentiality Agreement | Yes - paid proprietary | BG21, BG22, BG23, BG24 |
| **FG19** | Digital Twin Protection Framework and Threat Analysis Toolkit | License | Yes – To be negotiated | BG25, BG26 |
| **FG20** | ML solution for quality inspection of automotive engines | Licence | Yes - paid proprietary | - |
| **FG21** | White goods industrial application | Confidentiality Agreement | No - not for sale | - |

| #FG | Project Result (FG) | Indicative Type of Protection | Restrictions? Conditions to use after the end of the project | Related BG Number used for the Foreground FG |
|---|---|---|---|---|
| **FG22** | Automotive industrial application | Confidentiality Agreement | No - not for sale | - |
| **FG23** | Aeronautics industrial application | Confidentiality Agreement | No - not for sale | - |
| **FG24** | ODIN research papers | Copyright | No - not for sale | - |
| **FG25** | ODIN web-portal and communication tools | Copyright | No - not for sale | - |
| **FG26** | Knowledge for standardisation frameworks | Copyright | No - not for sale | - |
| **FG27** | ODIN novel business models and exploitation plans | Copyright | No - not for sale | - |

# 3. ODIN Final Market Research, Competition Analysis, and IP Landscape Analysis

## 3.1. Market Research and Competition Analysis

### 3.1.1. ODIN Target Markets Summary

The ODIN Key Exploitable Results, as a whole, target 3 core main markets - Manufacturing automation and robotics market, Industrial IoT Market, Industrial Safety & Security Market . Research by Deloitte [1] indicates that companies implementing integrated solutions across these market segments are seeing 20-30% improvements in operational efficiency.

#### *Manufacturing automation and robotics market*

The global manufacturing automation and robotics market has demonstrated significant growth, reaching $205.86 billion in 2022 according to Fortune Business Insights [2]. This market is experiencing a transformative phase, driven by the widespread adoption of Industry 4.0 technologies. Research by McKinsey & Company [3]. indicates that manufacturing companies are accelerating their automation investments, with 94% of manufacturing leaders reporting that Industry 4.0 has helped them keep their operations running during the COVID-19 crisis. The projected growth to $351.78 billion by 2029 is supported by several key factors, including the increasing need for operational efficiency and the growing labor shortage in developed economies. According to the International Federation of Robotics [4], the operational stock of industrial robots hit a new record of about 3.5 million units worldwide.

#### *Industrial IoT market*

The Industrial IoT (IIoT) market has emerged as one of the fastest-growing segments, signaling a current valuation of $544 billion in 2022 [5]. The projected growth to $3.3 trillion by 2030 represents a remarkable transformation in industrial digitalization. According to Gartner's research [6], 75% of organizations implementing IoT have already implemented or plan to implement digital twin technologies within a year. The number of connected IoT devices worldwide will reach 27 billion by 2025 [7]. This growth is particularly evident in manufacturing settings, where digital twin technology is revolutionizing production processes and predictive maintenance capabilities.

#### *Industrial Safety & Security market*

The industrial safety and security market, currently valued at $5.5 billion (2022), is experiencing significant growth driven by increasingly stringent regulatory requirements and the need for enhanced cybersecurity measures. Research by the International Labor Organization (ILO) [8] emphasizes the growing importance of workplace safety, particularly in human-robot collaborative environments. The projected growth to $9.2 billion by 2028 is supported by data from the World Economic Forum, which identifies cybersecurity (a domain also addressed by ODIN) as one of the top risks facing industrial operations [9]. The 9.0% CAGR reflects the increasing investment in both physical and digital safety measures across industrial sectors.

### 3.1.2. Market Segmentation by Application

#### *Manufacturing and Assembly Operations*

The manufacturing and assembly operations segment represents the largest application market for integrated industrial solutions. This sector accounts for approximately 35% of the total market share, with particular strength in automotive and electronics manufacturing. The segment is experiencing robust growth, driven by the increasing adoption of smart manufacturing principles and Industry 4.0 technologies. Recent data from the Manufacturing Institute indicates that 73% of manufacturers are planning to increase their investment in smart factory technologies over the next year [10].

#### *Logistics and Warehouse Management*

The logistics and warehouse management segment has emerged as a rapidly growing application area, particularly accelerated by the e-commerce boom. The warehouse automation market alone is expected to grow from $15.84 billion in 2022 to $41.48 billion by 2028 [11]. This growth is primarily driven by the need for efficient order fulfilment and inventory management systems. Amazon's investment of over $1 billion in warehouse automation technologies in 2022 exemplifies this trend.

#### *Quality Control and Inspection*

Quality control and inspection applications represent a critical segment, particularly in high-precision industries. Automated inspection systems are becoming increasingly prevalent, with adoption rates growing by 18% annually. The automotive sector leads this application, where according to McKinsey & Company, AI-powered quality inspection systems have reduced defect rates by up to 50% in early-adopting facilities [12].

#### *Human-Robot Collaboration*

The human-robot collaboration segment is experiencing significant growth, particularly in complex assembly operations. The International Federation of Robotics reports that collaborative robot installations increased by 19% in 2022, with this trend expected to accelerate [13]. This application area is particularly relevant in industries requiring both human dexterity and robotic precision, such as electronics assembly and medical device manufacturing.

#### *Predictive Maintenance and Asset Management*

Predictive maintenance applications have become increasingly crucial for industrial operations. According to PwC's analysis, predictive maintenance can reduce maintenance costs by 12% and downtime by up to 9% [14]. The integration of IoT sensors and AI-powered analytics has made this application particularly valuable in capital-intensive industries such as power generation and heavy manufacturing.

#### *Safety and Security Systems*

The safety and security systems application segment has gained prominence due to increasing regulatory requirements and workplace safety concerns. The European Agency for Safety and Health at Work reports that investments in advanced safety systems have resulted in a 25% reduction in workplace incidents in automated environments [15]. This segment includes both physical safety systems and cybersecurity applications for industrial control systems.

### 3.1.3. EU Market Overview and Dynamics

The European Union (EU) represents one of the world's most sophisticated and mature markets for industrial automation and smart manufacturing technologies. According to Eurostat, the EU's manufacturing sector accounts for 16% of total GDP, with manufacturing technology investments reaching €384 billion in 2022 [16]. The European Commission's Digital Economy and Society Index (DESI) indicates that 65% of EU enterprises have achieved at least a basic level of digital intensity, with manufacturing leading digital adoption rates.

The European manufacturing automation and robotics market presents a significant portion of the global landscape, accounting for approximately 25% of the worldwide market. The EU market reached €51.4 billion in 2022, with projections indicating growth to €87.9 billion by 2029 [17]. This substantial market size and growth trajectory create a favorable environment for ODIN's innovative solutions. Germany maintains its position as the powerhouse of European manufacturing automation, commanding 38% of the market share, translating to approximately €19.5 billion, as reported by the European Investment Bank's digitalization report [18]. The German market's dominance is followed by significant contributions from Italy, France, and Spain, collectively representing another 35% of the European market. This concentration of market share in these industrial nations provides ODIN with clear target markets for initial deployment and scaling.

The European Commission's updated Industrial Strategy has become a crucial driver for market growth, with a dedicated €750 million allocation for manufacturing automation through 2027. This public sector commitment is complemented by private sector investments, particularly in response to pressing challenges such as labor shortages. Digitisation and automation will make 20 to 30 % of jobs obsolete over the next 5 to 10 years, creating an urgent need for automated solutions[19]. European companies maintain strong positions in the global automation landscape, with ABB, Siemens, and KUKA collectively controlling 45% of the EU market, according to the European Robotics Federation (https://eu-robotics.net/). This competitive environment, while challenging, demonstrates the market's maturity and readiness for innovative solutions like ODIN's integrated approach to manufacturing automation. The EU's emphasis on sustainability through the Green Deal has emerged as a unique driver for automation adoption, with approximately 35% of new installations focusing on energy efficiency improvements. This trend aligns well with ODIN's digital twin protection framework and OpenFlow platform, which can contribute to optimizing energy usage in manufacturing processes.

Automation is increasingly recognized as vital for maintaining competitiveness in Europe's industrial sector, with 60% of surveyed companies predicting fully automated manufacturing within five years. Germany and the Netherlands lead in automation levels, while France lags but shows ambitious growth potential. The primary focus areas include Cloud Computing and IoT, while Big Data Analytics and AI/ML remain underutilized. [20]

**Adoption Levels by Country** [20]

- Germany & Netherlands: Leaders in automation, with over 40% of manufacturing processes automated. High adoption of Cloud (47%-48%) and IoT (46%-48%).
- Italy: Competitive automation (40%) but slightly lower Cloud (43%) and IoT (35%) integration.
- France: Lowest automation (37%) but plans significant adoption. Low IoT (32%) and Cloud (30%) usage.

The EU market's projected CAGR while slightly lower than the global rate, is characterized by higher technology adoption rates in specific sectors. This growth pattern suggests that ODIN's solution suite, encompassing quality inspection, robotics integration, digital twin implementation is well-positioned to capture market share, particularly in the leading manufacturing nations of the EU.

### 3.1.4. Regulatory Framework and Policy Impact

The European Union's regulatory landscape for manufacturing automation, robotics, and digital technologies is significantly shaped by several key initiatives and frameworks. The European Commission's "Europe's Digital Decade" policy sets ambitious targets for industrial digitalization, aiming for 75% of EU enterprises to adopt AI, cloud computing, and big data technologies by 2030 [22]. This policy framework directly impacts ODIN's market potential. The Machinery Directive 2006/42/EC, currently being revised to become the Machinery Regulation, introduces specific requirements for AI-enabled machinery and collaborative robots. According to EURobotics (https://www.eu-robotics.net/), this regulatory evolution is expected to create a €4.2 billion market opportunity for compliant automation solutions by 2025. The new regulation particularly emphasizes human-robot collaboration safety, aligning with ODIN's AR Suite for collaborative assembly operations. The European Union Agency for Cybersecurity (ENISA) reports that manufacturing cybersecurity investments will reach €3.8 billion by 2025 [23]. This regulatory pressure strengthens the market position of ODIN's digital twin protection framework and threat analysis toolkit. The European Green Deal's manufacturing requirements are driving significant changes in industrial automation. The Commission's Industrial Strategy update emphasizes sustainable manufacturing, requiring companies to demonstrate energy efficiency improvements. According to the European Environmental Agency, manufacturing companies must reduce their carbon emissions by 40% before 2030. This creates opportunities for ODIN's OpenFlow Platform, which can support the orchestration of production processes for energy efficiency.

Worker safety regulations, particularly the EU Framework Directive on Safety and Health at Work (Directive 89/391 EEC), have been updated to address human-robot collaboration. The European

Agency for Safety and Health at Work estimates that companies will invest €2.1 billion in safety-compliant automation systems by 2025. This regulatory requirement directly benefits ODIN's integrated safety features in its AR Suite and robotics solutions. Standardization initiatives, led by the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC), are creating unified requirements for industrial automation. These standards, particularly in areas like IoT integration (EN 303 645) and robot safety (ISO/TS 15066), provide a clear framework for ODIN's technology implementation.

## 3.2. Updated SWOT Analysis

| STRENGTHS | WEAKNESSES |
|---|---|
| • Ability to integrate multiple technologies (robotics, AR, ML, digital twins); a solution that few competitors can match. According to the European Commission's Industry 4.0 report (https://ec.europa.eu/growth/industry/policy/advanced-technologies_en), only 7% of EU manufacturers have successfully integrated similar multi-technology solutions.<br>• Integrated cybersecurity approach through the digital twin protection framework addresses a critical market gap. ENISA reports that 78% of manufacturing companies lack integrated security solutions for their automation systems.<br>• The AR Suite for collaborative assembly operations provides superior human-machine interaction capabilities, essential as the EU reports a 15% annual increase in collaborative robot installations. | • Need for specialized hardware components and extensive data sets for ML training could limit scalability.<br>• Implementation costs might be higher compared to single-solution providers.<br>• Lack of extensive real-world implementation examples could make conservative manufacturers hesitant to adopt the technology. |
| **OPPORTUNITIES** | **THREATS** |
| • EU's upcoming AI Act and enhanced cybersecurity requirements create market opportunities.<br>• EU funding through Digital Europe Programme (€7.5 billion) and national Industry 4.0 initiatives provides significant market expansion opportunities.<br>• Aging workforce in EU manufacturing (20% reaching retirement age by 2030) drives automation adoption, particularly for collaborative solutions.<br>• EU Green Deal's manufacturing requirements create opportunities for ODIN's optimization capabilities. | • Major players like Siemens and KUKA could develop similar integrated solutions, leveraging their existing market presence and customer relationships.<br>• Manufacturing investment cycles are sensitive to economic conditions.<br>• Rapid changes in AI and robotics technologies could require frequent updates and adaptations to maintain competitive advantage. |

## 3.3. IP Landscape Analysis

This section provides an Intellectual Property (IP) landscape analysis for the ODIN project's technologies. Conducting this analysis is an important step for partners planning to introduce new products or enter new markets, as it helps assess the risk of infringing existing IP rights. Each partner is encouraged to perform a complementary FTO analysis tailored to their specific needs and business strategies for the KERs; the exploitation leader(s) of each KER will further analyse the IP landscape for the innovation they want to introduce in the market. However, here we make an initial analysis for the scope of ODIN in order to identify potential barriers, existing patents and exploit opportunities. Our approach involves a systematic and practical methodology to ensure informed IP management and exploitation decisions, with a particular emphasis on the European context.

To start, two widely recognized tools have been employed, namely:

- **Espacenet** (https://worldwide.espacenet.com)
- **Google Patents** (https://patents.google.com)

We initiated the analysis by defining its scope, focusing primarily on the KERs while including the key technologies and target markets associated with other ERs. Specific objectives included identifying existing patents, evaluating potential IP risks, and exploring opportunities for collaboration or licensing.

**Key Search Terms Used:**

- Robotics and automation systems
- Augmented Reality (AR) applications in manufacturing
- Virtual Reality (VR) applications in manufacturing
- Machine Learning (ML) for quality inspection in manufacturing
- Data modeling and web services in manufacturing
- Digital twin modeling in manufacturing
- Cybersecurity and threat analysis tools in manufacturing

We use then focused search queries, enhanced with Boolean operators (AND/OR), were executed to identify relevant patent records linked to ODIN's innovations and technologies. The retrieved patents were meticulously reviewed for relevance to the ODIN project, emphasizing titles, abstracts, claims, and publication dates. This step identified key patents and potential holders with intellectual property relevant to the project.

The analysis covered patents within domains relevant to ODIN's innovations, such as Additive Manufacturing, Digital Transformation, Cloud Computing, Immersive Technologies, Digital Manufacturing, Machine Learning, and Robotics. A dedicated IP tracking template was developed, categorizing patents by title, applicant, publication number, date, technological domain, and relevance (high, medium, low).

Thus, we found a list of potential relevant patents, as reported in Annex 1. From these, we made a classification into the following categories. Next, we classified these patents compared to their relevant to the ODIN technologies. The results are as follows:

**Table 3: ODIN IP Landscape Analysis**

| No | Title | Applicants | Tech Area | Relevance to ODIN |
|---|---|---|---|---|
| **1** | Ontology-based generation and integration of information sources | Drumm et al. | Digital Transformation | High |

| No | Title | Applicants | Tech Area | Relevance to ODIN |
|---|---|---|---|---|
| **2** | Augmented Reality Application for Manufacturing | Tesla, Inc. | Robotics and Automation | High |
| **3** | Augmented reality task identification and assistance | Schuster Michael J. | Mixed Reality | High |
| **4** | Robotic Systems and Methods for Robustly Grasping and Targeting | University of California | Robotics and Automation | High |
| **5** | Systems for Generating Control Solutions for Robotics | Tata Consultancy Services Ltd | Robotics and Automation | Medium |
| **6** | Vision-Based Robotic Assistance System | Indira Gandhi Institute of Tech. | Robotics and Automation | Low |
| **7** | System for Object Tracking and Transposition | Cron Systems Pvt Ltd | Robotics and Automation | Low |
| **8** | Robot Fleet Management for Value Chain Networks | Strong Force VCN Portfolio 2019 LLC | Robotics and Automation | High |
| **9** | Digital Manufacturing | Accenture Global Solutions Ltd | Digital Manufacturing | Medium |
| **10** | Robot Fleet Management & Additive Manufacturing | Strong Force VCN Portfolio 2019 LLC | Robotics and Automation | High |
| **11** | Digital Manufacturing System | Accenture Global Services Ltd | Digital Manufacturing | Medium |
| **12** | Digital-Twin-Enabled Digital Product Network System | Strong Force VCN Portfolio 2019 LLC | Digital Transformation | High |

Recommendations from the analysis:

- ODIN has a favorable FTO in areas where its technologies are sufficiently novel or target underserved niches.
- High-relevance patents demand detailed claim analysis to ensure non-infringement.
- Licensing or collaboration opportunities with relevant entities could mitigate IP risks while enhancing market integration.
- Additional FTO studies focusing on claims' specifics are recommended before commercialization.

# 4. ODIN EXPLOITATION ACTIVITIES ALONG WITH THE HORIZON RESULTS BOOSTER SERVICE

This section presents the updated exploitation strategy based on the recommendations from the Horizon Results Booster service, covering critical elements such as Background IP use, management expertise, customer targeting, competition analysis, resource needs, financial outlook, and next steps.

Over the last year of the project, and in order to enhance our exploitation activities, we consulted with the horizon results booster service. Specifically, we applied for two services that suited the nature and the status of the exploitation activities of ODIN, namely: (i) G2M Business Feasibility, and (ii) G2M Options. In the first case, we assessed the initial versions of the ODIN business plans and exploitation strategy, while in the second case we analysed the various exploitation strategies and the expert suggested possible ways to improve the existing business plan. In total, 3 online sessions were organized with the HRB expert, where the exploitation plan of ODIN was discussed in detail, as follows:

- 1st session on the 10th of May, 2024
- 2nd session on the 26th of August, 2024
- 3rd session on the 18th of October, 2024

All in all, the HRB expert indicated his satisfaction about the project's exploitation activities; he also suggested some areas for further development and focus.

Based on the HRB experts' feedback we updated the current deliverable, and we also made changes and updates on the business plans for the KER, presented in Section 5 of the current document.

In summary, the areas for further development covered important elements such as Background IP use, management expertise, customer targeting, competition analysis, resource needs, financial outlook, and next steps.

- We will better delve into the **Background IP elements** that were developed prior to its start, which form the basis for its innovations and ensure a strong foundation for further development. These assets are integral to enhancing the technical capabilities of the Key Exploitable Results and accelerating their deployment.
- The **management team** supporting the exploitation process comprises partners with technical and business expertise has been also included in the business plans and further elaborated. This includes expertise in key areas relevant to the project's objectives, as well as strong connections with industry stakeholders, providing a clear pathway for commercialization and market integration.
- The **target customer segments** for the KER were further aligned with the project's technological advancements and market positioning. The defined market niche reflects the emerging needs and trends in these segments, ensuring a strategic fit for the solutions developed.
- The **competition analysis** was also updated to outline the landscape of comparable solutions currently available in the market.
- The deployment of the project's results requires specific **resources**, including essential materials, components, and proprietary technologies. Resource availability have been considered to ensure effective implementation and risk mitigation.
- The **financial analysis** has been also updated, providing an overview of potential revenue streams and the investment needed for further development and commercialization.
- We also provide the **next steps for exploitation** focus on further advancing the technical capabilities of the results, performing additional testing and validation, and forming strategic collaborations to enhance market reach (also described in Section 3.3 within the market entry strategies).

# 5. FINAL EXPLOITATION AND COMMERCIALISATION PLAN PER KER – UPDATED BASED ON HRB SERVICES FEEDBACK

## 5.1. ODIN Partners' Final Exploitation Strategies

Over the last months of the project, an exercise under the exploitation task was performed in order to gather the final exploitation strategies per partner. A template was shared with partners to facilitate input collection. The table below present the final exploitation strategies, which are provided by ODIN partners themselves, explaining what they have gained from the project and how they will use the project results in future commercial and/or research applications

| Partner Name | Exploitable Result(s) (ER) involved | **Your interest** (exploitation intention) | Contributions |
|---|---|---|---|
| **LMS** | ER #9, ER #15, #17, ER #25 | LMS participates as leading partner in four ERs of ODIN, namely the "Reconfigurable tools for parts' manipulation", the "AR Suite for collaborative assembly operation", the "Model based task planner" and the "ODIN web-portal and communication tools". LMS will pursue its future collaboration with INTRA to introduce the results of these ER in future EU funded projects as background IP.<br>LMS will follow three different exploitation paths for its leading ERs. The first exploitation path will be to use the ER in grant applications presenting its innovative background and technical capability in different industrial use cases. In this way, LMS will strengthen its collaboration with other technology providers as well as end users. Additionally, LMS will focus on further maturation of the ODIN results through EIT-Manufacturing where LMS is a leading partner.<br>LMS will focus on further enhancement of ODIN results and bringing the technologies in higher TRL level and adaptation in real factories through the utilization of Teaching Factory Competence Center (TF-CC) which has been conceptualized by LMS through many years of research and development.<br>The introduction of solutions in the market will be supported by INTRA. The ERs will be offered with a yearly base license (yearly license fees/ subscription). Maintenance and technical support will be provided as a purchasable option. Additionally, custom integration services (connection with Enterprise Resource Planning (ERP) systems, connection with specific sensors etc.) may be provided as a separate revenue stream. | ER #9: In the context of Task 2.2 led by LMS, a set of reconfigurable robot tools has been designed and validated in industrial environments.<br>ER #15: LMS has developed an AR application to support the operators during assembly tasks' execution<br>ER #17: In terms of task 3.4 LMS has modelled all the required tasks and resources for the task planner algorithm.<br>ER #25: As the project coordinator, LMS supported INTRA on the development and maintenance of ODIN web-portal and communication tools. |
| **TECNALIA** | ER#1, ER#5, ER#6, ER#7, ER#22, ER#23 | TECNALIA has identified a significant demand for flexible and easily configurable robotic automation cells, particularly among SMEs engaged in components assembly. These needs include the ability to handle small production lot sizes, accommodate a high variety of product variants, and ensure a rapid return on investment (ROI). Such requirements emphasize the importance of a robotic system that is not only easy to set up and program but also equipped with advanced perception and autonomy features. TECNALIA views the ODIN solution as a | |

| Partner Name | Exploitable Result(s) (ER) involved | **Your interest** (exploitation intention) | Contributions |
|---|---|---|---|
| | | pivotal opportunity to meet these demands and address the needs of dozens of potential customers.<br>To maximize the exploitation potential of ODIN, TECNALIA intends to extend its application beyond the project's specific use cases. Leveraging its expertise in various industrial sectors, TECNALIA aims to adapt and deploy the solution to serve a broader range of industries, ensuring its impact and value are not confined to the initial target applications. | |
| **KTH** | ER #4 and #16 | KTH is the sole owner of the digital twin using sensor data fusion, and a joint owner of the perception skill library for flexible robotics. As a leading higher education and research institution, KTH plans to exploit these exploitable results in education hand research activities. First, they will serve as core components in future teaching materials, enriching the educational curriculum for production engineering students. Additionally, KTH intends to incorporate these results into fundamental research modules, driving cutting-edge scientific exploration in digital twin technology, sensor fusion, and robotic perception. These tools will also be used to support research projects aimed at advancing flexible and autonomous robotic systems, with potential commercialization pathways explored through industry collaborations, technology transfer initiatives, and future partnerships with companies seeking to enhance their robotic solutions with advanced digital twin capabilities and perception technologies. | Task 2.3, Task 3.2<br>KTH developed the deep neural networks processing human motions. KTH also developed key modules supporting the digital twins. |
| **TAU** | ER#4, ER#8, ER#10, ER#11 | TAU has been participating mainly in four ERs: "Perception skill library for flexible robotics", "Environment monitoring and robot control SW library", "VR-based safety training", and "Data model of resource descriptions and web service".<br><br>TAU will exploit these results in four ways. The first exploitation way will be to use these ERs in new grant applications to showcase our innovative background and technical capability in various industrial use cases. This includes presentations and lab demos to potential industrial and research partners to spread technological developments and engage them in future projects. Second, the results will be used in our education as new materials for courses and to enhance lab assignments. The developed ERs offer new platforms and resources for students to experiment with. | In the context of Task 2.3 TAU has developed three main ERs. The first two ERs, #4 and #8, are tightly intertwined in our case and form a projector-based AR solution developed within the ODIN project. This includes calibration routines and a bundle of interactive user interface features such as mobile displays with interactive buttons, a slots |

| Partner Name | Exploitable Result(s) (ER) involved | **Your interest** (exploitation intention) | Contributions |
|---|---|---|---|
| | | Third, TAU will focus on further enhancing ODIN results with new features and bringing the technologies to a higher TRL level. This includes extending the results to new use cases and domains. This will open also possibilities to engage new talents and offer them thesis opportunities. Fourth, TAU will promote our developments through open source / open data approaches, allowing others to use and further develop our results from ODIN. | concept for safe part exchange, and dynamic safety borders. These features are designed, implemented, and finally validated in an industrial environment.<br>ER #10: TAU has developed a template-based concept for VR Safety Training for operators. This helps them understand the safety of the work cell and trains them to work in collaboration with robots in safe environment before facing the real system. The developed solution can also be used for other types of assembly training.<br>ER#11: In the context of Task 3.1 led by TAU, we have described a set of Resource Descriptions (RDs) that digitally describe the HW modules used in ODIN use cases. We have also developed a web application to publish and share these RDs publicly. |
| **COMAU** | KER #5 | COMAU is the sole owner of the Autonomous mobile manipulator for collaborative operations used on Automotive use case.<br>This Novel mobile robotics platform permits an easy and flexible management of production tasks. The platform is based on the integration of two COMAU stand- | Task 2.1 and 5.2 |

| Partner Name | Exploitable Result(s) (ER) involved | **Your interest** (exploitation intention) | Contributions |
|---|---|---|---|
| | | alone robotic resources: the Agile 1500 AGV and the Racer5 Cobot. COMAU plans to exploit this solution within several industrial sectors including Manufacturing companies, logistics companies, warehouse operators, e-commerce companies. COMAU intend to promote the new products directly to potential customers by means of direct sales, online marketplace, trade shows and events, Integrators and distributors network. COMAU plans to offer after sales service and training tools to the customer. | |
| **PILZ** | ER #13 | Enhance the safety and efficiency of Human-Robot-Collaboration(HRC) applications integrating advanced risk assessment methodologies that combine simulation models with traditional techniques to streamline the design and validation process for industrial deployment is our primary objective in exploiting (ER#13).<br>The target market includes:<br>• **End Users:** Manufacturing, construction, and logistics companies seeking cost-effective solutions to validate their HRC applications.<br>• **Industrial Safety Service Providers:** Companies specializing in safety assessments and validations.<br>• **Machine Builders and OEMs:** Organizations involved in the design and manufacturing of robotic systems.<br>We plan to commercialize the results and knowledge through the following activities:<br>• **Consulting and implementation services:** Providing specialized consulting services to assist companies in implementing the new risk assessment methodology and standardizing their safety procedures.<br>• **Training Services:** Offering training sessions and webinars to educate industrial safety service providers and end users on the new methodology.<br>• **Direct Sales and Marketing:** Leveraging our sales team to promote the new methodology directly to potential customers through presentations, demonstrations and personalized consultations. | PILZ has developed and introduced as digital safety devices inside VIS simulation tool to support the safety design process. |

| Partner Name | Exploitable Result(s) (ER) involved | **Your interest** (exploitation intention) | Contributions |
|---|---|---|---|
| | | • **Online platform:** Developing an online platform to offer training, support, and resources related to the new risk assessment methodology. This platform will serve as a hub for continuous learning and support. | |
| **ROBO** | ER #4 | Roboception is the full and sole owner of the object pose estimation methods and quality inspection modules. Roboception aims to disseminate these developments as extensions to the software portfolio. The pose estimation Roboception plans to commercialize these developments by leveraging Roboception sales team and sales partner network to promote the new products directly to potential customers through presentations, demonstrations and personalized consultations.<br>In addition, Roboception plans to offer training services for our AI-based software modules for pose estimation. | Task 2.3, WP5 for validation |
| **VIS** | ER#12, ER#14 | Visual Components is the sole owner of the ODIN Simulation Library. The simulation library creates digital replica of physical assets of ODIN in Visual Components Software. The newly developed component becomes part of the catalogue library of Visual Components 4.0 product family. The simulation library components will be available to users having product license of Visual Components 4.0 product family. This will provide new digital models to Visual Components software users ranging from machine builders, system integrators to manufacturers.<br><br>- Virtual Commissioning module is owned solely by Visual Components. Some of the features developed in this module will be evaluated by Visual Components and will be made available to users of Visual Components 4.0 product family. Some of the technology in this module like ROS2 based virtual Commissiong needs to be further explored in future research projects. Robot commissioning tool will be available to users with product license as addition to connectivity feature. | Task 3.3 and Task 3.5 |

| Partner Name | Exploitable Result(s) (ER) involved | **Your interest** (exploitation intention) | Contributions |
|---|---|---|---|
| **INTRA** | ER #15, #17, #18 | INTRA acts as the sole owner of the OpenFlow platform, where the company's exploitation activities will focus on. INTRA also participates in other ER, where collaborations via joint exploitation schemes will be pursued after the end of the project, mostly in the form of introducing the results as Background IP in new research projects. For the OpenFlow platform specifically, INTRA envisions to offer it as a service. One exploitation path will be to use this IP as a foundational component in grant applications, showcasing innovation and technical capability in different scenarios and use cases. Including this ER in new consortiums will allow INTRA to strengthen partnerships with key players in the manufacturing domain—both technology providers and end users. This can lead to deeper collaborations and access to advanced technologies that complement the company's service portfolio and market penetration in the digitalisation of manufacturing in the EU.<br>The second exploitation path we envision is to offer a yearly base license (yearly license fees/ subscription) for the software's core orchestration and integration capabilities, positioning it as a cost-effective solution for manufacturers aiming to digitally transform their operations. The license will cover basic features such as system orchestration, production monitoring, and response to shop floor events. In the license agreement, we will include ongoing maintenance and technical support as a purchasable option. In addition to licensing fees, we will offer custom integration services as a separate revenue stream. This will include specific IT and integration services like connecting the platform to existing Enterprise Resource Planning (ERP) systems or incorporating specialized sensor arrays for enhanced machine monitoring, pending on the specific request of the potential customer. | Task 4.1, Task 4.3<br>INTRA developed the OpenFlow platform |
| **S21SEC** | ER #19 | S21Sec acts as the full owner of the digital twin protection framework and threat analysis toolkit developed in the task T4.2.<br>S21Sec will add this component to the managed cybersecurity services that the company provides via the Service Operation Centre (SOC). This will provide the SOC with improved security monitoring and response capabilities for automated and industrial environments. | T4.2 S21Sec developed the digital twin protection framework and threat analysis toolkit |

| Partner Name | Exploitable Result(s) (ER) involved | **Your interest** (exploitation intention) | Contributions |
|---|---|---|---|
| **AIC** | KER #5 | With the focus on the factory of the future and the improvement of processes, working flexible mobility together with process intelligence, AIC proposes an AGV with an industrial robot on it to complement different capacities and different lines of action by means of an autonomous mobile manipulator. This AGV will do a variety of jobs within the factory, from the manufacturing process itself to quality inspection processes, which is the focus of this project.<br>From AIC we will take the exploitation in two lines of work, the first one will be as an exhibitor so that everyone who passes through our facilities can see where we are putting the focus on the factory of the future in a more open and informative type of visit.<br>On the other hand, we will be demonstrating technologies to carry out product controls incorporated into an automated line using deep learning software to obtain the most accurate data. | Task 2.1 and 5.2 |
| **DGH** | KER #6 | DGH is a full and sole owner of the Machine Learning software solution for quality inspection of automotive engines, including the AI based methods module, learning software module and production quality inspection software module. DGH has the intention of include this software developed on ODIN project, on our portfolio of industrial solutions in the Automotive industry. For that DGH has prepared a physical demonstrator in our premises for disseminate the result in Automotive OEMs and Tier 1 customers that we have. In addition, DGH will have customized solutions of the software depending industrial application that our customers need in the future. DGH will have the possibility to do a training sessions tests with our customers to industrial examples need to do. | Task 2.3 and 5.2 mainly, but in general WP2 and WP5. |
| **STELLANTIS** | Several KER | The collaboration H/R gives flexibility, adaptability, versatility and efficiency in various applications in our plants who are working in moving line. The development of advanced and safe collaborative applications and robots able to be managed in global increase productivity by hight quality and flexibility. The Odin's project demonstrator with the 3 operations is interesting for all these topics. | Pilot use case. |

| Partner Name | Exploitable Result(s) (ER) involved | **Your interest** (exploitation intention) | Contributions |
|---|---|---|---|
| **AEROTECNIC** | ER#23 | The technologies developed in ODIN are designed to go beyond the production of a single set of components. The core technologies are fully scalable, enabling their application across various work cells and production lines within AEROTECNIC's facilities. These include between 100 and 200 different assembly and inspection operations, as well as other aircraft parts such as the fuselage. Additionally, the technologies can be adapted for the manufacturing of Fan-Cowls for multiple aircraft models. Following successful demonstration, testing, and validation of the pilot line, AEROTECNIC plans to implement these solutions across its facilities, enhancing efficiency and versatility in its manufacturing processes. | Pilot use case. |
| **BEKO** | ER#21 | BEKO will actively contribute to the exploitation plan as an industrial user by extending the insights gained through the ODIN project to other existing cobot applications across EMEA factories. This includes incorporating the specification requirements identified during the project into future implementation initiatives and establishing new internal standard requirements for cobot acquisition to ensure consistency and alignment with advanced automation practices. | Pilot use case. |

## 5.2. ODIN Business Model Canvas for the Key Solutions

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Propositions</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr>
<td rowspan="2">• Developers of AI, IoT, robotics, and perception systems.<br>• Regulatory Bodies: Ensuring compliance with safety, security, and data privacy regulations.<br>• Investors and Funding Agencies: Horizon Europe, EU Digital Programme, and other funding sources supporting R&D.<br>• IT infrastructure providers.</td>
<td>• Refining ODIN’s exploitable results, such as predictive maintenance, dynamic scheduling, and human-robot interaction (HRI).<br>• Positioning ODIN in manufacturing automation, IoT, safety systems, and quality control markets.<br>• Customizing solutions for target industries like automotive<br>• Adherence to industrial safety standards and cybersecurity protocols.</td>
<td rowspan="2">• Enhanced operational efficiency through Industry 4.0 automation solutions.<br>• Improved quality control using AI-powered inspection systems. Reduction in defect rates using AI-based inspection systems.<br>• Safer human-robot collaboration environments, reducing workplace incidents.<br>• Reduced downtime and maintenance costs by leveraging IoT and AI analytics.</td>
<td>• Helping clients adapt to ODIN technologies through tailored training programs.<br>• Co-developing solutions with key customers in automotive and logistics industries.</td>
<td rowspan="2">• Large Manufacturers (Automotive, Electronics, Consumer Goods): Companies seeking to adopt automation and improve production efficiency.<br>• OEMs and Tier 1 Suppliers: Focused on improving manufacturing capabilities and integrating robotics into production lines.<br>• Smart Manufacturing Facilities: Factories undergoing digital transformation to become Industry 4.0-compliant.</td>
</tr>
<tr>
<td>Key Resources<br>• Intellectual Property Portfolio (27 exploitable results)<br>• AI algorithms, IoT integration frameworks, robotic modules, and safety systems.<br>• Skilled engineers, AI specialists, and safety compliance experts.<br>• Data analytics platforms and IoT-enabled devices.</td>
<td>Channels<br>• Online marketing targeting Industry 4.0 stakeholders.<br>• Advanced Factories; Industry 4.0 events<br>• Regional support centres<br>• Partner network – word of mouth</td>
</tr>
<tr><th colspan="3">Cost Structure</th><th colspan="2">Revenue Streams</th></tr>
<tr>
<td colspan="3">• R&D Investments: Developing advanced AI, robotics, and IoT systems.<br>• Integration Costs: Customizing ODIN solutions for diverse industries.<br>• IT Infrastructure needed<br>• Sales and Marketing: Promoting ODIN’s solutions across target markets.</td>
<td colspan="2">• Offering ODIN’s robotic and software solutions under licensing agreements.<br>• Service Contracts: Maintenance, integration, and training services.<br>• Consulting Fees: For implementing customized solutions in manufacturing and logistics.</td>
</tr>
</table>

## 5.3. Methodological Overview of the ODIN Commercialisation Plans

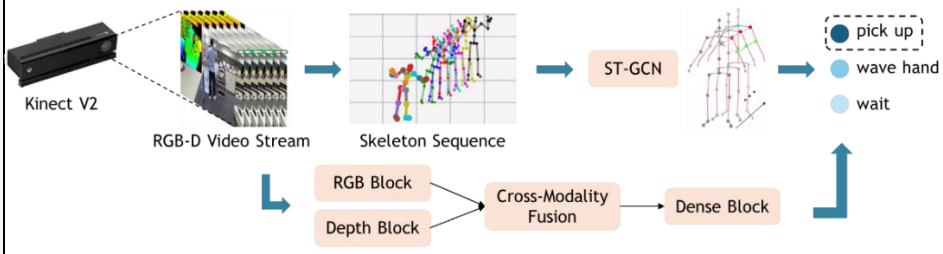
The ODIN Exploitation and Commercialization Plan provides a strategic roadmap for effectively bringing Key Exploitable Results (KERs) to market. It identifies target customer segments, highlights each KER's unique value proposition, and outlines revenue streams, cost structures, and strategic partnerships essential for successful market entry. The plan incorporates detailed strategies for commercialization, distribution, marketing, customer support, and future opportunities, leveraging insights from market research, partner feedback, and an exploitation survey to maximize the impact of the KERs and ensure sustainable commercialization.

Compared to the previous version, the **commercialization plans have been refined based on feedback from the Horizon Results Booster expert**. Key updates include a deeper analysis of Background IP elements foundational to the KERs, an expanded focus on the exploitation management team with both technical and business expertise, and refined target customer segments aligned with market trends and technological advancements. The competition analysis was enhanced to assess comparable market solutions, and resource requirements were detailed to ensure smooth deployment and risk mitigation. Financial projections were updated to outline revenue potential and required investments, while next steps emphasize advancing technical capabilities, additional validation, and strategic collaborations to optimize market entry and commercialization.

## 5.4. Commercialisation plans' update and validation based on the Horizon Results Booster service suggestions

We present hereby the updated and final business plans of ODIN's Key Exploitable Results, based on the feedback we received from the expert who consulted us from the Horizon Results Booster service.

### 5.4.1. KER #1: Perception skill library for flexible robotics

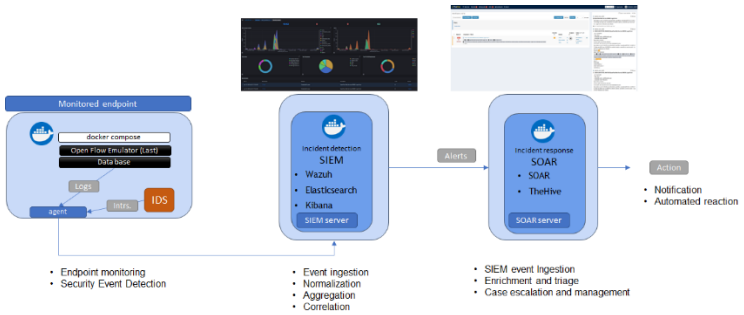
| **ODIN Business Plan**<br>*KER #1: Perception skill library for flexible robotics* | |
|---|---|
| **Description** | The result will provide modules for object detection, quality inspection and human detection and interaction to enable flexible production in a wide range of industrial use cases. |
| **Image** |  <br>  |
| **Result Type** | Library |
| **Technical Category** | Robotics and automation |
| **Partner(s) Involved** | ROBOCEPTION and TAU and KTH |
| **Background IP use in the Project** | TAU: Perception and projector-based AR modules developed in TRINITY project |
| **Management Team and Expertise** | KTH developed the 3D object detection module which enables the robot to interact robustly with the real world. By localizing parts and assemblies relative to the robot, it becomes independent to inaccuracies of preceding process steps. Both complete objects, as well as parts, are used for the detection depending on their appearance on the production line. The solution is robust to varying lighting |

| ODIN Business Plan<br>*KER #1: Perception skill library for flexible robotics* | |
|---|---|
| | conditions and small deviations from the provided 3D product model. The 3D object detection is used as input for the quality inspection that visually verifies correct assembly learned from given good and bad examples.<br>TAU developed libraries and solutions on perception based on needs of projector-based AR solution. This includes features such as detection of presence and location of human hand or arm; presence or absence of assembled objects; and locating moving display areas.<br>As a leading higher education and research institution, KTH plans to exploit these exploitable results in education and research activities. |
| **Anticipated time-to-market** | 1 - 3 years after the project ends |
| **Target Customer Segments and Market Niche** | • Manufacturing companies that use robotic systems: assembly systems where human operator performs the assembly and needs either instructions or monitoring<br>• Robotics software providers – system integrators<br>• Training and maintenance service providers<br>• Education and research institutes |
| **Competition Analysis** | • Will compete with other Human and Object detection technologies, e.g. Assembly Line Activity Recognition Project<br>• Compared with the competitors, the KER #1 approach utilised the depth video stream besides the RGB stream. It provides better performance in conducting 3D Spatial info, Lighting Invariance and robustness.<br>• Competition with TAU's perception at projector-based AR case:<br>  ○ LightGuide Systems (https://www.lightguidesys.com/),<br>  ○ Sempre Group / Arkite (https://www.thesempregroup.com/automation-integration/arkite-operator-guidance-system/)<br>  ○ Delta Sigma Company / ProjectionWorks (https://deltasigmacompany.com/mixed-reality/)<br>  ○ Virtek Vision (https://virtekvision.com) |
| **Value Proposition** | • Better product quality by operation monitoring, quality inspection, and operator guidance<br>• Reduced programming costs for robotic systems<br>• Higher flexibility in production through efficient perception capabilities<br>• Better Human-Robot Collaboration (HRC) through harmonized interfaces and functions. Safer environment for operator in HRC.<br>• Less interrupts / faster cycle times for the work cell<br>• Reduced skill requirements for operator and faster new process introduction for operators as system supports and guides them more |

| ODIN Business Plan<br>*KER #1: Perception skill library for flexible robotics* | |
|---|---|
| **Revenue Streams** | • Subscription-based revenue model for software providers who want to integrate the perception skill library into their products<br>• One-time purchase revenue model for manufacturing companies who want to use the perception skill library to enhance their robotic systems<br>• Recurring revenue model for training and maintenance services |
| **Cost Structure** | • Research and development costs<br>• Employee salaries and benefits<br>• Equipment and infrastructure costs |
| **Key Partnerships** | • Robotics manufacturers (access to robotic systems and equipment)<br>• Access to robotic systems and equipment<br>• Strong partnerships with main exploitation partners and industry players |
| **Key resources needed for deployment (materials, components)** | • Hardware: RGB-D sensor, GPU for model training<br>• ROBOCEPTION: HW: RC Visard sensor (Stereo vision)<br>• KTH: HW: Specialized Microsoft Kinect v2 sensor (RGBD)<br>• TAU: HW: Microsoft Azure Kinect sensor (RGBD)<br>• Software: deep learning supporting libraries such as PyTorch<br>• TAU: SW: Requires/depends on libraries: ROS, Google's Mediapipe, OpenCV, VISP for hand-eye-calibration, ARuCo lib, |
| **Commercialization and Market Entry Strategy** | • Include library in Roboception's existing software portfolio<br>• Advance existing detection modules and develop new software modules based on the library<br>• Directly sell the library to manufacturers who want to use the perception skill library to enhance their robotic systems<br>• License the library to robotic software-providers, training, and maintenance providers |
| **Distribution Channels** | • Direct sales and marketing<br>• Online platform for trainings and support<br>• Collaboration with main exploitation partners for distribution and integration<br>• Exploiting existing sales and promotion partnerships for indirect sales<br>• Develop bundle products with existing partners that include the library |
| **Marketing and Promotion** | • User- and application-centered marketing approach, focus on the usability and purpose of the product and how it helps potential customers<br>• Content-driven marketing with high value content in form of white papers<br>• Directed online marketing via industrial networking platforms and business platforms |

| ODIN Business Plan<br>*KER #1: Perception skill library for flexible robotics* | |
|---|---|
| | • Promotional activities for universities and research institutions (special discounts, free use for educational purposes, scaled down version for educational use) |
| **Customer Support and Training** | • Online platform for trainings and support<br>• Develop training videos and online tutorials<br>• Establish online forum/ community for answering questions and building a database |
| **Financial Analysis** | • The main cost come from Initial R&D investment, including hardware, software, and operational expenses.<br>• Revenue Potential comes from Anticipated selling and renting of the solution.<br>• Expected to achieve break-even after selling 10 units within 12 months. |
| **Exploitation next steps** | • Integrate more perception skills and novel quality control skills<br>• Improve ML-platform by advanced training capabilities<br>• Combine with other library skills for e.g., path planning<br>• KTH, TAU: Integrate courses and lab experiments for education<br>• TAU: Apply for research funding for a) additional features and b) applications on different use cases and domains |

### 5.4.2. KER #2: Digital twin protection framework and threat analysis toolkit

| **ODIN Business Plan**<br>*KER #2: Digital twin protection framework and threat analysis toolkit* | |
|---|---|
| **Description** | Prototype for a tailor-made cybersecurity solution, including the process and methodology for threat modelling and a cybersecurity toolkit with two main modules for incident detection and incident response. |
| **Image** |  |
| **Result Type** | As a Service |
| **Technical Category** | Planning and scheduling |
| **Partner(s) Involved** | S21Sec |
| **Background IP use in the Project** | • **IDS**: Suricata[1]. Open-source intrusion detection system.<br>• **SIEM**: Wazuh[2]. Open-Source Security Information and Event Management<br>• **SOAR**: The Hive[3]. Open-Source Security Orchestration, Automation and Response |
| **Management Team and Expertise** | Guidelines to complete this part:<br>• S21Sec in 100% will exploit this KPI<br>• S21Sec brings cybersecurity expertise that has been used in the project, together with the requirements identified, to generate this KPI<br>• S21Sec will use this KER to provide managed cybersecurity services to their industrial clients. |
| **Anticipated time-to-market** | more than 3 years after the project completion |
| **Target Customer Segments** | • Companies that use digital twin systems, including manufacturing, construction, and logistics companies<br>• Cybersecurity and data privacy service providers |

[1] https://suricata.io/

[2] https://wazuh.com/

[3] https://github.com/TheHive-Project/TheHive

| ODIN Business Plan<br>*KER #2: Digital twin protection framework and threat analysis toolkit* | |
|---|---|
| **Target Customer Segments and Market Niche** | • Manufacturing companies that use robotic systems and require cybersecurity incident and detection capabilities in order to be able to overcome the possible cybersecurity attacks.<br>• Robotics software providers – system integrators could be interested in the inclusion of cybersecurity incident detection and response capabilities in their software stack<br>• Training and maintenance service providers. Companies involved in the training and maintenance of industrial systems may be interested in teaching about cybersecurity issues in their customers' environments, raising awareness of the need to protect these environments, and how they can do so with tools such as this KER. |
| **Competition Analysis** | Competitors:<br>• Sumo Logic4: Cloud based SIEM-SOAR: Automate time-consuming manual tasks to focus on higher-value tasks with the ultimate integration flexibility. Sumo Logic Cloud SOAR delivers complete SOAR functionality in all cloud environments — private cloud, single cloud, multi-cloud or hybrid cloud. Automate real-time threat investigation, incident management and threat response while reducing false positives and analyst fatigue.<br>• IBM QRADAR5: Provides a proactive managed detection and response. It integrates seamlessly with QRadar's threat detection to provide automated workflows and playbooks. The platform supports collaboration through case management and communication tools. Additionally, it provides advanced analytics and reporting to enhance situational awareness and optimize response strategies.<br>• Cortex® XSOAR™6 is integrated with the Cortex platform for a seamless user experience and ease of deployment. XSOAR can be used to orchestrate incident response and automate workflows across Palo Alto Networks portfolio to extract more value out of a given security investment.<br>Unique selling point:<br>• This KER has been created starting from open-source components to which specific detection and response features for specific cybersecurity attacks have been added. Specifically, it has focused on securing a specific digital twin environment that uses ROS but can be useful for digital twins using other communication protocols. In addition, specific connectors have been developed to detect and send |

[4] https://www.sumologic.com/

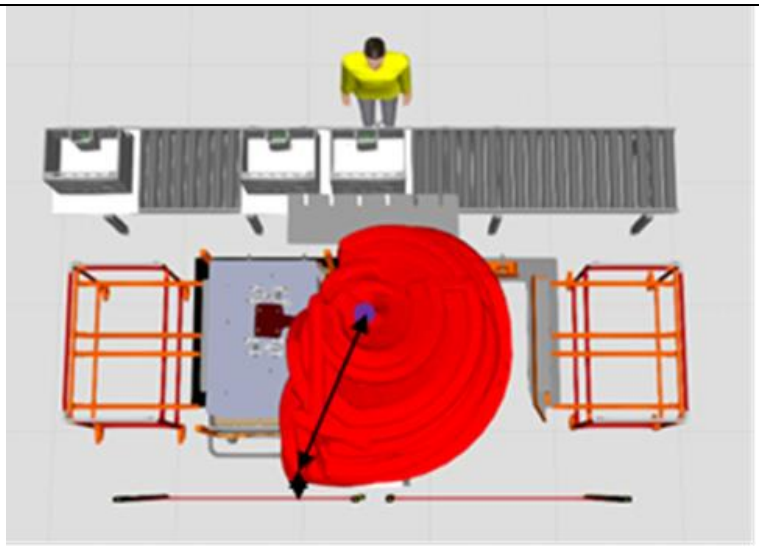
[5] https://www.ibm.com/es-es/qradar

[6] https://www.paloaltonetworks.es/cortex/cortex-xsoar

| ODIN Business Plan<br>*KER #2: Digital twin protection framework and threat analysis toolkit* | |
|---|---|
| | cybersecurity alerts to the SOAR and in the SOAR, specific responses have been developed to respond to specific cybersecurity issues that arise in digital twins. |
| **Revenue Streams** | • Subscription-based revenue model for software providers to integrate the protection framework and threat analysis toolkit into their products<br>• Consulting and implementation services for companies who want to enhance their digital twin security<br>• Training services for digital |
| **Cost Structure** | • Personnel costs<br>• Technical infrastructure costs<br>• Indirect/ utility costs<br>• Research and Development costs |
| **Key Partnerships** | • Cybersecurity firms (knowledge exchange)<br>• Industrial companies (promote the result) |
| **Key resources needed for deployment (materials, components)** | • **Monitored endpoint**: no specific SW or HW requirements. Can be installed in Windows or Linux based OS. The device should be able to run ROS1.<br>• **SIEM**: 8GB RAM, 2 CPU and 60GB HDD<br>• **SOAR**: 12GB RAM, 4 CPU and 150 GB HDD<br>These components have been designed to operate on commodity hardware. |
| **Commercialization and Market Entry Strategy** | • Integration in the S21Sec teams to improve the services given to the clients |
| **Distribution Channels** | • Direct sales and marketing<br>• Online platform for trainings and support<br>• Collaboration with main exploitation partner for distribution and integration |
| **Marketing and Promotion** | • S21Sec marketing channels |

| ODIN Business Plan<br>*KER #2: Digital twin protection framework and threat analysis toolkit* | |
|---|---|
| **Customer Support and Training** | • Continuous support to end-users for implementing and using the solution |
| **Financial Analysis** | Cost 1st year<br>• Personnel costs: 1,5-person full time: 100K€<br>• Cloud services: 5K€<br>Cost 2nd year<br>• Personnel costs: 1 person part time: 30K€<br>• Hardware cost: 5K€<br>Cost 3rd year<br>• Personnel costs: 1 person part time: 30K€<br>• Hardware cost: 5K€<br>Revenues<br>• Revenue 1 year: 0€<br>• Revenue 2 year: 150K€<br>• Revenue 3 year: 300K€<br>Installation of the solution will be a core service offered as a service to different customers in different tenants so the revenue will scale with more customers using the same infrastructure.<br>Maintenance services will be offered to provide advanced support and technical knowledge to customer when operating a cybersecurity incident detection and response service.<br>Customization and consultancy services will be offered for fine tune and to cover more cybersecurity incident detection and response use cases in the context of the customer.<br>Training services will be offered to integrate new staff in the customer side and to better understand the cybersecurity incident detection and response process performed. |
| **Exploitation next steps** | • Presentation of the result to the different S21Sec teams in M1, with an emphasis on the SOC and ICS teams<br>• Identification of improvements and new requirements to be done in the project, by M6<br>• Define a roadmap during M3-M12 for the necessary improvements needed for the component to be integrated into production. |

### 5.4.3. KER #3: Risk assessment, virtual safety components and safety validation methods for industrial deployment

| ODIN Business Plan<br>*KER #3: Risk assessment, virtual safety components and safety validation methods for industrial deployment* | |
|---|---|
| **Description** | One of the main constraints for the adoption of collaborative robotics is the high complexity of design of HRC applications, and more specifically the introduction of Safety Systems in balance with productivity. In order to reduce efforts during safety systems design phases, normally several iterations of the whole concept are required (tool shape, robot speeds, etc.). In ODIN, new risk assessment and safety design methodologies for HRI applications development have been conceived combining enhanced simulation models and tools with traditional methodologies.<br>Different ODIN components have been developed and introduced as digital safety devices inside VIS simulation tool to support the safety design process. These components provide:<br>• Compliance verification: Ensuring that the installation distance of safety devices from potential hazards complies with established safety standards.<br>• Automatic safety distance calculation: Automatically calculating the minimum safety distance for warning and safety zones of scanners.<br>Automatic calculation of the closest point (Hazard) within the specific working area of a robotic arm to be further used it for safety distance calculations. |
| **Image** |  |
| **Result Type** | As a Service |
| **Technical Category** | Robotics and automation |
| **Partner(s) Involved** | PILZ |
| **Background IP use in the Project** | • Methodologies for risk assessment and safety validation including impact measurement procedures and tools (PRMS).<br>• Performance Level (PL) and Safety Integrity Level (SIL) calculations of safety functions knowledge and tools (PASCal®). |

| ODIN Business Plan<br>*KER #3: Risk assessment, virtual safety components and safety validation methods for industrial deployment* | |
|---|---|
| **Management Team and Expertise** | • Partners supporting: PILZ, LMS, VISUAL COMPONENTS<br>• PILZ has a deep understanding of safety standards, safety design methodologies, safety devices knowledge, ensures the development of the virtual safety components and the safety validation methods.<br>• LMS offers an integration of the safety virtual devices in the real virtual pilots of the project.<br>• VIS provides a software tool to support the integration of the safety virtual devices.<br>• As an industrial safety service provider, PILZ has a broad and diverse customer base who might be interested with this tool. These clients are potential direct users, benefiting from its application in their own projects. |
| **Anticipated time-to-market** | • One year after the completion of the project for internal development and validation. |
| **Target Customer Segments** | • End users such as manufacturing, construction, and logistics companies that want a cost-efficient way to validate their HRC applications.<br>• Industrial safety service providers, to optimize the design time of the safety concepts.<br>• Machine builders, system integrators that focus that apply HRC technologies in their solutions and OEMs, optimize the design time of the safety concepts and they also want to validate in simulation that the proposed designs comply with the standard.<br>• PILZ consulting and engineering teams for internal use and all the subsidiaries globally. On the same terms as the safety service providers. |
| **Competition Analysis** | • Siemens Safety Evaluation Tool: Siemens offers a comprehensive tool for evaluating the safety of machinery. It includes validations of safety functions.<br>• Machine Safety Specialists: They provide independent verification and validation services for safety systems. Their services include compliance verification with regulatory requirements and validation of machine safety functions.<br>• Rockwell Automations Safety Automation Builder: This software helps design and validate safety systems for machinery. It includes tools for risk assessment, safety calculations, and integration of safety components.<br>PILZ will offer a cross-platform compatibility in his solution, making it versatile and accessible to a wide range of users. The result tool will have a modular design, allowing the users to select and integrate only the components they need, reducing unnecessary complexity.<br>The difference of our tool is that while we allow the verification of a number of safety requirements such as safety devices, compared with other software, we do it directly on the 3D simulation tool so that we speed up the process of design and simulation testing of safety concepts. |

| ODIN Business Plan<br>*KER #3: Risk assessment, virtual safety components and safety validation methods for industrial deployment* | |
|---|---|
| **Value Proposition** | • Increased safety of industrial systems and HRC applications through better standardization of assessment and validation procedures.<br>• More effective and efficient method to conduct risk assessments and design of safety measures. Saving engineering hours.<br>• New services and training opportunities. More productive hours of engineering and consulting teams. Expected savings of 5 hours per risk assessment. (cost savings leading to extra profits). |
| **Revenue Streams** | • Consulting and implementation services for companies who want to implement the methodology and standardize their safety procedures.<br>• Training services for safety assessment, implementation and validation using new methodology. Direct commercialization of new methodology via trainings and webinars. |
| **Cost Structure** | • Material and production costs<br>• R&D expenses<br>• Employees' salaries and benefits. |
| **Key Partnerships** | • Strong partnerships with robotic manufacturers, main exploitation partners and industry players.<br>• Industrial safety service providers. |
| **Key resources needed for deployment (materials, components)** | • Software for virtual simulation of the real application, including all elements and processes, such VIS but also others.<br>• Specifications from PILZ to replicate real devices and device behaviours in the virtual simulation tool.<br>• Specific algorithms for each safety device to ensure installation distances of safety devices comply with established safety standards. |
| **Commercialization and Market Entry Strategy** | • Train all PILZ engineers to start using the new methodology in their risk assessments, design and validation for HRC applications.<br>• Create training and webinars for industrial safety service providers and end users interested in a cost-efficient way to validate their machines. |
| **Distribution Channels** | • Direct sales and marketing.<br>• Online platform for trainings and support.<br>• Collaboration with main exploitation partner for distribution and integration. |
| **Marketing and Promotion** | • Promote new training and webinars in PILZ website.<br>• Use sales representatives to preset new methodology to be interested partners and end users.<br>• Encourage engineers to promote the new methodology using word of mouth during their visits to clients. |

**ODIN Business Plan**

*KER #3: Risk assessment, virtual safety components and safety validation methods for industrial deployment*

**Customer Support and Training**

- Review training and webinars yearly based on customer feedback.
- Provide remote technical support to customers during risk assessment, design, implementation and validation

**Financial Analysis**

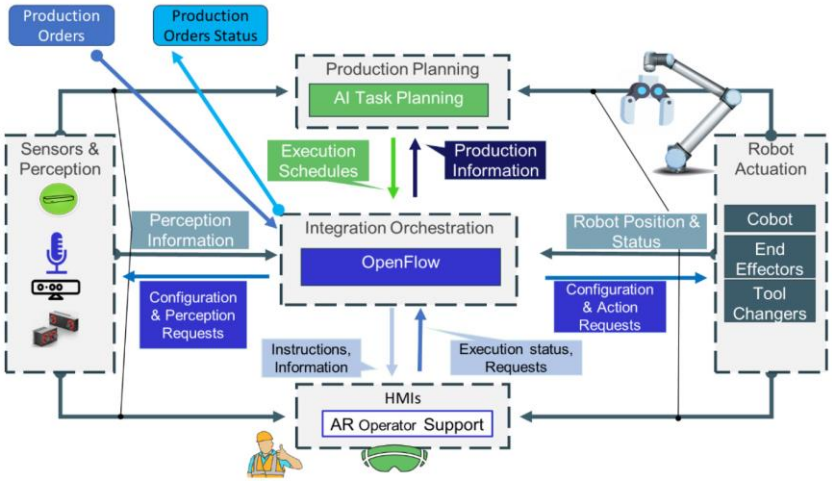
- Via licenses of the tool to the simulation software providers.
- Via payments for the integration (development necessary to adapt it to the costumer environment) of the tool into third party software.
- Via SaaS licenses on its own platform

| Financial viability | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| Revenues - Annual sales (€) | 67.800 | 102.000 | 204.000 | 306.000 | 357.000 |
| Costs (€) | 144.250 | 76.500 | 153.000 | 229.500 | 267.750 |
| Direct costs | 85.000 | 73.500 | 147.000 | 220.500 | 257.250 |
| Indirect costs | 59.250 | 3.000 | 6.000 | 9.000 | 10.500 |
| Profit(€) | -76.450 | 25.500 | 51.000 | 76.500 | 89.250 |
| Accumulated profit(€) | -76.450 | -50.950 | 50 | 76.550 | 165.800 |

**Exploitation next steps**

- Possibility to make the new methodology the standard for HRC risk assessments and gain market recognition and expansion.
- Develop the tool as a plugin as own independent platform and services to ensure compatibility and seamless integration with existing simulation tools. (Q1)
- Conduct extensive beta testing with a diverse group of users to identify and fix any issues.(Q2)
- Implement cybersecurity testing to protect against vulnerabilities and ensure data privacy.(Q3)
- Develop a marketing strategy to promote the tool, including digital marketing.(Q3)
- Prepare detailed documentation and user manuals to support compliance and user adoption.(Q4)
- Indicate timelines or milestones where possible (e.g., “Pilot integration of new quality control skills in Q3”).
- PILZ can explore a partnership with VIS as a first simulation tool.

### 5.4.4. KER #4: OpenFlow Platform (previously Open flexible orchestration of workplaces)

| **ODIN Business Plan**<br>*KER #4: OpenFlow Platform* | |
|---|---|
| **Description** | A software solution based on OpenFlow that integrates and orchestrates HRC modules, monitors the execution and responds to shopfloor events to complete a given production goal. OpenFlow can orchestrate, model and control many diverse state-of-the-art software and mechatronic systems such as cobots, mobile robots, agvs, AR applications, AI detection and prediction software, as well as sensors, machinery, planning and ERP systems. |
| **Image** |  |
| **Result Type** | As a Service |
| **Technical Category** | Planning and scheduling |
| **Partner(s) Involved** | INTRA |
| **Background IP use in the Project** | Netcompany-Intrasoft provides its background intellectual property to support the OpenFlow platform, including software for real-time orchestration, decision-making, and monitoring of manufacturing resources. It offers a knowledge repository for modelling and retrieving orchestration and monitoring data and custom APIs for seamless integration with ERP systems, planning tools, sensors, and machinery. |
| **Management Team and Expertise** | The management of the OpenFlow platform result is led by Netcompany-Intrasoft, serving as the Intellectual Property Rights (IPR) and exploitation leader. With decades of experience in delivering innovative digital solutions, INTRA specializes in managing complex R&D projects and transforming research outcomes into market-ready products. INTRA brings a proven track record in successfully bridging research and industry through its expertise in developing and deploying cutting-edge software solutions in manufacturing and other critical sectors. Leveraging its deep knowledge of interoperability frameworks, real-time systems, and orchestration platforms, INTRA is well-positioned to guide OpenFlow's transition from project development to a scalable, market-ready solution. Its global presence and established network |

| ODIN Business Plan<br>*KER #4: OpenFlow Platform* | |
|---|---|
| | of partners further enhance its ability to foster collaborations and secure licensing opportunities for this result. |
| **Anticipated time-to-market** | 1-2 years after the end of the project |
| **Target Customer Segments** | The two main target segments for the OpenFlow platform are **large manufacturing companies with automated production lines** and **technology integrators in manufacturing**. We will target, at first the EU market, and especially countries with strong manufacturing background, targeting Spain, Italy, Garmany and France mostly.<br><br>Large manufacturing companies, particularly those in automotive, electronics, and consumer goods, face increasing pressure to optimize production efficiency, reduce downtime, and integrate disparate systems across their facilities. OpenFlow addresses these needs by orchestrating various technologies such as robots, AGVs, AR systems, and ERP solutions into a production workflow, improving operational flexibility and responsiveness to unforeseen events. The market was valued at USD 61.85 billion in 2021 and is expected to grow at a robust CAGR of 9.8% from 2022 to 2029.[7] Technology integrators, on the other hand, specialize in tailoring automation solutions for clients by integrating different hardware and software components. They could use aa platform like OpenFlow that can orchestrate and monitor complex systems, ensuring smooth interoperability between robots, sensors, AI-based systems, and existing production software. |
| **Competition Analysis** | In the competitive landscape for manufacturing orchestration software, key players include Siemens, GE Digital, Rockwell Automation, and Dassault Systèmes. Siemens' MindSphere platform offers industrial IoT solutions with real-time data monitoring and predictive maintenance, similar to OpenFlow's capabilities. GE Digital's Predix platform also focuses on optimizing processes through real-time analytics and AI, aligning with OpenFlow's objectives in production orchestration. Rockwell's FactoryTalk suite integrates industrial automation with AI to provide real-time process optimization, while Dassault Systèmes' 3DEXPERIENCE enables digital twins for system simulation and process optimization. However, these could not be considered as direct competitors, but rather as indirect ones. |
| **Value Proposition** | • OpenFlow integrates cobots, AI, and ERP systems, reducing downtime and improving productivity by up to 20% (McKinsey, 2023; Deloitte, 2023).<br>• Real-time orchestration allows rapid adaptation to disruptions, cutting operating costs by 10–15% through predictive maintenance (Deloitte, 2023).<br>• The unified platform reduces integration and maintenance costs, with AI in manufacturing projected to save up to $1.5 trillion globally by 2030 (PwC, 2023). |
| **Revenue Streams** | • Payment per project based on the conditions of a licensing agreement |

[7] https://www.fortunebusinessinsights.com/industry-reports/industrial-automation-market-101589

| ODIN Business Plan<br>*KER #4: OpenFlow Platform* | |
|---|---|
| | • Service contracts for extra features, pending on each use case |
| **Cost Structure** | • Costs associated with customizing the platform, fixing bugs, and adding new features to meet customer demands.<br>• Expenses related to deploying and maintaining cloud to ensure scalability.<br>• Costs for integrating OpenFlow with customers' existing machinery, ERP systems, and other manufacturing technologies.<br>• Marketing and sales costs<br>• Admin costs |
| **Key Partnerships** | • Technology providers in manufacturing who will implement their solutions on the platform |
| **Key Resources** | • Skilled teams to develop, customize, and integrate the OpenFlow platform with existing customer systems (cobots, ERP, AI tools).<br>• Scalable cloud infrastructure to host and maintain the platform, ensuring it can handle real-time data processing and orchestration.<br>• A dedicated team for ongoing service, troubleshooting, and updating the platform, ensuring customer systems remain optimized and secure.<br>• Resources for creating user-friendly documentation and providing training to ensure smooth adoption of the platform by manufacturers.<br>• Marketing to promote the platform, engage potential customers, and expand the user base across the target segments (manufacturing companies and tech integrators). |
| **Commercialization and Market Entry Strategy** | • Engage large players in the industry to check the desirability of the solution – engage relevant partners from our network from previous/existing projects.<br>• Leverage pilot projects and demonstrations from previous research to showcase OpenFlow's interoperability and productivity gains at industry events and digital innovation hubs. |
| **Distribution Channels** | • Direct sales (licensing, service contracs)<br>• Access to the software via binaries provided by INTRA |
| **Marketing and Promotion** | • Collaboration with existing partners from use cases<br>• Referrals, utilizing word of mouth to reach adopters<br>• New use cases via new research projects |

| ODIN Business Plan<br>*KER #4: OpenFlow Platform* | |
|---|---|
| **Customer Support and Training** | • Ad-hoc interactions via emails and online calls<br>• Continuous support and maintenance of the solution pending on licensing agreements |
| **Financial Analysis** | • License Agreements: We estimate an average of 10,000 EUR per year per license, and considering potential market adoption, the revenue from these agreements can grow significantly over time. For instance, if 20 customers sign on within 5 years, this results in 200,000 EUR in yearly revenue from licensing alone.<br>• Service Contracts: Estimated at 350 EUR per man day, service contracts could provide recurring income from project-specific support and customization. Assuming an average of 20 man-days per contract, this brings in approximately 7,000 EUR per contract. If 10 contracts are signed annually, this adds 70,000 EUR in revenue from services. |
| **Exploitation Next Steps** | • Develop new applications in different manufacturing sectors, such as automotive or electronics, to validate the platform and refine its features.<br>• Integrate advanced technologies like AI and machine learning for improved decision-making and real-time analytics, addressing evolving customer needs.<br>• Scale the platform's cloud capabilities for better performance and handle increased data loads from a growing customer base.<br>• Promote the OpenFlow platform via conferences and online resources, like the Horizon Results platform to enhance adoption. |

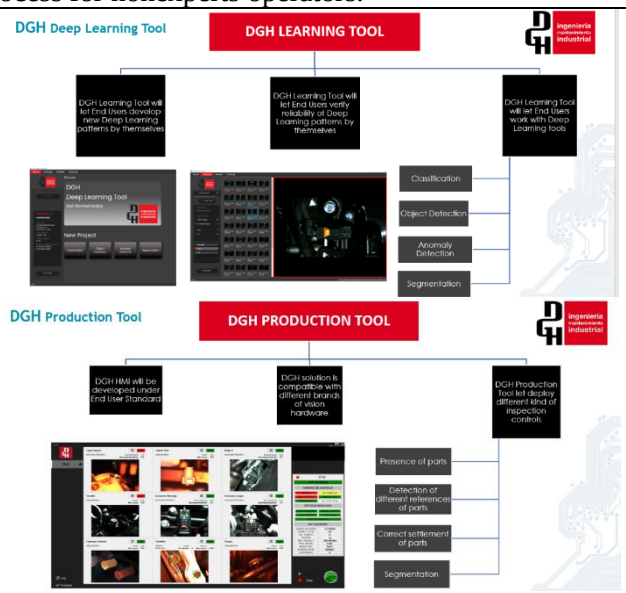
### 5.4.5. KER #5: Autonomous mobile manipulator for collaborative operations

| **ODIN Business Plan**<br>*KER #5: Autonomous mobile manipulators for collaborative operations* | |
|---|---|
| **Description** | Novel mobile robotics platforms that permit an easy and flexible management of production tasks. The one mobile robotics platform is based on the integration of two COMAU stand-alone robotic resources: the Agile 1500 AGV and the Racer5 Cobot. The second mobile robot is deployed by AIC and integrates the advantages of an industrial robot arm, an automated guided vehicle, and other smart capabilities. This KER refers in essence to two distinct solutions, one owned by COMAU and one owned by AIC, as described above. For reasons of simplicity, these two solutions where bundles into on KER. |
| **Image** |  |
| **Result Type** | As a Service |
| **Technical Category** | Robotics and automation |
| **Partner(s) Involved** | COMAU, AIC |
| **Background IP use in the Project** | The project uses the existence of an automated line with process intelligence to provide flexibility to incorporate more than one process within the framework of advanced manufacturing. To this end, the Promind software is used to provide all the information, data and parameters of the automated line and its processes that exist in the ASF (Automotive Smart Factory) of the AIC (Automotive Intelligence Center) today. This technology will be used to absorb the data from the quality controls that will be carried out in the ODIN project and to process the data and be able to visualise them in real time. |
| **Management Team and Expertise** | The AIC team carries out the project, with knowledge in the field of advanced manufacturing and industry 4.0 in factory improvement projects and implementation of solutions, and in this case with the collaboration of the DGH team. On the other hand, for the exploitation from AIC in close relationship with ACICAE Cluster of Basque automation, we have the ability to show our solutions to the 160 partners first hand and all the companies that come to visit our facilities. |
| **Anticipated time-to-market** | Within a year after the end of the project |
| **Target Customer Segments** | As factories transform towards Industry 4.0, there is a growing demand for solutions that integrate artificial intelligence to perform real-time inspections. Automation is key to competing in a global market where efficiency is crucial. |

| **ODIN Business Plan**<br>*KER #5: Autonomous mobile manipulators for collaborative operations* | |
|---|---|
| | As production moves faster, inspection systems must adapt to a dynamic environment and be able to detect small defects accurately. This fosters the need for intelligent systems that can process large volumes of visual data in real time.<br>Companies prefer integrated solutions that can handle both quality inspection and logistics within a single platform, such as autonomous robots that move on AGVs to inspect products as they are transported along the production line.<br>There is a growing demand for modular and scalable inspection systems that adapt to different environments and production needs without the need for costly reconfiguration. Customer profiles could be:<br>• Manufacturing companies that your manufacturing process consist on serial operations and flexibility on operations positioning in traceability of product is needed.<br>• Manufacturing companies needs flexible production for to produce a lot of versions of product. |
| **Competition Analysis** | So far different option could be available on the market with a similar approach and features, such as:<br>• Robotnik Rb-kairos+UR5<br>• MIR100 + UR5<br>• Kuka KMR iiwa and KMR iisy<br>The solutions developed by COMAU and AIC respect to the others available on the market present an extended payload that could be applied for a larger wide range of application. |
| **Value Proposition** | • Increased productivity through higher flexibility in production and better HRC<br>• Direct commercialization of products (HW/SW)<br>• Automation can be done on turnkey way, customize it a lot depending on production processes. |
| **Revenue Streams** | • One-time purchase revenue model for companies who want to use the autonomous mobile manipulator to enhance their robotic systems<br>• Subscription model for software updates, maintenance and support contracts, consulting services.<br>• Implementations of new customizations of Automation or mobile robot needed in the future |
| **Cost Structure** | • Material and production costs<br>• R&D expenses<br>• Marketing and sales costs, salaries and benefits<br>• Infrastructure and operations costs |
| **Key Partnerships** | • Component suppliers<br>• System integrators<br>• Technology partners |

| ODIN Business Plan<br>*KER #5: Autonomous mobile manipulators for collaborative operations* | |
|---|---|
| | • Distribution partners<br>• Research institutions. |
| **Key resources needed for deployment (materials, components)** | For the development of the inspection process carried out in the ASF, on the one hand we would have standard resources to carry out the process such as: 2D and 3D cameras, a conveyor belt, a robot, Ethernet communication elements. On the other hand, we would have more complicated resources to obtain: An AGV with the loading capacity of an industrial robot, specific software with AI for training and processing inspections on a product. |
| **Commercialization and Market Entry Strategy** | • Design and Validation trough research projects<br>• Direct Launch to the market through physical demonstrator available working<br>• Possibility to demonstrate the running mode of the solution directly with the customers products in the physical demonstrator available. |
| **Distribution Channels** | • Direct sales<br>• Online marketplace<br>• Trade shows and events<br>• Referrals<br>• Integrators and distributors |
| **Marketing and Promotion** | • Trade fair and events (e.g.: AUTOMATICA)<br>• Conferences (e.g., ERF, EFFRA)<br>• Social Media (e.g., LinkedIn, YouTube)<br>• Official web site (www.comau.com)<br>• National and international magazines |
| **Customer Support and Training** | • After sales services (COMAU, AIC, DGH)<br>• Training tools (COMAU, AIC, DGH) |
| **Financial Analysis** | For the possibility of the expected revenue streams, this technology will be included, if necessary, in the strategic transformation projects that we launch from the ASF, the costs that we generate are minimal, we look at the consumption and wear of the use of the system in the presentations and visits that we have. |
| **Exploitation next steps** | From the ASF we will take the next steps focusing on using this technology in different processes and different products such as composite materials: Glass carbon fibre, plastics. Focus is put on identifying visual errors in high-speed automated lines where the material is different than metal.<br>We will also try to include this technology to improve some geometric inspection process we have on the ASF line. We will try to compare the existing technology with the one that has been carried out in the ODIN project and to be able to implement the results of it in other processes in our line. |

### 5.4.6. KER #6: ML Solution for inspection of automotive engines

| **ODIN Business Plan**<br>*KER #6: ML Solution for inspection of automotive engines* | |
|---|---|
| **Description** | The ML solution for quality inspection (QI) consists of a system that can work on inspecting quality of automotives engines in real time. The QI system incorporates two main modules or tools, a) a learning tool module and b) a production tool module. ML solution is an industrial software for Quality inspection process for nonexperts operators. |
| **Image** |  |
| **Result Type** | ML Model |
| **Technical Category** | Robotics and automation |
| **Partner(s) Involved** | DGH |
| **Background IP use in the Project** | • The technology used is Artificial vision functions for to detect predefined objects in the space, compare with data tables.<br>• Second step was to build this data tables with artificial vision cameras and update it dynamically and starting use generic Machine learning algorithms to do it.<br>• Finally develop a customize deep learning algorithm for to learn system of the data sets of images create by artificial vision system images and apply it for to do different quality controls in a lot of types of industries. |
| **Management Team and Expertise** | • DGH has a different agreement with different artificial vison systems builders for more than 15 years; to develop specific product for us sometimes and other times implement in their portfolio our software solutions for like KER.<br>• DGH has experience for more than 15 years developing, programming and implementing industrial production lines with artificial vision systems doing a lot of types of controls, robots' guidance, and defects, etc. DGH has a dedicated team developing this Artificial vision technologies applied to the industry.<br>• DGH not only develops ML solution, updates it, and implements the KER6 solution in existing production lines including, if necessary, automation, robotization, mechanical design of tools, etc. DGH can do the complete industrial solution. |

| ODIN Business Plan<br>*KER #6: ML Solution for inspection of automotive engines* | |
|---|---|
| | • Finally, DGH has a commercial department with around 40 members working to sell our solutions in all of Europe mainly, and some countries of Africa and Asia. |
| **Anticipated time-to-market** | Within a year after the end of the project |
| **Target Customer Segments** | • Automotive manufacturing companies with automated production lines requiring advanced objects and defect detection<br>• Automotive manufacturing companies working with robotic systems that align well with the project's develops done.<br>• All the levels of industries OEMs, and TIER 1 and TIER 2 suppliers. Manufacturing companies working in these types of industries. |
| **Competition Analysis** | • Competitors for DGH ML solution are on individual parts of this KER6. |
| **Value Proposition** | • Reduced costs<br>• Improved productivity, higher accuracy and consistency in inspection<br>• Predictive maintenance<br>• Implementation of the ML Solution in actual standards of manufacturing factories would be very fast. |
| **Revenue Streams** | • One-time purchase revenue model for companies who want to use the ML solution to enhance their inspection capabilities.<br>• Subscription model for software updates, maintenance and support contracts, consulting services. |
| **Cost Structure** | • R&D expenses<br>• Hardware and software costs<br>• Marketing and sales costs<br>• Salaries and benefits<br>• Infrastructure and operations costs |
| **Key Partnerships** | • Automotive manufacturers and suppliers<br>• Aftermarket service providers<br>• Data providers<br>• System integrators |
| **Key resources needed for deployment (materials, components)** | • Hardware likes cameras 2D and 3D.<br>• Data sets libraries, these libraries are not very easy to get it. Specific DL software modules commercial and develop by us<br>• Expert team working specifically in these development for KER6.<br>• HMI friendly software for non-expert operators where ML solution can integrate it. |
| **Commercialization and Market Entry Strategy** | • DGH Commercial Network (National and International (Mainly Europe, Afrique, Asia…)<br>• Through OEMS, TIER1 1 and 2; collaborate with existing customers (Factories, etc.)<br>• Hardware providers on their specific market solutions |
| **Distribution Channels** | • Direct sales<br>• OEM partnerships |

| **ODIN Business Plan**<br>*KER #6: ML Solution for inspection of automotive engines* | |
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| | • Online marketplace<br>• Trade shows and events<br>• Referrals. |
| **Marketing and Promotion** | • Creating demo workshops on customers installations.<br>• Referring information of implementation ML software system in customer factories.<br>• Promote new projects and services on potential new use cases on clients. |
| **Customer Support and Training** | • Through our presence on customer factories<br>• Industrial maintenance business unit on many different WorkCentre's of customers. |
| **Financial Analysis** | • Customized solution for each type of industrial processes and industries. Turnkey projects of the KER6 solution, pay per use KER6 solution in customer production lines, and finally licensing KER6 solution for existing Artificial vison system implemented in industrial processes.<br>• The revenues for each of these project formats prevision are: Turkey projects 60 %, licensing 30 %, pay per use 5%, and 5% more for others likes special agreements with hardware builders' companies, etc.<br>• The expected cost reduction in the implementation of quality inspection, defect detection with artificial vision systems prevision is 20%.<br>• The commercialization cost in the future will be centralized in creating specific and specialized commercial expert for to sell KER6 solution.<br>• The revenues expected after last one final year of refinement KER6 is to reach at least 20%. |
| **Exploitation next steps** | • New Opening of new international delegation in France (October 23)<br>• DGH commercial department expansion with new technician people working.<br>• Include this KER6 in a total software artificial vision solution imbibed in friendly HMI DGH software (Launcher).<br>• Implementing PLC tradability system on our HMI launcher with KER6 imbibed.<br>• The intention is to have a KER6 solution in less than 1 year directly inside of our main industrial solutions portfolio. |

### 5.4.7. KER #7: AR Suite for collaborative assembly operations

| ODIN Business Plan<br>*KER #7: AR Suite for collaborative assembly operations* | |
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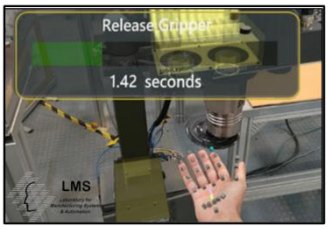
| **Description** | Augmented reality suite assisting operators in Human-Robot Collaborative environments in which resources collaboration is required for different assembly tasks execution. Thanks to its integration with the shopfloor's Digital Twin and Robotic Operation System (ROS), the AR suite achieves the efficient HRC in multiple aspects namely:<br>• assembly guidance provision;<br>• robot controlling;<br>• interaction with gripping tools;<br>• safety awareness;<br>• resilience in case of robot actions failure;<br>• cyber security and;<br>• quality inspection result awareness. |
| **Image** |  <br>Instructions for assembly tasks' execution and system's recovery<br>  <br>Visualization of robot trajectory and safety zones<br>  <br>Interaction with gripping tools |
| **Result Type** | As a Service |
| **Technical Category** | Robotics and automation |
| **Partner(s) Involved** | LMS, INTRA |
| **Background IP use in the Project** | LMS has a strong background in developing HRI applications through its participation inside different European projects such as ROBO-PARTNER, THOMAS and SHERLOCK EU projects. LMS has previous knowledge on the following topics:<br>• Android applications on smart wearable devices for operators' communication with the rest of the resources inside the factory.<br>• Augmented reality applications' designing and development for supporting operators during human robot collaborative assemblies. |

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| | Design and development of multi modal interfaces supporting human robot interaction through force sensing, smart wearables and gesture recognition applications. |
| **Management Team and Expertise** | LMS supported by INTRA has developed the AR application to assist human operators during assembly tasks' execution inside the ODIN pilots. Both partners have expertise on this kind of activities through their participation in other EU projects (THOMAS, SHERLOCK). INTRA will lead the exploitation activities towards the commercialization of the result and through their big communication channels will boost the exploitation of the result. |
| **Anticipated time-to-market** | 1-2 years after the project ends |
| **Target Customer Segments** | • Manufacturing companies interested in human-robot collaborative operations to ensure the effective and safely co-existence of human operators and robot.<br>• Robotic Integrators in case of Human-Robot Collaborative workstations.<br>• Assembly line operators without background knowledge on the assembly procedure.<br>• Manufacturing companies interested to inform human operators on demand regarding corrective actions on products (e.g. quality inspection results, corrective actions)<br>• Training providers to train in a more efficient way new employees. |
| **Competition Analysis** | Competitor of the proposed solution is the Gestalt Robotics Augmented Reality & Spatial Interaction (link).<br>Selling point is the integration of AI functions with novel sensing/wearable devices and modelling methods create high potential of developing applications towards the safety feeling of human workers and increasement of system reliability. |
| **Value Proposition** | • Easier programming capabilities for HRC<br>• Enhanced flexibility in production processes<br>• Adaptation to human needs and activities<br>• Improved productivity<br>• Ergonomic improvement in HRC activities<br>• Reduced training time |
| **Revenue Streams** | • Subscription model for software licensing,<br>• Maintenance and support contracts,<br>• Training/ Consulting services. |
| **Cost Structure** | • R&D expenses<br>• Hardware costs<br>• Software licenses<br>• Marketing and sales costs<br>• Infrastructure and operations costs |

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| **Key Partnerships** | • Manufacturing companies,<br>• Assembly line operators,<br>• Training providers,<br>• Robotic integrators<br>• AR hardware and software vendors. |
| **Key resources needed for deployment (materials, components)** | • Augmented Reality glasses (e.g. Microsoft Hololens V2) to run the Augmented Reality application of ODIN.<br>• Software development platform for the AR application (e.g. Unity platform). |
| **Commercialization and Market Entry Strategy** | Market entry via a joint exploitation scheme between LMS and INTRA (KER no7 could be an add-in service of the OpenFlow Platform, namely KER no 4); this solution could be offered as a package (AR suite and OpenFlow platform) to potential end-users and initial adopters, via licensing business model (a service contract with periodic one-off license fees to getting access and using the package). The networks, client base, collaborators and vendors of INTRA will be used to support the market entry of this KER. New use cases in various operational environment will be also pursued. |
| **Distribution Channels** | • Direct sales<br>• Online marketplace<br>• Trade shows and events<br>• Referrals<br>• Social media |
| **Marketing and Promotion** | • Industry events<br>• Manufacturing exhibitions<br>• Scientific publication about this software's integration to industrial use cases<br>• Social media posts pointing out the benefits of its use<br>**Bottom-up or top-down approach**: Both approaches will be followed. The bottom-up approach will be followed pointing out the good support which will be provided to the customers in case of questions or problems about software's execution. Top-down approach will be implemented as well, through the dissemination of the software through the network of the customers of the project. It is considered that after the deployment of the solution, the first customer will increase the awareness in the similar customers. |
| **Customer Support and Training** | • Support services such as training, maintenance and further customization will be provided by LMS and INTRA<br>• Questionnaires to be fulfilled by operators evaluating the usage and added value of the AR suite<br>• Documents about the installation of this suite's software. |

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| **Financial Analysis** | The type of the payment will depend on the needs of each client and the agreement between each client. An upfront payment for the license and initial customization of the software will be requested. This pricing model will include an FFP (firm fix price) contract, an initial license fee, and per manhours charging of additional services effort (consulting, training, customization). This is also applicable for future research initiative integrations as well as real market customers.<br><br>Regarding the revenue of this KER, it is expected that:<br><br>License Agreements: The price per year per license will be 25,000 EUR. It is foreseen that 15 customers will sign up within 5 years. These numbers result in 375,000 EUR in revenue from licensing alone.<br><br>Service Contracts: 300 EUR per man day from service contracts will provide revenue related to project-specific support and customization. If the average is 15 man-days per contract, this results to approximately 4,500 EUR per contract. In case of 12 contracts per year, this adds 54,000 EUR in revenue from services. |
| **Exploitation next steps** | Some actions towards the further enhancement of the AR application of ODIN are:<br>• Connection of AR application with other type of sensors (vision, distance, force etc.) for the real-time visualization of sensor data to increase human awareness regarding assembly line status.<br>• Integration of the AR suite in different robotic installations or products to further validate its functionality.<br>• New projects and initiatives to extend the AR suite by adding even more functionalities.<br>• Collaboration with other software development companies will be evaluated to add new functionalities in the AR application.<br><br>LMS and INTRA have defined several milestones in order to ensure the successful exploitation of the KER#7. This time plan and the corresponding milestones are presented below:<br>• Creation of public videos and participation in industrial and manufacturing events – April 2025 (Q1/2025).<br>• Sell the product to potential customers and integrate this to the corresponding industrial environments – October 2025 (Q3/2025)<br>• Collect feedback from customers and update the AR suite with new mechanisms and sensors – November 2025 (Q3/2025)<br>• Evaluate product's functionality and price in order to satisfy customers' needs – February 2026 (Q1/2026)<br><br>Provide the final product of the AR suite to the customers – September 2026 (Q3/2026) |

## 5.5. Exploitation Cases/ Efforts in ODIN

### *Case #1: LMS Reconfigurable Tools and Advanced Industrial Applications*

**Overview**: LMS is the leading partner for several innovations in the ODIN project, each targeting specific challenges in advanced manufacturing and digital transformation.

**Exploitation Pathway**

- LMS will integrate these KERs as background IP in upcoming EU-funded research projects, enhancing its role as a technology leader.
- LMS plans to **mature the ODIN results further through EIT-Manufacturing**, where it holds a leadership position.
- The **TF-CC**, conceptualized by LMS through years of research, will **serve as a testing ground** to adapt these technologies for real-world factory environments.
- LMS plans to work closely with industrial clients to offer bespoke solutions, ensuring the tools are adapted to meet unique operational requirements.

### *Case #2: OpenFlow Platform by INTRA*

**Overview**: INTRA's OpenFlow platform serves as an orchestration tool for manufacturing digitization, providing advanced system integration, production monitoring, and shop floor event responses. It stands out as a modular and scalable solution for manufacturers transitioning to Industry 4.0.

**Exploitation Pathway**

1. INTRA will offer the platform on a yearly subscription basis (**licensing agreement**), providing essential features for system orchestration and integration.
2. Tailored solutions will be developed for ERP connectivity or integration with advanced sensor arrays.
3. Inclusion of **OpenFlow as background IP in new EU-funded projects** to strengthen collaborations and expand market presence.

### *Case #3: Autonomous Mobile Manipulators by COMAU and AIC*

**Overview**: The autonomous mobile manipulators combines COMAU's Agile 1500 AGV and Racer5 Cobot, and the second mobile robot is deployed by AIC and integrates the advantages of an industrial robot arm, an automated guided vehicle, and other smart capabilities. This offers two distinct solutions which are flexible and easy-to-manage for production tasks. AIC's focus complements this by integrating quality inspection processes using advanced deep learning.

**Exploitation Pathway**

1. **COMAU plans direct promotions** via trade shows, an online marketplace, and integrator networks.
2. **AIC will utilize its facilities as exhibition centers** to demonstrate the technology to potential customers.
3. AIC in close relationship with ACICAE Cluster of Basque automation has the ability to show their solutions to the 160 partners firsthand and all the companies that come to visit our facilities.
4. Both companies offer tailored solutions for specific applications and training services.

### *Case #4: Digital Twin and Sensor Fusion by KTH and S21Sec*

**Overview:** KTH's digital twin integrates sensor data fusion to enhance robotic perception, while S21Sec's digital twin protection framework offers robust cybersecurity capabilities for industrial environments. Together, these results create a comprehensive digital solution for advanced manufacturing and automation.

**Exploitation Pathway**

1. **KTH will enrich academic curricula and research projects**, with commercialization explored through industry partnerships.
2. Enhancement of the security monitoring and response capabilities offered through **S21Sec's Service Operation Centre**.

### *Case #5: DGH's AI-Driven Quality Inspection for Automotive Engines*

**Overview:** Involves a Machine Learning software solution designed for quality inspection of automotive engines.

**Exploitation Pathway**

- DGH will organize training sessions for customers, enabling them to fully understand the software's capabilities and perform tests with real-world industrial examples. This is a vital step for customer adoption and building long-term partnerships.
- **DGH has created a physical demonstrator of the software**, showcasing its capabilities to prospective clients and allowing them to experience its value firsthand.
- DGH intends to integrate this software solution into their portfolio, focusing on high-value customers in the automotive industry, specifically targeting OEMs (Original Equipment Manufacturers) and Tier 1 suppliers.

### *Case #6: Human-Robot Collaboration (HRC) Risk Assessment Tool by PILZ*

**Overview:** The HRC Risk Assessment Tool introduces a methodology to improve the safety and efficiency of human-robot collaboration, targeting compliance with safety standards while addressing the needs of manufacturers operating in Industry 4.0 environments.

**Exploitation Pathways**

- Position the methodology as the industry standard for HRC risk assessments by engaging with regulatory bodies, industry consortia, and showcasing real-world applications.
- Develop the tool as an independent plugin compatible with existing simulation platforms (e.g., VIS) to ensure seamless adoption, starting with pilot integrations by Q1 2025.
- Conduct extensive beta testing with diverse users to refine usability and functionality, followed by rigorous cybersecurity validation to meet data protection standards, targeted for completion by Q3 2025.
- Launch a targeted digital marketing campaign and leverage the partnership with PILZ and VIS to demonstrate compatibility and gain broader market traction, aligning efforts with the tool's official release in Q4 2025.

### *Case #7: Use the ODIN Use Cases as Initial Adopters for the KER*

Another exploitation case involves ODIN fostering collaborations with pilot use cases to explore the post-project adoption of its solutions. We aim to leverage the industrial environments where ODIN technologies were demonstrated; assess the feasibility of integrating its results into operational workflows. We will examine the cases in factories in White Goods, Automotive, and Aeronautics. These partnerships will focus on demonstrating the value of ODIN's innovations, such as the reconfigurable tools, AR applications, and task planners, in addressing specific industrial challenges. Feedback and real-world application insights from pilot partners will guide further refinement and adaptation, facilitating the seamless transition of ODIN solutions from research to industry.

### *Case #8: Promotion of the KER via online platforms and conferences*

The exploitation strategy for this case involves promoting the results through multiple dissemination and exploitation channels to ensure broad visibility and sustainable impact. Key results have already been highlighted on online platforms like the Horizon Results Platform, where they can attract the attention of industry stakeholders, policymakers, and academic audiences.

Specifically, we have uploaded the following results:

| ID | TITLE | STATUS | LAST UPDATED |
|---|---|---|---|
| 79537 | Digital twin protection framework and threat analysis toolkit | Published | Oct 25, 2024, 4:08:35 PM |
| 79459 | Autonomous mobile manipulators for collaborative operations | Published | Oct 22, 2024, 5:40:33 PM |
| 69855 | ML Solution for inspection of automotive engines | Published | Feb 23, 2024, 1:27:08 PM |
| 69836 | AR Suite for collaborative assembly operations | Published | Feb 23, 2024, 10:57:43 AM |
| 69802 | OpenFlow Platform (Open Flexible Orchestration of Workplaces) | Published | Feb 22, 2024, 6:43:49 PM |

**Figure 2: ODIN Results on the Horizon Results Platform**

The platform acts as a repository and showcase for outcomes from EU-funded projects, amplifying their visibility and potential impact. Featuring project results on the HRP expands their visibility by presenting them to a diverse global audience, including industry leaders, investors, and policymakers. This facilitates the exploitation and commercialization of research by connecting results with potential adopters and collaborators. Moreover, the HRP ensures long-term access and preservation of results, allowing them to remain accessible and impactful beyond the project's completion.


Additionally, these results will be presented at high-profile industrial and academic conferences to engage with potential adopters and collaborators. Beyond dissemination, the results will serve as valuable Background Intellectual Property (IP) in future projects, supporting further development and innovation. This approach not only enhances the reach and relevance of the project outcomes but also establishes a foundation for advancing related technologies in new collaborative initiatives, ensuring continuity and scalability in research and exploitation efforts.

## 5.6. Market Entry and Further Exploitation Steps

The market entry strategy for ODIN will leverage the successful use cases and partner networks established during the project phase to create a sustainable growth path in the European manufacturing sector. We present here an indicative five-year strategy which focuses on transforming proven technological solutions into commercial success through strategic licensing and partnership approaches.

Starting in 2025, ODIN will initiate market entry through existing use cases in Germany, Italy, and Spain. These implementations will serve as reference sites, demonstrating the platform's capabilities in real manufacturing environments. The commercial offering is structured through a dual approach. Customers can either implement the complete ODIN platform as an integrated solution or select specific components based on their needs. This flexibility allows for both digital transformation projects and targeted solution implementations. The consortium can also offer licensing agreements tailored to different customer needs, ranging from basic component licensing to full enterprise implementations with dedicated support and customization options. It should be highlighted here that partner networks play a crucial role in the strategy's success. Initial market penetration relies heavily on existing project partners' networks in the target countries. These partnerships extend beyond simple distribution agreements to include technical implementation support, industry-specific customization, and ongoing customer service. The strategy emphasizes building long-term relationships with system integrators, industrial automation providers, and manufacturing technology consultants. Additional funding sources will be actively pursued to support continued development and market expansion. This includes participation in European Digital Innovation Hub initiatives, national Industry 4.0 programs, and regional development funds. These resources will fund both technical enhancements and market expansion activities, ensuring ODIN maintains its technological leadership while growing its market presence.

By 2027, the strategy shifts focus to expansion beyond initial markets and use cases. At this phase we will emphasize on cross-sector applications of proven solutions and development of new use cases based on market feedback. The licensing model will evolve to include industry-specific packages and platform-as-a-service offerings, providing customers with more flexible engagement options. Of course, technology development will remain central throughout the strategy's implementation. We seek at continuous enhancement of the platform's capabilities, particularly in AI/ML functionalities, cybersecurity features, and integration capabilities. Via this we aim to ensure that ODIN maintains its competitive advantage. This development could be funded through a combination of licensing revenue, additional EU funding programs, and strategic partnership investments.

The strategy concludes in 2030 with ODIN technologies being more mature and gain traction as automation solutions in Europe. In this case, success metrics include market presence in key European countries, a diverse portfolio of implementations across multiple industries, and a network of partners and customers.

# 6. ODIN STANDARDISATION ACTIVITIES

Technology transfer, health & safety as well as standardization activities are considered pillars of wide adoption of robotics applications. One of ODIN's objectives is the exploitation in an industrial environment of the results obtained during the implementation of the project. To this end, it is essential that the technology and new knowledge developed in the project can be aligned with existing standards or those that will replace the current ones and those newly created.

On the other side, ODIN did include extensive research activities related with industrial technologies that represents a step beyond state of the art, and therefore a step towards current standards and normally some parts also represent a step beyond current standardization activities into development. In order to facilitate the potential adoption of ODIN related technologies into upcoming standards, some activities are conducted within the project aimed to provide specific information to standardization stakeholders, i.e. relevant standardization offices and organizations.

For this beforementioned purpose, within the framework of the project, a number of activities are undertaken concerning its contribution to the standardisation activities conducted by EU and international bodies by providing project findings with respect to standardization.

The method followed during this period of the project included several activities aligned in order to achieve the set objectives. These activities include, as initially foreseen, the following:

- Identification and analysis of gaps: open/vague areas, missing norms etc. (further referred as gaps); between ODIN technologies and existing standards, including the reporting of findings and feedback to these working groups.
- Identification of related technical committees.

The aim of this section is to collect all the information considered relevant in terms of standardisation found during the implementation of the ODIN project. In this way, it is intended to make this information available to organisations and standardisation groups so that it can be referenced and/or used within their activities.

## 6.1. Identified gaps between ODIN technology and existing standards

During the risk assessment process performed for the three pilot cases, PILZ had the opportunity to review the legal framework for the different scenarios. In some cases, it has been found that the current “state of the art” of the main reference standards in relation to ODIN technologies are not fully covering safety aspects of the risk assessment, safety design or verification, and guidelines to the application of other ODIN related technologies.

This is a common occurrence within these research and innovation actions and is the main reason why, within ODIN, a continuous process of identification of these gaps (open or vague areas within current standards, missing standards) has been implemented in collaboration with all ODIN partners in order to provide relevant information to the standardisation stakeholders. The aim is to allow this information to be harnessed in ongoing standardisation processes, so that currently not standardised project findings in that regard can be considered.

The analysis of the gaps is reported below. Each of the identified gaps has a brief description of the origin of this gap is included, together with the ODIN modules that are related to it. In addition, a synthetic analysis of references and related clauses in current standards is included. Lastly, a series of suggestions and actions to be taken by those involved in the standardisation processes are indicated.

**Table 4: Combined impact between IMR and operator**

<table>
<tr><td>FINDING</td><td colspan="4">Combined impact between IMR and operator</td></tr>
<tr><td rowspan="6">TYPE</td><td></td><td>Terminology</td><td rowspan="2">ODIN Related activities</td><td rowspan="2">AUTO, AERO</td></tr>
<tr><td>X</td><td>Practices and Procedures</td></tr>
<tr><td></td><td>Conventions</td><td rowspan="2">ODIN related Exploitable Result (ER)</td><td rowspan="2">1 - Mobile robot screwing on moving part.<br>2 - Autonomous mobile manipulator for collaborative operations<br>5 - 3D-modeling based inspection of aeronautics parts</td></tr>
<tr><td>X</td><td>Characteristics of product /service</td></tr>
<tr><td></td><td>Signs and Symbols</td><td rowspan="2">ODIN related partner</td><td rowspan="2">TECNALIA, COMAU, AIC</td></tr>
<tr><td></td><td>Organization</td></tr>
<tr><td>Relevant current Standard/s analysis</td><td colspan="4">2006/42/EC does not contain specific requirements that apply exclusively to collaborative on-board applications for AMR or AGVs. The applicable requirements would generally fall under Parts 1 and 3 of Annex I, without prejudice that Parts 2, 4 and/or 5 should also apply due to the specific characteristics of the application.<br><br>The essential health and safety requirements of the Machinery Regulation 2023/1230, which will apply from January 2027, offer a similar treatment. However, it is somewhat more specific as it explicitly covers applications with a hazard of contact during interaction between people and machinery and introduces the concept of ‘autonomous mobile machinery’ or ‘supervisory function’. In any case, all hazards and risks associated with a collaborative robot on board an AMR or AGV are covered by Parts 1 and 3 of Annex III, without prejudice that Parts 2, 4 and/or 5 should also apply due to the specific characteristics of the application.<br><br>EN ISO 11161:2009 focuses on the safety requirements of integrated manufacturing systems (IMS), incorporating two or more interconnected machines for specific applications. It therefore applies to the integration of machines and/or partly completed machines for their overall treatment as a machine, in accordance with the definition of machine as laid down in Directive 2006/42/EC.<br><br>EN ISO 3691-4:2024 specifies safety requirements and means of verification for driverless industrial trucks, which includes AGVs and AMRs. However, the definition of a driverless industrial truck specifies that the use is for the transport of loads. If we understand a load as a product that is picked up in one place and dropped off in another, a robot for collaborative applications on board an AGV or an AMR does not seem to be fully within the scope of this standard. However, the integrator in his risk analysis could consider following the standard to address the hazards associated with mobility.<br><br>ISO/FDIS 10218-1.2:2022. It includes in its scope robots intended for collaborative applications, including those that are attached to mobile platforms. However, it excludes uses of mobile platforms. These would be covered by ISO 3691-4.<br><br>ISO/FDIS 10218-2:2021. Addresses the integration of robot systems and industrial robotic applications, including collaborative applications. In relation to robots on board AMR or AGVs, it excludes uses such as ‘mobile platforms or driverless trucks’. However, the standard in the introduction makes it clear that the standard provides</td></tr>
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| | basic requirements for robots with these cited uses, but does not cover all hazards. It should be understood in that case that the hazards specific to or arising from AMR or AGVs are covered when applying ISO 3691-4.<br><br>The provisions of ISO/TS 15066:2016, relating to collaborative applications, will be integrated into the ISO/FDIS 10218 series of standards.<br><br>Both ISO/FDIS 10218-2:2021 and ISO/TS 15066:2016 specify force and pressure limit values and measurement methods for their verification and validation in order to comply with the force and pressure limiting capabilities of the collaborative application. For this purpose, the robot movements and speeds involved in the process have to be taken into account.<br><br>However, the possibility for the robot to ride on a platform or for the operator to also move in the same or different directions or senses is not specifically stated. |
| **Suggested Further standardization work** | The industrial use of collaborative applications on-board AMRs or AGVs is becoming more and more widespread, with the demand for collaborative operations during the movement of AMRs growing. It seems clear, moreover, that the capabilities of collaborative applications must be maintained whether or not the robot is in motion relative to the ground. It is clear that the possible transient or quasi-static contacts that the robot may produce under force and pressure limited option must be within the threshold values established by the standard and not be a source of hazard for the exposed person.<br><br>From this point of view, it seems that the current or imminent EU regulations do not clearly include the PFL option for collaborative applications on board AMR or AGVs. The integrator of such systems may be confused and uncertain. about the technical requirements to be followed to provide a presumption of compliance with the essential requirements in the absence of at least a recognised standard to provide some legal certainty.<br><br>Thus, it seems advisable to clarify by means of a standard, a specific technical text or a guideline:<br><br>- The integration of a system including AGV or AMR with industrial robot, which may include collaborative applications, as well as means of verification.<br><br>- The correct way to combine the aforementioned standards and obtain integration of a system that includes AGV or AMR with an industrial robot, which may include collaborative applications.<br><br>- Following on from the previous points, a specific type C standard integrating AMR with collaborative applications should consider simultaneous robot and AMR operations, such as "Screw While Moving", and other related aspects, such as coupling conditions to third party equipment (e.g. Automotive Pilot conveyor) or the need for synchronization of response times to safety shutdown demands, to avoid unsafe temporary operation of any constituent part of the assembly.<br><br>This would help to limit possible discrepancies arising from different risk assessment criteria by integrators, as it is currently the element that most determines the aforementioned safety conditions to be implemented in collaborative applications on board AMR. |

**Table 5: Validation of the solution within a real industrial environment where collaborative actions and a shared working space are needed**

<table>
<tr><td>FINDING</td><td colspan="4">Validation of the solution within a real industrial environment where collaborative actions and a shared working space are needed</td></tr>
<tr><td rowspan="6">TYPE</td><td></td><td>Terminology</td><td rowspan="2">ODIN Related activities</td><td rowspan="2">AUTO</td></tr>
<tr><td>X</td><td>Practices and Procedures</td></tr>
<tr><td></td><td>Conventions</td><td rowspan="2">ODIN related Exploitable Result (ER)</td><td rowspan="2">3 - High payload robot in-line hand guiding system manipulation</td></tr>
<tr><td></td><td>Characteristics of product /service</td></tr>
<tr><td></td><td>Signs and Symbols</td><td rowspan="2">ODIN related partner</td><td rowspan="2">COMAU</td></tr>
<tr><td></td><td>Organization</td></tr>
<tr><td>Relevant current Standard/s analysis</td><td colspan="4">Collaborative operations require the robot involved to have characteristics aimed at reducing the risks arising from the collaborative task and from human exposure in the restricted and collaborative spaces.<br><br>ISO TS 15066 specifies safety requirements for collaborative industrial robot systems and the work environment, and supplements the requirements and guidance on collaborative industrial robot operation given in ISO 10218-1 and ISO 10218-2. It thus supplements the requirements of 5.10 of ISO 10218-1 and 5.11 of ISO 10218-2. It establishes design conditions for collaborative robot system application, indicating that the robot design shall comply, in addition to the conditions of ISO TS 15066 itself, with part 5.11 of ISO 10218-2.<br><br>ISO 10218-2 sets out in section 5.11 the requirements for the operation of cooperative industrial robots, requirements for the robot, for the workspaces and for the operation of the robot in the cooperative space. In particular, it states that the robot must have special features and be designed for cooperative operation and comply with ISO 10218-1.<br><br>ISO 10218-1 specifies requirements and guidelines for inherently safe design, protective measures and information for the use of industrial robots. In its part 5.10 it sets requirements for cooperative operation, introducing the collaborative methods (HGC, SSM and PFL) which are developed ISO TS 15066<br><br>ISO FDIS 10218-1 and ISO FDIS 10218-2 integrate the state-of-the-art requirements of ISO 10218-1, ISO 10218-2 and ISO TS 15066 (in addition to ISO TR 20218-1 and ISO TR 20218-2) into their body of standards. As a new feature, the concept of collaborative robot is removed and does not use the concept of collaborative operation. Thus the standard focuses on developing requirements for robotic systems, which may include collaborative applications (including collaborative tasks). Part 5.14 of ISO FDIS 10218-2 addresses the requirements to be satisfied by the robotic system when it involves collaborative applications. In the same way that ISO 10218-2 links to ISO 10218-1, with respect to the robot used, ISO FDIS 10218-2 establishes the obligation to comply with ISO FDIS 10218-1, in particular with its part 5.10 where the capabilities to be provided by the robot, including collaborative technologies (HGC, SSM and PFL) and associated safety functions, are specified.</td></tr>
<tr><td>Suggested Further standardization work</td><td colspan="4">A question currently arises for the integrator as a result of a complementary risk assessment. What to do, and how to do it, in cases such as the following: The robotic system involves the integration of a large industrial robot, not designed, in principle, for collaborative applications. The robotised system could include in its work cycle some collaborative task within the collaborative space (such as HGC of the Automotive pilot). This implies meeting conditions that the market does not currently</td></tr>
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| | offer (large industrial robots designed for collaborative applications) and the integrator may have to make changes to the robot design or additions not initially foreseen by the robot manufacturer, in order to meet the regulatory requirements.<br><br>A gap is identified for the treatment of cases such as this where a large industrial robot or loads require collaborative tasks to be performed in its cycle. Conditions, for example, such as the provision of specific conditions for contact detection systems (air skin), speeds adapted to moving masses, specific performance levels for these tasks (with more apparent risk), limitation or restriction of some collaborative technology (HGC, PFL, SSM) or higher operator qualifications. It seems advisable to study this casuistry and add it to the regulation, either as an annex or a technical report, which can guide the integrator. |

**Table 6: Interfaces for AR projections**

| | | | | |
|---|---|---|---|---|
| **FINDING** | Interfaces for AR projections | | | |
| **TYPE** | | Terminology | **ODIN Related activities** | AUTO, WHG |
| | | Practices and Procedures | | |
| | | Conventions | **ODIN related Exploitable Result (ER)** | 8 - Environment monitoring and robot control SW library |
| | X | Characteristics of product /service | | |
| | | Signs and Symbols | **ODIN related partner** | TAU |
| | | Organization | | |
| **Relevant current Standard/s analysis** | Not sure can this work lead to a standard by its nature. Not seeing that the technical features and implementation should be standardized. However, what could be standardized are the interface for interaction, and features and expected behavior behind the interfaces.<br><br>The interfaces used are already included to OpenFlow. Thus, if interface of OpenFlow will be standardised, also this feature will be standardised at the same time. | | | |
| **Suggested Further standardization work** | Not seeing this work leading to industrial standard. Creating a Technical Report could be possible. | | | |

**Table 7: Requirements for VR based training operator regarding safety measures**

| | | | | |
|---|---|---|---|---|
| **FINDING** | Requirements for VR based training operator regarding safety measures | | | |
| **TYPE** | | Terminology | **ODIN Related activities** | AUTO, AERO, WHG |
| | X | Practices and Procedures | | |
| | X | Conventions | **ODIN related Exploitable Result (ER)** | 10 – VR/AR based safety training |
| | | Characteristics of product /service | | |
| | | Signs and Symbols | **ODIN related partner** | TAU |
| | | Organization | | |

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| **Relevant current Standard/s analysis** | Relevant background information for the work and implementation are all safety standards, warnings and alarms taking place at the production cell, and symbols and colors to be used in such environment, or any connected standard.<br>The development and implementation itself we are not seeing as potential to be standardised. The only plausible feature to be standardised is the template concept for creating a new VR applications at quicker way by using a templates. Technical report could be the right way for documenting it. |
| **Suggested Further standardization work** | Not seeing this work leading to industrial standard. Creating a Technical Report could be possible. |

**Table 8: Standardization of the data model for Resource Descriptions**

| | | | | |
|---|---|---|---|---|
| **FINDING** | Standardization of the data model for Resource Descriptions | | | |
| **TYPE** | X | Terminology | **ODIN Related activities** | AUTO, AERO, WHG |
| | X | Practices and Procedures | | |
| | X | Conventions | **ODIN related Exploitable Result (ER)** | 11 - Data model of resource descriptions and web service |
| | | Characteristics of product /service | | |
| | | Signs and Symbols | **ODIN related partner** | TAU |
| | | Organization | | |
| **Relevant current Standard/s analysis** | The proposed data model Resource Description (RD) is used to describe production modules or resources as a whole and from many perspectives. This comprehensive description aims to cover all aspects of a production resources module in a machine-readable description. One can compare the proposed description with EDS, GSD, or EDD descriptions (IEC 61784-3) used at control technology module descriptions, which can be read in by the development environment, and understand the characteristics and capabilities of a module by a known electronic specification. However, the RD will be on higher level of abstraction and comprehensiveness. Also, the context of description is different. It aims to capture mechanical, communication, manufacturing, process, and control information of a production module such as a robot or gripper.<br>We are not aware that there exist standards with the same aim and context for describing atomic production resources.<br>The description utilises, links, and refers to many other specifications and definitions such as eCl@ss or AutomationML (System level descriptions) IEC 62714. | | | |
| **Suggested Further standardization work** | This content is not published in any current standards. Thus, development of new standard from a scratch is needed, if this work should be progressed.<br>Good candidate for standardization work group could be *IEC/TC65 TC 65 Industrial-process measurement, control and automation* or *ISO/TC 184 Automation systems and integration*. | | | |

**Table 9: Validation/RA for different robots performing the same operation**

<table>
<tr><td>FINDING</td><td colspan="4">Validation/RA for different robots performing the same operation (e.g. Automotive use case Screwing with TECNALIA or COMAU platforms interchangeably).</td></tr>
<tr><td rowspan="6">TYPE</td><td></td><td>Terminology</td><td rowspan="2">ODIN Related activities</td><td rowspan="2">AUTO</td></tr>
<tr><td>X</td><td>Practices and Procedures</td></tr>
<tr><td></td><td>Conventions</td><td rowspan="2">ODIN related Exploitable Result (ER)</td><td rowspan="2">13 - Risk assessment & safety validation methods for industrial deployment ,</td></tr>
<tr><td></td><td>Characteristics of product /service</td></tr>
<tr><td></td><td>Signs and Symbols</td><td rowspan="2">ODIN related partner</td><td rowspan="2">PILZ</td></tr>
<tr><td></td><td>Organization</td></tr>
<tr><td>Relevant current Standard/s analysis</td><td colspan="4">EN ISO 10218-1:<br>Industrial robotic system: system comprising:<br>• The industrial robot<br>• The terminal item(s)<br>• Any machinery, equipment, devices, devices, external auxiliary axes external auxiliaries, etc. that assist the robot in performing its task.<br>IN ISO 10218-2:<br>The robot system may be part of an integrated manufacturing system.<br>EN ISO 11161:<br>IMS: Group of machines working together in a coordinated way, linked by a coordinated, linked by a material handling system and interconnected by means of drive components, for the interconnected by means of actuators, for the manufacture, processing, or packaging of different components or assemblies.<br>A set of machines such as the Automotive project is therefore an IMS. The conformity assessment and subsequent EC certification will therefore be the responsibility of the integrator. He must, among other things, determine its limits and tasks (for the possible configurations of the IMS), while also taking into account the limits of the machines and quasi-machines that make up the IMS.<br>Therefore, the installation of a robot of one or the other manufacturer, as long as they do not differ in their limits and tasks (for the configurations defined by the integrator), could be covered by the conformity assessment procedure selected by the integrator, in accordance with Article 12 of 2006/42/EC.<br>Therefore, the IMS risk assessment performed considering an AIC robotic mobile platform shall also be valid for the Comau robotic mobile platform.<br>The user must be aware of the interchangeability conditions that would still be supported by the EC Declaration of Conformity, including the necessary tests and verifications to be performed and documented for the validation of the change. This must be clearly indicated in the IMS instruction manual.</td></tr>
<tr><td>Suggested Further standardization work</td><td colspan="4">The concept of modification that necessarily entails a new conformity assessment process is not clearly defined in 2006/42/EC.<br>Replacement of machines within an IMS is quite common.<br>It would be useful to clarify in an applicable standard, e.g. EN ISO 10218-2 (or EN ISO 11161, more general), or technical report (EN ISO/TR), the conditions for</td></tr>
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| | interchangeability of equipment, as well as the necessary steps for its validation, so that the EC Declaration of Conformity covers both cases, in application of the Directive 2006/42/EC. |

**Table 10: Standard for AR projections at industrial site**

<table>
<tr><td>FINDING</td><td colspan="4">Standard for AR projections at industrial site.</td></tr>
<tr><td rowspan="6">TYPE</td><td>X</td><td>Terminology</td><td rowspan="2">ODIN Related activities</td><td rowspan="2">AUTO, WHR</td></tr>
<tr><td>X</td><td>Practices and Procedures</td></tr>
<tr><td></td><td>Conventions</td><td rowspan="2">ODIN related Exploitable Result (ER)</td><td rowspan="2">14 - AR Suite for collaborative assembly operations</td></tr>
<tr><td></td><td>Characteristics of product /service</td></tr>
<tr><td>X</td><td>Signs and Symbols</td><td rowspan="2">ODIN related partner</td><td rowspan="2">LMS, INTRA</td></tr>
<tr><td></td><td>Organization</td></tr>
<tr><td>Relevant current Standard/s analysis</td><td colspan="4">EN ISO 12100:2012, (6.4.3):<br>Visual signals and acoustic signals can be used to warn of an impending hazardous event. They can also be used to warn before the initiation of automatic preventive measures. It is essential that these signals<br>• are given before the event occurs<br>• are unambiguous<br>• clearly perceptible and distinguishable from all other signals<br>• can be clearly recognised by the operator and other persons.<br>EN 61310-1:2008, Specifies requirements Reference to visual, audible and tactile methods for conveying safety-related information at the man-machine interface and to exposed persons.<br>Active signal: Information provided by an element whose state can be appropriately modified, which is used to indicate a change of state or to warn of a change in the level of risk. Active signals must be used to signal a hazard and warn people to take specific actions. Examples of active signals:<br>• On/off or change of:<br>• Colour<br>• Brightness<br>• Contrast<br>• Saturation<br>• Brightness<br>• Change of position<br>A visual sign shall:<br>• Be positioned so that it is within the person's field of vision. (4.2.2)</td></tr>
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| | • Have sufficient brightness and colour contrast in relation to its surroundings. (4.2.3)<br><br>Coding methods shall be explained in the instruction manual for the equipment or on the machine. Sufficient information to enable appropriate instructions to be given to persons who may have to respond to these codes (5.2).<br><br>EN 981:1996+A1:2008, applies to all danger and information signs, which must be clearly perceived and distinguishable.<br><br>Design according to EN 842 and ISO 8995 (4.4) The colours are coded in table 4:<br><br>• Red:<br>• Meaning: Danger, abnormal state.<br>• White: Emergency, Alarm stop, Prohibition, Fault<br>• Yellow: Meaning: Caution:<br>• Meaning: Caution<br>• Target: Attention required, Change of status, Intervention<br>• Blue:<br>• Meaning: Indication of the need for a mandatory action<br>• Target: Action, protection, special attention,<br>• Priority safety related standard or provision<br><br>EN 842:1996+A1:2008, specifies safety and ergonomic requirements for visual danger signs, as well as indications for the design of signs so that they are clearly perceived and differentiated.<br><br>3.1. Visual hazard sign, indicates the imminent occurrence of a hazardous situation, which requires a human response. Two types: warning and emergency<br><br>Establishes conditions of Detectability, Discrimination, Glare, Distance and Duration.<br><br>EN ISO 10218:2011 establishes the need for floor markings or signs in collaborative workspaces (5.11.3).<br><br>EN ISO 3691-4:2020 sets out conditions when the person detection means are not active or when the truck changes its direction of travel (6.2).<br><br>EN ISO 11161:2007 does not define specific conditions relating to the marking of hazards in IMS.<br><br>ISO/IEC 23000-13:2017, specifies the following:<br><br>• scene description elements for representing AR content;<br>• mechanisms to connect to local and remote sensors and actuators;<br>• mechanisms to integrated compressed media (image, audio, video, graphics);<br><br>mechanisms to connect to remote resources such as maps and compressed media. |
| **Suggested Further standardization work** | Where indicated by the risk assessment, the application of floor projection by presence detection safety devices in hazardous areas or adjacent to hazardous areas could be suitably designed after taking into account the above-mentioned standards. |

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| | However, designers and manufacturers would be helped by the existence of a technical reference document, which would simplify the implementation of dynamic signaling and information measures between the machine and the operator, in particular for integrated manufacturing systems and robotic systems.<br>It could also be appropriate for equipment and devices that project signaling to be standardized in this respect, for example in relation to compliance with the requirements of perception, brightness, contrast, color, etc., as well as changes in range depending on operating conditions and the extent of hazardous areas. |

**Table 11: Human resource management - Workforce allocation**

| **FINDING** | Human resource management – Workforce allocation | | | |
|---|---|---|---|---|
| **TYPE** | X | Terminology | **ODIN Related activities** | AUTO, WHG |
| | X | Practices and Procedures | | |
| | | Conventions | **ODIN related Exploitable Result (ER)** | 16 – Model based task planner |
| | | Characteristics of product /service | | |
| | | Signs and Symbols | **ODIN related partner** | INTRA/LMS |
| | | Organization | | |
| **Relevant current Standard/s analysis** | ISO/TS 15066:<br>Design and implementation of a HRC workspace reducing the risk for human operators. This ISO has impact on the modelling of tasks and resources used by the ODIN Task Planner in order to assign only the non-risky tasks to human operators. | | | |
| **Suggested Further standardization work** | In the literature, there is an available standard for the designing of Human-Robot collaborative workspaces (ISO/TS 15066) but there is a gap on a standard to define how the alternatives of the Task Planner module could be evaluated in a safety way. The ODIN partners have already modeled in the Digital Simulation the safety laser scanners and Safety barriers of PILZ including the safety formula used also in the physical devices. This simulation is used for the evaluation of the generated task plans but there is no ISO to define if the evaluation of the safety concept in the simulation environment takes place in a safety certified way. | | | |

**Table 12: Standards for digital twin cybersecurity protection**

| **FINDING** | Standards for digital twin cybersecurity protection | | | |
|---|---|---|---|---|
| **TYPE** | | Terminology | **ODIN Related activities** | AUTO, AERO, WHG |
| | X | Practices and Procedures | | |
| | | Conventions | **ODIN related Exploitable Result (ER)** | 18 – Digital twin protection framework and threat analysis toolkit |
| | | Characteristics of product /service | | |
| | | Signs and Symbols | **ODIN related partner** | S21SEC |
| | | Organization | | |

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|---|---|
| **Relevant current Standard/s analysis** | Digital twin protection framework helps to provide compliance to **Article 21 of NIS2** - Cybersecurity risk-management measures - b) incident handling e) security in network and information systems acquisition, development and maintenance, including vulnerability handling and disclosure and f) policies and procedures to assess the effectiveness of cybersecurity risk-management measures.<br>Also, the functionalities of the Digital twin protection framework helps providing the defence-in-depth cybersecurity approach described by **IEC 62443** standards series. This standard is the reference in the implementation of cybersecurity for industrial automation and control systems. |
| **Suggested Further standardization work** | • **IEC 62443-2-1 Definition of an IACS Security Program (Section 12):** 12.2 Event and Incident Management: Tools like SIEM and SOAR for incident detection and incident response may be added as additional guidance.<br>• **IEC 62443-4-2 Technical Safety Requirements for IACS Components (Section 10.04 CR 6.2 – Continuous Monitoring):** 10.4.2 Rationale and Supplemental Guidance: SIEM is mentioned, but additional tools like SOAR for incident response maybe added. Additional tools for automation and orchestration (SOAR) may also be added as supplemental guidance.<br>• **IEC 62443-3-3 System Security Levels and Requirements (Section 10.4 SR 6.2 – Continuous Monitoring): 10.4.1 Requirement:** The control system shall provide the capability to continuously monitor all security mechanism performance using commonly accepted security industry practices and recommendations to detect, characterize, and report security breaches in a timely manner. **10.4.2 Rationale and Supplemental Guidance:** SIEM is mentioned, but additional tools like SOAR for incident response may be added. |

**Table 13: Architecture enabling reconfigurable human - robot based production lines**

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|---|---|---|---|---|
| **FINDING** | Architecture enabling reconfigurable human - robot based production lines | | | |
| **TYPE** | | Terminology | **ODIN Related activities** | AUTO, WHR, AERO |
| | X | Practices and Procedures | | |
| | | Conventions | **ODIN related Exploitable Result (ER)** | 23 – ODIN research papers |
| | X | Characteristics of product /service | | |
| | | Signs and Symbols | **ODIN related partner** | INTRA |
| | X | Organization | | |
| **Relevant current Standard/s analysis** | Since the OpenFlow architecture introduces an integration and orchestration framework for flexible, responsive and robust HRC manufacturing systems. The approach is modular and is designed with scalability and extensibility in mind. It considers and utilizes ROS 1 and ROS 2 that are currently de facto standards in the area and builds on top of them. | | | |
| **Suggested Further standardization work** | A standardized architecture for flexible and robust HRC manufacturing systems is a challenging endeavor, although standardization would contribute to align developments on the field. | | | |

**Table 14: Standards for wireless E-Stop**

<table>
<tr><td>FINDING</td><td colspan="4">Standards for wireless E-Stop</td></tr>
<tr><td rowspan="6">TYPE</td><td></td><td>Terminology</td><td rowspan="2">ODIN Related activities</td><td rowspan="2">AUTO, AERO</td></tr>
<tr><td>X</td><td>Practices and Procedures</td></tr>
<tr><td></td><td>Conventions</td><td rowspan="2">ODIN related Exploitable Result (ER)</td><td rowspan="2">24 – ODIN research papers</td></tr>
<tr><td></td><td>Characteristics of product /service</td></tr>
<tr><td></td><td>Signs and Symbols</td><td rowspan="2">ODIN related partner</td><td rowspan="2">PILZ</td></tr>
<tr><td></td><td>Organization</td></tr>
<tr><td>Relevant current Standard/s analysis</td><td colspan="4">Regarding wireless communication and in relation to safety, for robotic systems, including collaborative applications, AGVs and their systems, as well as IMS (integrated manufacturing systems):<br><br>- EN ISO 10218-1 and EN ISO 10218-2 set conditions for wireless guidance controls, whereby safety response must be obtained in case of loss of communication and not restart motion when communication is re-established.<br><br>- In addition, the draft standards ISO FDIS 10218-1 and ISO FDIS 10218-2 establish a link to the communication categories defined in IEC 61508-2 and IEC 62280 and require that wireless communications of safety functions comply with IEC 62745.<br><br>- EN ISO 3691-4 and EN 1175 do not address specific requirements and refer to EN 60204-1.<br><br>The treatment of other Type C standards for wireless communication in relation to safety is similar.<br><br>EN ISO 11161 (IMS integrated manufacturing systems) does not differentiate between wired and wireless safety functions, and also refers to EN 60204-1.<br><br>EN IEC 60204-1 (electrical equipment) establishes general requirements for wireless control, as well as control of the ability of a wireless control system to control a machine, conditions for control limits or the use of multiple wireless control stations or the resetting of the emergency stop. It refers in turn to IEC 62745. It also establishes a link to IEC 61784-3 in relation to communication failures and safety-related data transmission requirements.<br><br>EN ISO 13850 (emergency stop) sets out conditions for emergency stop devices and their resetting in wireless control stations, referring to IEC 60204-1.<br><br>EN ISO 13849-1 (safety-related parts of control systems) does not specify wireless communications in particular, but any safety-related part of the control system must comply with this standard in terms of design, implementation and validation.<br><br>Finally, more specifically, EN 62745 (requirements for wireless machine control systems), type B2 standard, establishes general requirements for wireless machine control systems, addressing both functional and safety aspects, and differentiating between emergency stop, safety-related stop or reset conditions. It also covers aspects related to special functions (e.g. ‘hold to run’) or behavior in case of loss of transmission or power supply. In addition, it offers methods for verification of compliance with the requirements.</td></tr>
<tr><td>Suggested Further</td><td colspan="4">In order to clarify and develop or specify the ways to fulfil the requirements, including with examples, it may be appropriate to prepare a technical report that can bring</td></tr>
</table>

| | |
|---|---|
| **standardization work** | together compliance with all related standards and guide the machine manufacturer or system integrator on good practice and technical or technological guidance for the final fulfilment of the essential health and safety requirements. |

## 6.2. ODIN related Technical Committees

One of the final tasks has been the communication of the project findings in terms of gaps between project developed technologies and current standards to the technical committees, allowing them to reference and use them in their activities. These results are presented in D6.5.

# 7. CONCLUSIONS AND FUTURE EXPLOITATION ROADMAP OF THE ODIN RESULTS

In this report we reflect the final exploitation activities done in the ODIN project, with a view to supporting the sustainability of the project's exploitable results. We present the final Results Ownership List which provides clarity on intellectual property ownership, facilitating a structured pathway for future use. This was complemented by IPR management efforts, including the re-validation of Background and Foreground IP, to ensure that the project adheres to best practices and protects the value of its innovations. The market research activities have provided a deep understanding of the target markets and niches, regulatory dynamics, and competitive landscape. These insights, supported by a SWOT and IP landscape analysis, have laid the groundwork for informed decision-making regarding the project's exploitation and commercialization strategies.

The collaboration with the HRB service has significantly enhanced the exploitation planning. It supported the refinement of the Business Model Canvas and tailored commercialisation strategies, ensuring that ODIN's value propositions, revenue models, and market entry strategies are not only well-defined but also aligned with real-world industry feedback. The deliverable also details individual exploitation plans crafted by each ODIN partner, outlining their strategies to leverage the project's innovations for future research and commercial activities. Additionally, 7 commercialization plans for Key Exploitable Results (KERs) and 8 exploitation cases were developed, providing actionable, long-term roadmaps for entering and thriving in competitive markets.

**Exploitation Roadmap Ahead**

In the individual commercialisation plans for the KER (Section 5.4), we have a dedicated section called exploitation next steps, where each partner has described the actions foreseen to promote the KER and support its sustainability after the end of the project. Also, in Section 5.6 we highlight some steps that could be taken to facilitate the commercialisation of some KER. We provide a summary of this information below. The exploitation activities for ODIN's KER will focus on transitioning from research outcomes to commercially viable solutions with a structured roadmap and clearly defined steps. Early efforts will include presenting the results to relevant teams, identifying areas for improvement, and setting timelines for technical and operational enhancements. Specific actions will prioritize integrating ODIN solutions into diverse industrial environments. This includes connecting advanced functionalities like AR to sensors for real-time monitoring, beta testing tools to ensure compatibility, and conducting cybersecurity testing to protect against vulnerabilities. Parallel efforts will expand ODIN's applications into sectors such as automotive and electronics, validating its features and performance in high-demand environments. Commercialization efforts will focus on both licensing agreements and tailored implementations with service contracts for new features. ODIN's flexibility to offer either comprehensive platform adoption or modular components ensures adaptability to varied customer needs. Strategic partnerships with system integrators and industrial technology providers will facilitate initial market penetration in key regions, such as Germany, Italy, and Spain, serving as reference points for the platform's capabilities. To support long-term market growth, ODIN will scale its cloud infrastructure, enhance AI/ML features, and develop new cross-sector use cases. By 2030, the aim is to capitalise on ODIN technologies with proven solutions in multiple industries and an ecosystem of partners and customers.

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# ANNEX I: IP ANALYSIS; LIST OF RELEVANT PATENTS ANALYSED

| No | Title | Applicants | Publication Number | Publication Date | Tech Area | Relevance to ODIN Innovations |
|---|---|---|---|---|---|---|
| 1 | Ontology-based generation and integration of information sources in development platforms | Drumm et al. | US20100031240A1 | 2010-02-10 | Digital Transformation | High |
| 2 | AUGMENTED REALITY APPLICATION FOR MANUFACTURING | TESLA, INC. [US]/[US] | WO2018223038 | 2018-12-06 | Robotics and Automation | High |
| 3 | Augmented reality task identification and assistance in construction, remodelling, and manufacturing | SCHUSTER MICHAEL J [US] | US20220358734A1 | 2018-11-22 | Mixed Reality | High |
| 4 | ROBOTIC SYSTEMS AND METHODS FOR ROBUSTLY GRASPING AND TARGETING OBJECTS | UNIV CALIFORNIA [US] | WO2019045779A1 | 2019-03-07 | Robotics and Automation | High |
| 5 | SYSTEMS AND METHODS FOR GENERATING CONTROL SYSTEM SOLUTIONS FOR ROBOTICS ENVIRONMENTS | TATA CONSULTANCY SERVICES LTD [IN] | US11141856B2 US20193899060A1 | 2019-12-26 2021-10-12 | Robotics and Automation | Medium |
| 6 | VISION BASED ROBOTIC ASSISTANCE SYSTEM | INDIRA GANDHI INST OF TECHNOLOGY SARANG [IN] | IN331KO2014A | 9/25/2015 | Robotics and Automation | Low |
| 7 | SYSTEM AND METHOD FOR TRANSPOSITION OF A DETECTED OBJECT AND ITS TRACKING TO A DIFFERENT DEVICE | CRON SYSTEMS PVT LTD [IN] | WO2021234623A1 | 11/25/2021 | Robotics and Automation | Low |
| 8 | Robot Fleet Management for Value Chain Networks | STRONG FORCE VCN PORTFOLIO 2019 LLC [US] | US20221877847A1 | 6/16/2022 | Robotics and Automation | High |
| 9 | DIGITAL MANUFACTURING | ACCENTURE GLOBAL SOLUTIONS LTD [IE] | US20191915262A1 | 2019-05-23 2020-09-15 | Digital Manufacturing | Medium |
| 10 | ROBOT FLEET MANAGEMENT AND ADDITIVE MANUFACTURING FOR VALUE CHAIN NETWORKS | STRONG FORCE VCN PORTFOLIO 2019 LLC [US] | WO2022133330A1 | 6/23/2022 | Robotics and Automation | High |
| 11 | DIGITAL MANUFACTURING SYSTEM | ACCENTURE GLOBAL SERVICES LTD [IE] | US20162715628A1 | 2016-09-22 2019-09-17 | Digital Manufacturing | Medium |
| 12 | Digital-Twin-Enabled Digital Product Network System | STRONG FORCE VCN PORTFOLIO 2019 LLC [US] | US20231237651A1 | 4/27/2023 | Digital Transformation | High |