
# D 7.8 –EXPLOITATION REPORT AND CPSOSAWARE BUSINESS MODELS


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| *Work Package* | WP7 – Exploitation and dissemination plan including standardization activities |



## Abstract

This report contains the output of Task 7.2 which lays the ground for exploitation of the project results. The report provides an overview of the exploitation team and activities, market analysis in terms of the commercial and economic potential of the project, product concept and exploitation plan including feedback from the external Commercial Interest Advisory Group, and business modelling.


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## Project Information

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|---|---|
| *Project start and duration* | 1.01.2020-31.12.2022 |
| *Project Coordinator* | Industrial Systems Institute, ATHENA Research and Innovation Center<br>26504, Rio-Patras, Greece |
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| *Website* | www.cpsosaware.eu |

## Control Sheet

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| Prepared by | RTC |
| Reviewed by | USI, CRF |
| Authorised by | RTC |

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## List of abbreviations

| | |
|---|---|
| ADAS | Advanced Driver Assistance Systems |
| CAGR | Compound Annual Growth Rate |
| DMS | Driver Monitoring System |
| ECU | Electronic Control Units |
| EIMB | Exploitation and Innovation Management Board |
| EU | European Union |
| EU-OSHA | European Agency for Safety and Health at Work |
| HiL | Hardware-in-the-Loop |
| HRC | Human-Robot Collaboration |
| IPR | Intellectual Property Rights |
| ITS | Intelligent Transportation Systems |
| LiDAR | Light Detection and Ranging |
| LTE | Long Term Evolution |
| MSD | Musculoskeletal Disorders |
| OEM | Original Equipment Manufacturer |
| ROI | Return of Investment |
| SaaS | Software-as-a-Service |
| SAE | Society of Automotive Engineers |
| SIEM | Security Information and Event Management |
| USD | United States Dollar |
| V2I | Vehicle-to-Infrastructure |
| V2V | Vehicle-to-Vehicle |
| V2X | Vehicle-to-Everything |

## Executive summary

This document is report of CPSoSAware project exploitation activities. The initial exploitation plan for the project was described within the deliverable D.7.3 “Preliminary Version of Exploitation Report and CPSoSaware Business Models”. The current report provides an update and extension of the former document, together with the report of the current state of the exploitation activities and their results.

The report contains up-to-date market analysis covering the domains of interest for the CPSoSAware project taking into account recent market changes due to global socio-economic situation resulting from recent events. The report also presents the CPSoSAware exploitation strategy, together with the planned revenue streams and current state of commercialization activities results. The non-commercial exploitation is also described for direct and indirect exploitation strategy. The document also reports the workshop organized with the intention of receiving advice and recommendations form external experts gathered in the project’s Commercial Interest Advisory Group (GIAG), together with the discussion results. Finally, the document contains business model canvas for the components developed within the project.

The document is a reflection of the project exploitation strategy, which is directly merged with the project standardization, IPR protection, and dissemination, project results exploitation activities reported in separate dedicated deliverables D7.10 (Zanella et. al., 2023), D7.9 (Kosmides et. al., 2023), and D7.7 (Papachristopoulou, 2023) respectively.

# 1 Introduction

The aim of this report is to present the project of the product concept with the exploitation plan and market analysis as well as the innovation management strategy within the consortium.

The following parts of the report provide an overview of the exploitation team and activities, market analysis in terms of the commercial and economic potential of the project, product concept and exploitation plan including feedback from the external Commercial Interest Advisory Group, and business modelling.

The whole report refers to two industrial pillars of the CPSoSaware project – automotive pillar and manufacturing pillar. The product concept includes modules dedicated to the two pillars and consequently, all the analyses respect this distinction.

## 2 Exploitation Team/Partners

CPSoSaware project partners can be described with the use of two categories: industrial (commercial) partners and research partners (universities and institutes). Table 1 provides consortium overview with regard to this distinction.

Table 1. CPSoSaware consortium partners list with respect to the research (R) vs. industrial (I) typology.

| # | Partner | Type (I/R) | # | Partner | Type (I/R) |
|---|---|---|---|---|---|
| 1 | Athina-Erevnitiko Kentro Kainotomias Stis Technologies Tis Pliroforias, Ton Epikoinonion Kai Tis Gnosis (ISI) | R | 7 | IBM Israel - Science And Technology Ltd (IBM Israel) | I |
| 2 | Fundacio Privada I2cat, Internet nb I Innovacio Digital A Catalunya (I2CAT) | R | 8 | Atos Spain SA (ATOS) | I |
| 3 | Universita Della Svizzera Italiana (USI) | R | 9 | Panasonic Automotive Systems Europe GMBH (PASEU) | I |
| 4 | Tampereen Korkeakoulusaatio Sr (TAU) | R | 10 | Eight Bells LTD (8BELLS) | I |
| 5 | University Of Peloponnese (UoP) | R | 11 | Catalink Limited (CATALINK) | I |
| 6 | Panepistimio Patron (UPAT) | R | 12 | ROBOTEC.AI Spolka Z Ograniczona Odpowiedzialnoscia (RTC) | I |
| | | | 13 | Centro Ricerche FIAT SCPA (CRF) | R |

Market-related exploitation activities mostly engage commercial partners; however, all consortium members support the activities.

## 3 Exploitation activities

Exploitation-related activities of the CPSoSaware project in the project duration concentrated around the definition of the project product concept and preparation of the exploitation framework as a basis for future project product exploitation activities, reaching out to external experts to receive feedback on the product concept market potential and advice concerning next steps towards product improvement and successful exploitation.

Within the scope of this activities, the following tasks were performed:

- Market analysis including the analysis of market potential and the project product economic potential;
- Components tests by CPSoSAware use-cases providers to assess the usefulness and potential of the project product;
- Potential target end users identification;
- Potential competitors identification;

- Innovation management process definition and project Exploitation and Innovation Management Board appointment;
- Continuous market trends monitoring;
- Identification of the project products/components with the highest exploitability potential;
- Presentation of the project products with the highest exploitability potential to external experts gathered in the Commercial Interest Advisory Group;
- Defining the next steps towards market outreach with the support of external experts gathered in the Commercial Interest Advisory Group;
- Development of business model canvas for project products/components with the highest exploitability potential.

The results of these activities will be referred to and reported in the following parts of this report.

Yet another step towards the most effective project results in exploitation is related to project dissemination activities. Well-targeted dissemination activities allow for reaching potential end users with information about the project products. Dissemination activities include research papers preparation and publication, conference presentation, web presence (website and social media), and white papers. Detailed information about dissemination activities is reported within a dedicated deliverable D7.7 (Papachristopoulou, 2023).

# 4 Market analysis

## 4.1 Product concept

The CPSoSaware product is a series of components, all of them designed for smart connected cars and smart connected factories. The common theme behind all components for both targeted domains is to increase safety and effectiveness. To achieve this goal, the targeted set of components includes Security Runtime Monitoring and Management (SRMM), Homezone Perception Engine, MOZART Systems Orchestrator, Driver State Monitoring, CASPAR- Semantic Information Fusion Framework, V2X Simulator, CPS connected Extended Reality System in HRC application, Posture and anthropometrics recognition, System for operator's state monitoring, Data Storage and Transformation Engine, Cooperative Awareness System (CAS), Quantum Resistant Hardware Security Token, and PoCL-Remote (TC2.2.2): Distributed Edge Offloading Software Runtime.

Altogether, the components build up a complex CPSoSaware system described initially in deliverable 1.3 (Kosmides & Adamopoulou, 2020) which provides a comprehensive overview of the systems architecture (Figure 1) and components specification.

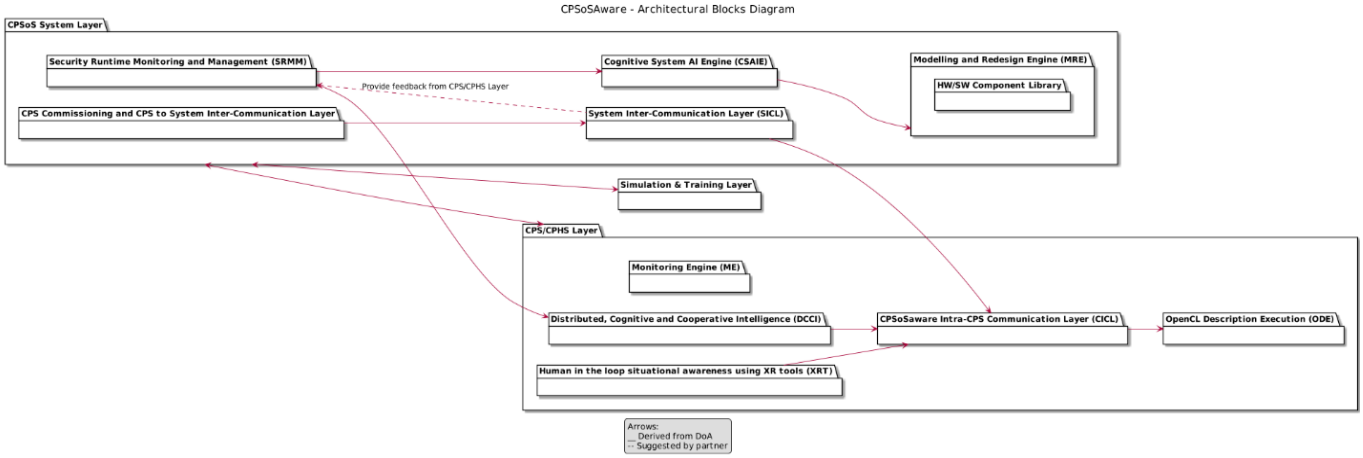


Figure 1. UML diagram - Architectural blocks and sub-blocks Source: Kosmides & Adamopoulou (2020).

## 4.2 Market and economic potential

Market and economic potential analysis of the CPSoSaware product is driven by the general assumption that the product is in fact a set of products designed for automotive and manufacturing environment automation with the leading role of human-robot interaction and its safety, as well as the idea of connected vehicle or manufacturing cell and related data security. The CPSoSaware products briefly described by the above theme, fall into a range of markets.

Apart from components designed to be used directly in the automotive or manufacturing context e.g., driver monitoring, V2X simulator, operators state monitoring, posture and anthropometrics recognition, or cooperative awareness solutions the CPSoSAware project also developed components oriented towards handling the complexity of the system and enabling its smooth operation, like MOZART – provision of services referring to simulation orchestration, containerization, environment setup, or data storage and transformation engine. The omnipresent trend towards digitalization, automation, and autonomization, results in growing complexity of the involved systems and opens up the market for systems complexity management. Figure 2, provides an overview of the raise observed in the complexity of embedded systems in the automotive industry, providing an argument for the expected market growth for this type of components (Burackay et al., 2021).

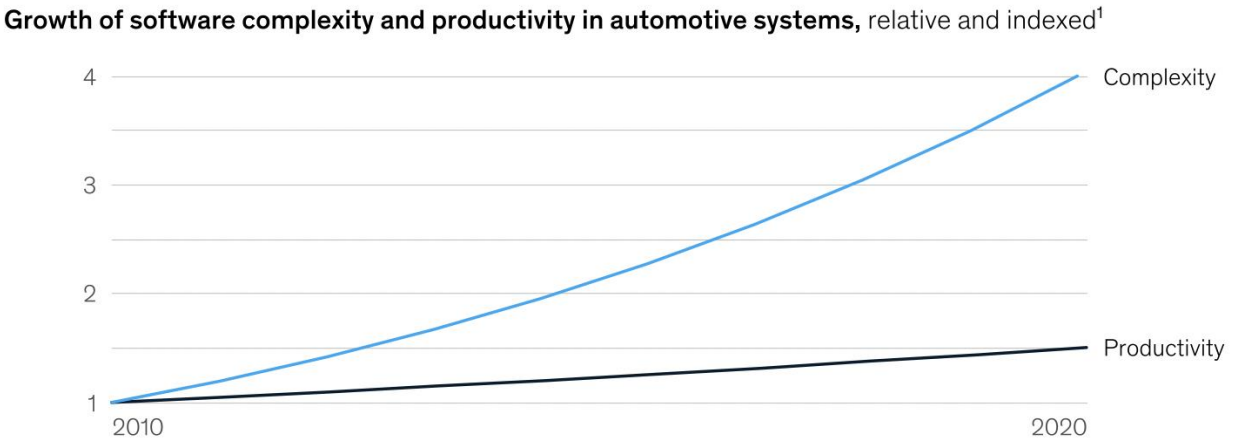


Figure 2. Growth of software complexity in automotive systems. Source: Burackay et al. (2021).

The first CPSoSAware usecase is directed towards automotive market and comprises of components oriented towards enabling higher vehicle automation and autonomization levels. This usecase is represented within the project by Panasonic Automotive Systems Europe (PASEU), recognized as a top 20 global automotive supplier and partners with the world's leading vehicle manufacturers in delivering high precision solutions in multiple fields of automotive.

For the automotive components, the main areas of interests in market potential analysis are software components, advanced driver assistance systems (ADAS), driver monitoring systems, automotive occupant sensing systems, connected vehicles, and vehicle to everything communication (V2X). Market and economic potential analysis presented below, refers to these areas of interest.

The automotive market was heavily affected by the global pandemic of Covid 19, which struck the world in 2020. The long-lasting course of events leads to a drop in consumer confidence and currencies uncertainty. Markets suffered from lower workforce availability and mobility, paired with global freight restrictions. This general market slowdown, followed by a series of events leading to a drop in semiconductors supply, is well reflected in the automotive market. According to the International Organization of Motor Vehicle Manufacturers (OICA, 2022), global vehicle sales dropped by 13,7% in 2020, as compared to 2019; and the drop in the global sales of passenger cars equaled 15,8%, with the European market being one of the most affected (Statista, 2022). 2021 brought market recovery of 5% (OICA, 2022), and 2022 was marked by a slow recovery, which lead the industry back to stable year-on-year growth in August 2022 on the Western European market, and 2023 is forecasted to bring approximately 20% year-on-year growth (Autovista24, 2022; Pontes, 2022). Consequently, the global automotive manufacturing industry revenue is forecasted to get close to the 2019 level by the end of 2022 (Statista, 2022).

Even though somewhat slowed by the global socioeconomic situation the automotive market shall not suffer from any major problems in the near future as we can conclude from the comparison of McKinsey & Company 2018 (Figure 3; Burkacky et al., 2019) and 2021 forecasts (Figure 4; after Deichmann et al., 2022).

In the report of 2018, the authors provided market growth estimates for the 10-year period between 2020 and 2030. For both software components and electrical and electronic components markets a forecast of 7% compound annual growth rate (CAGR) was reported (from USD 238 billion to USD 469 billion), while for the Automotive market in general a 3% CAGR was expected respectively (from USD 2,755 billion to USD 3,800 billion). According to the estimations, certain software components and electrical and electronic components submarkets were going to grow with an expected CAGR of 9% for software components; 10% for integration, verification, and validation services; 5% for electronic control units/ domain control units and 8% for sensors (see Figure 3).

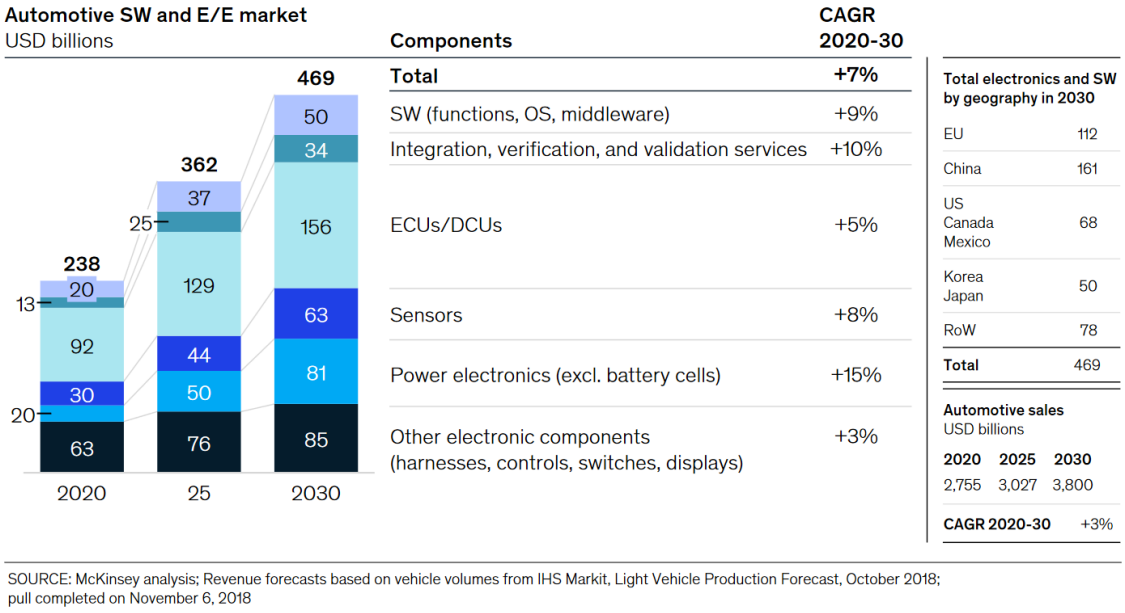


**Figure 3. A graphical overview of Automotive submarkets' sizes forecasts for 2020-2030. Source: Burkacky et al. (2019)**

The 2021 analysis presents some changes, but no major breakdown. According to the estimations, software components and electrical and electronic components submarkets are going to grow with an expected CAGR of 9% for software components; 9,5% for integration, verification, and validation services; 4% for electronic control units/ domain control units and 8,1% for sensors (see Figure 4).

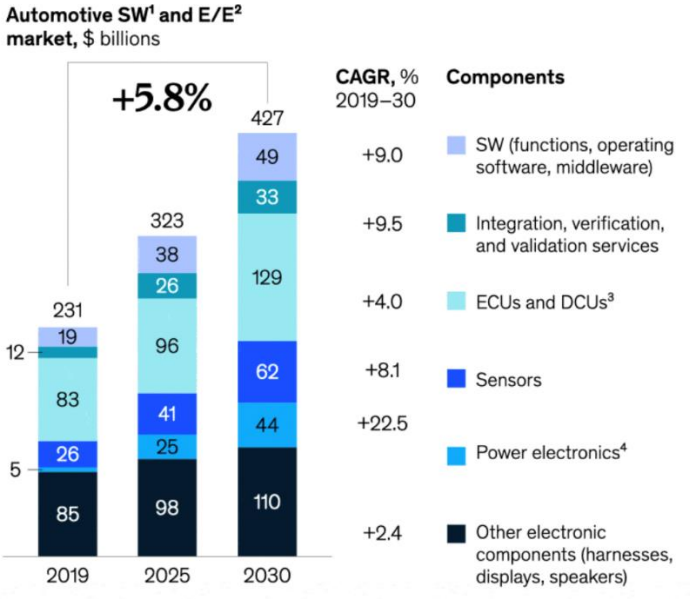


Figure 4. A graphical overview of Automotive submarkets' sizes forecasts for 2019-2030 with post pandemic update. Source: Deichmann et al. (2022).

The second use case in the CPSoSaware project is targeted at the automotive manufacturing sector, represented by the CRF (Centro Ricerche FIAT) "World Class Manufacturing Research & Innovation department". Automotive sector accounts for approximately 6% of the total employment in the European Union, automotive manufacturing industry is reported to account for 11% of the whole European manufacturing employment, and the manufacturers are spread across the whole Europe (Brown et al., 2021). Figure 5 presents the spread of automobile assembly plants across Europe.

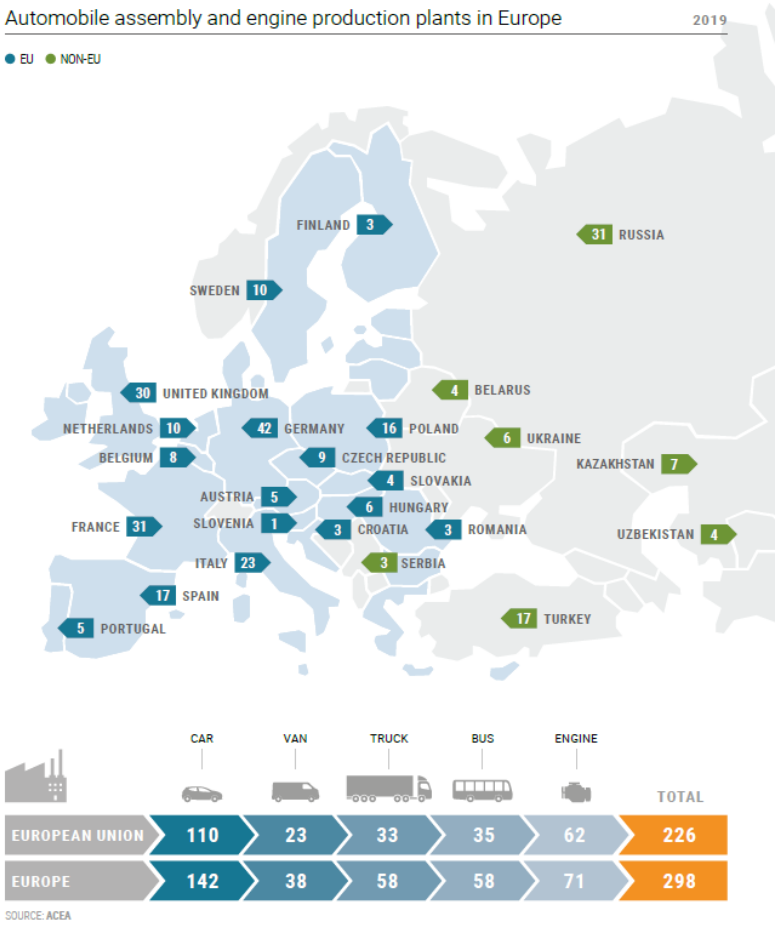


Figure 5. Automobile assembly and production plants in the EU. Source: European Automobile Manufacturers' Association (2020).

Figure 6 presents the employment share taken by the automotive industry within the whole EU manufacturing industry.

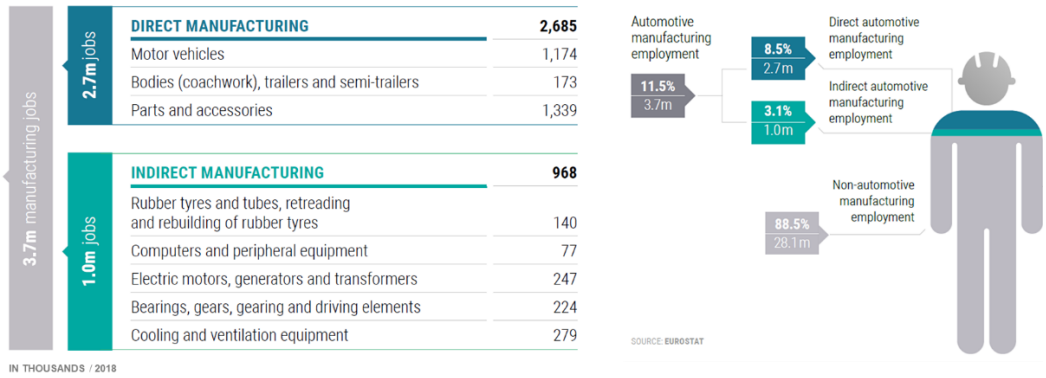


Figure 6. Automotive sector: direct and indirect employment in the EU. Figures extracted and adapted from European Automobile Manufacturers' Association (2020).

Additionally, automotive industry was one of the leaders in the industrial safety market size in 2021 (see Figure 7 according to Research and Markets (2022).

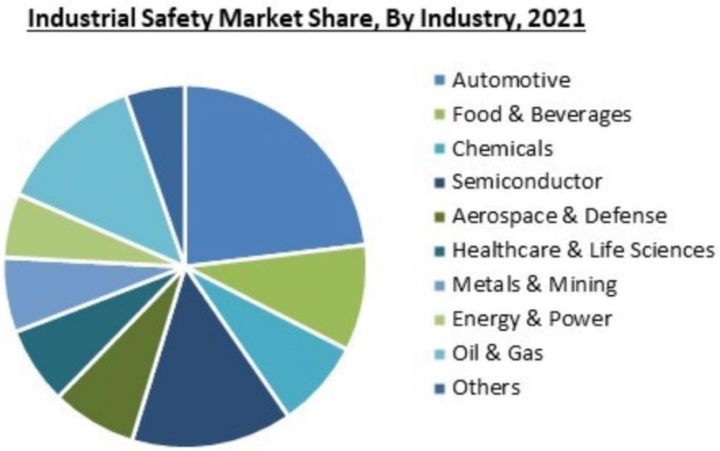


Figure 7. Industrial safety market share in 2021. Source: Research and Markets (2022).

The CRF, in turn, is a part of Stellantis Group – the 4$^{th}$ largest automaker globally, and with its employment count of nearly 300 thousand (Stellantis, 2021) and 52 facilities spread worldwide (Figure 8; FIAT Group World) is considered a good model for manufacturing industry as a whole.

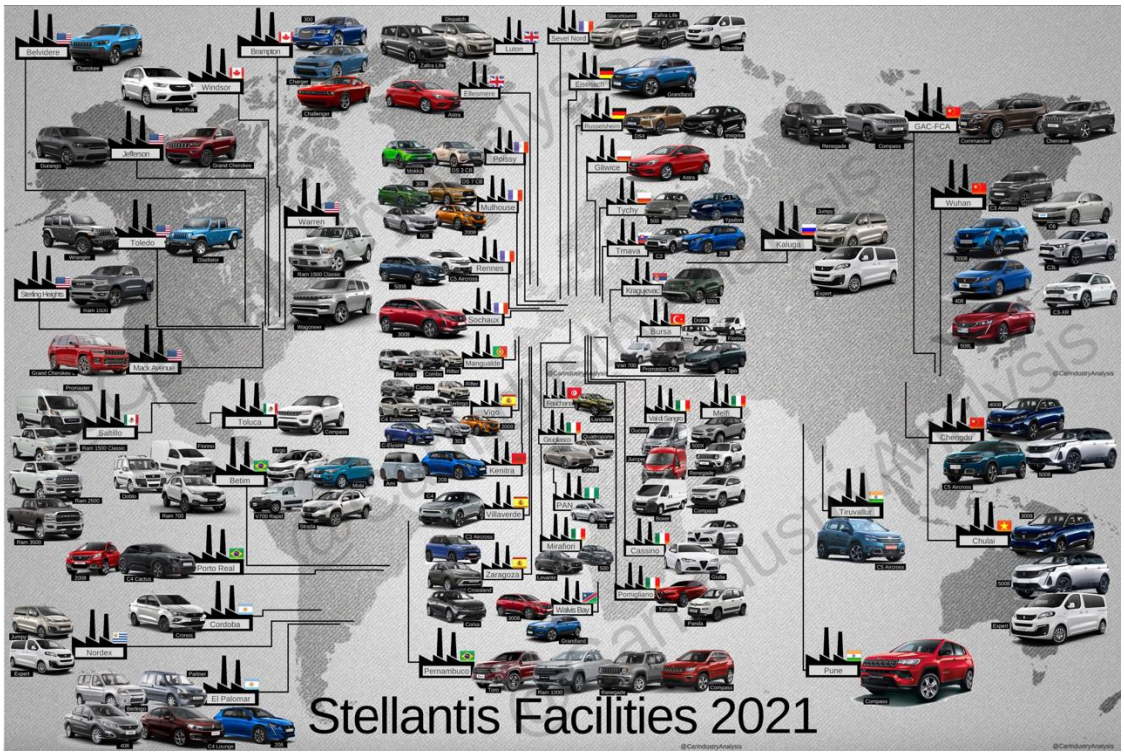


Figure 8. Stellantis facilities. Source: FIAT Group World[2].

Several development aspects of CPSoSaware components are tested by CRF, which is also the end user of certain components. The components, however, can be extended to target the general manufacturing market later in their lifecycle producing new commercialization opportunities. The analysis below is prepared from the point of view of exploitation by the currently targeted end user and the general market potential as led by the following areas of interest: collaborative robots, workplace safety, and industrial safety.

### 4.2.1 Market and economic potential analysis in automotive pillar

The ADAS & safety systems segment accounted for 22.5% revenue share of the automotive market in 2021 and reached USD 5.45 billion in 2021 (Precedence Research, 2021b). Still, embedded systems are becoming more and more integral parts of the vehicle, serving numerous functions. The ongoing change in the automotive software market landscape results in new – so far not automotive-oriented – players entering the market to fill in the space for software and cloud-based solutions for in-vehicle systems (see Figure 9). Many OEMs are teaming up with the technology companies to introduce new features. For example, in February 2021, Bosch teamed up with Microsoft to develop a software-defined vehicle platform for seamless integration between cars and the cloud.

[2] https://carindustryanalysis.files.wordpress.com/2021/04/stellantis-factories-1.jpg

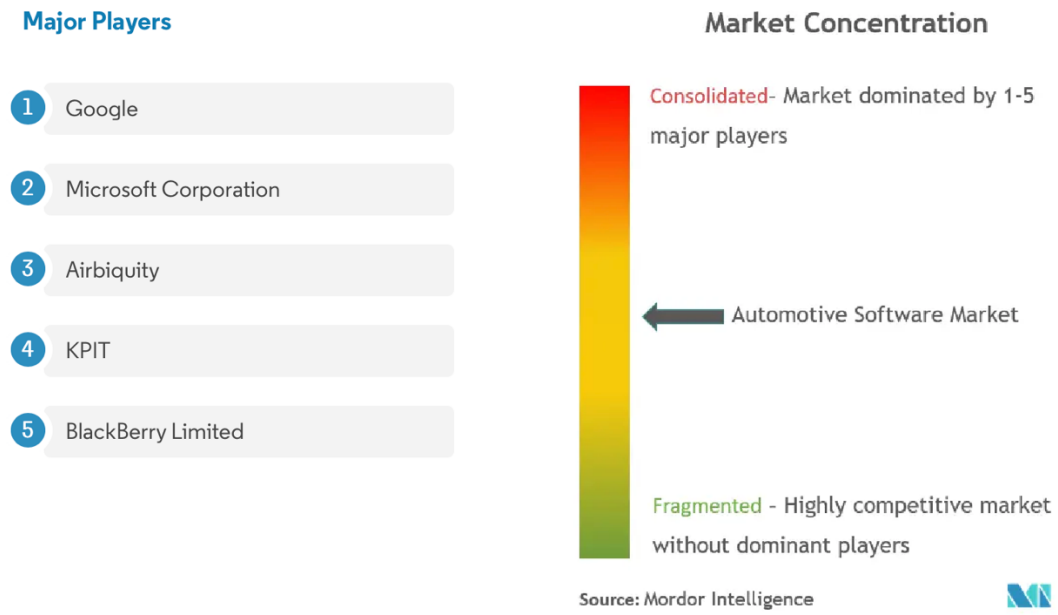


Figure 9. The main stakeholders in the automotive software market. Source: Precedence Research (2021b).

Among others, advanced driver assistance systems (ADAS) and automated driving (AD) systems in general are heavily reliant on the software components, what opens huge market opportunities. McKinsey & Company (2021) expects the automotive software market to grow at a GAGR of 9% by 2030 giving a rather moderate growth forecast, compared to other experts. Yet, another moderate growth forecast is provided by Mordor Intelligence (2022a), including the forecast of 5,11% CAGR from 2021 till 2026. According to other analyses, the global automotive software market is expected to grow at the CARG of 13.1% between 2022 and 2027 and account for 40.1 billion USD (Markets and markets, 2022a). The analysis performed by the experts of Allied Market research (Abhay and Sonia, 2020), forecasts the CARG of 14.5% from 2020 to 2027, and the market value of 43.5 billion USD in 2027. Straits Research analysis predicts the automotive software market to grow at a CAGR of 14.8% in the 2022-2030 period and to reach 57.68 billion USD value as a result (GlobeNewsWire, 2022). Precedence Research (2021) expects the automotive software market to reach 107.15 billion UDS by 2030 and to grow at a CARG of 17.4%. The latest Market Research Future report issued in December 2022, provides the highest 20% CAGR from 2022 to 2030.

The global advanced driver assistance systems (ADAS) market size itself was valued at USD 38.56 billion in 2021 (Precedence Research, 2021a). As a result of the emerging safety – related regulations (including EuroNCAP, 2022 and EU et al., 2021) the demand for advanced driver assistance systems (ADAS) increases. The global ADAS market is expected to grow at a CARG of 11.9% between 2021 and 2030 and account for 74.9 billion USD (Markets and markets, 2021a). According to Precedence Research (2021a), the growth rate will be even higher – 13.8% and the market size is expected to reach 108.04 billion USD by 2030. Market Research Future (2020a) report issued in the last quarter of 2020 gave more moderate, but still considerably high forecast of 10% CAGR between 2022 and 2030.

The European market itself (valued 6 billion USD in 2021) is estimated to grow at a CAGR of 17% in the 2021-2021 period, and to reach 21 billion USD by 2027 (Mordor Intelligence, 2021).

Driver monitoring system market represents 7-10% of total sales in the global advanced driver assistance system market (Future Market Insights, 2022a). According to the Business Research Company (2022), the global driver monitoring systems market was valued at 1.31 billion USD in 2021, and expected to grow - at CAGR of 10.2% - to 1.44 billion USD in 2022, and 2.12 billion in 2026. Future Market Insights (2022a) has valued the global DMS market at 4.2 billion USD in 2022 (as compared to 1 billion USD in 2021). Their analysis estimates the market to grow at a CAGR of 7.5% and reach 8.7 billion USD by 2032. Their experts expect passenger vehicles to account for 70% of the market share by the end of the forecast period 2022-2032, with camera-based solutions accounting for 70% of the DMS systems employed. Report Linker (2022a) predicts even faster growth of the market, at CAGR 11.74%. Allied Market Research analysis (Gunjan and Sonia, 2022) predicts market size of 4.6 billion USD by 2031 after continuous grow up at a CAGR of 10.2%.

The global automotive occupant sensing system market was valued 1.8 billion USD in 2021 as reported by Expert Market Research (2022). It is further expected to grow at a CAGR of 6.80% in the forecast period of 2023-2028 and to reach a value of 2.7 billion USD by 2027. Allied Market Research (Divyanshi et al., 2021) report valued the global vehicle occupancy detection system market at 42.5 million USD, and projects the CAGR 19.1% from 2021 to 2030, to reach the final value of 225.5 million USD by 2030.

Pre-pandemic analyses assumed approximately 20% CAGR for connected vehicles market. In Market Overview section of Connected Vehicle Market – Growth, Trends, Covid-19 Impact, and Forecasts (2021-2026) (Mordor Intelligence, 2020), an estimate for overall Connected Vehicle market was over 24.00% CAGR in the period 2020-2025. A similar forecast for the same period could be found in Markets and Markets (2020b) analysis (25.2% CAGR), with the estimations of USD 53.9 billion for 2020 and USD 166.0 billion by 2025. Allied Market Research report issued in April 2020 (Abhay and Lalit, 2020) forecasts market value of 222.16 billion USD by 2027 and CAGR of 17.1% as referred to 2019 market value of 63.03 billion USD.

According to more recent analyses, the global connected vehicles market is expected to grow at the CARG of 19% between 2021 and 2026 and account for 56.3 billion USD (Markets and markets, 2021b). According to Future Business Insights (2021), the globally connected car market size will reach 191.83 billion USD by 2028, exhibiting a CAGR of 18.1%. Within the connected car market, ADAS and safety systems are expected to account for most of the growth (Figure 10; Abhay and Lalit, 2020).

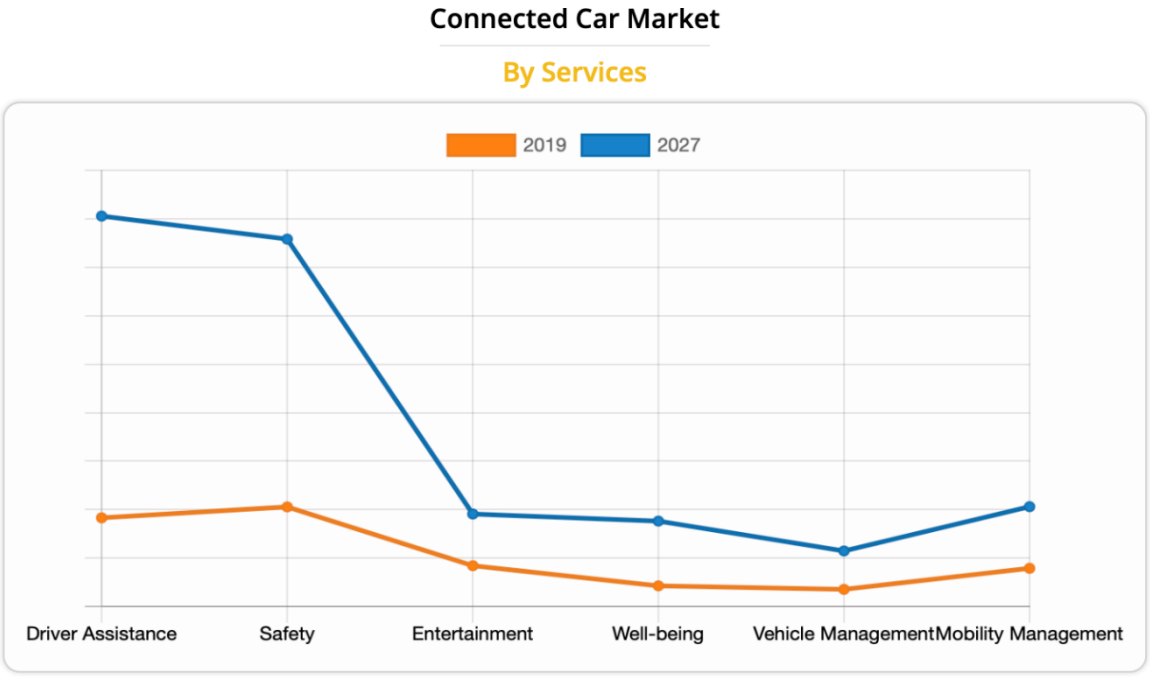


Figure 10. Connected car market growth forecast by services. Source: Abhay and Lalit (2020).

Mordor Intelligence (2022c) expects the market to grow at CARG of 19% in terms of revenue during the 2022-2027 period and to reach the expected value of 187.75 billion USD by 2027.

The very recent Straits Research analysis published in October 2022 (update on 17 November 2022; 2022b) refers to 2021 as the base year with 86 billion USD estimated global connected car market size. The report forecasts CAGR of 17.3% during the 2022-2030 period and a final market value of 361 billion USD by 2030. The report claims North America to be the largest market, and Europe to be the second largest, but at the same time the fastest growing market with an expected CAGR of 20.6% and an expected value of 145 billion USD by 2030. Figure 11 presents the connected vehicle market growth rate (2022-2027) by region as estimated by Mordor Intelligence (2022c).

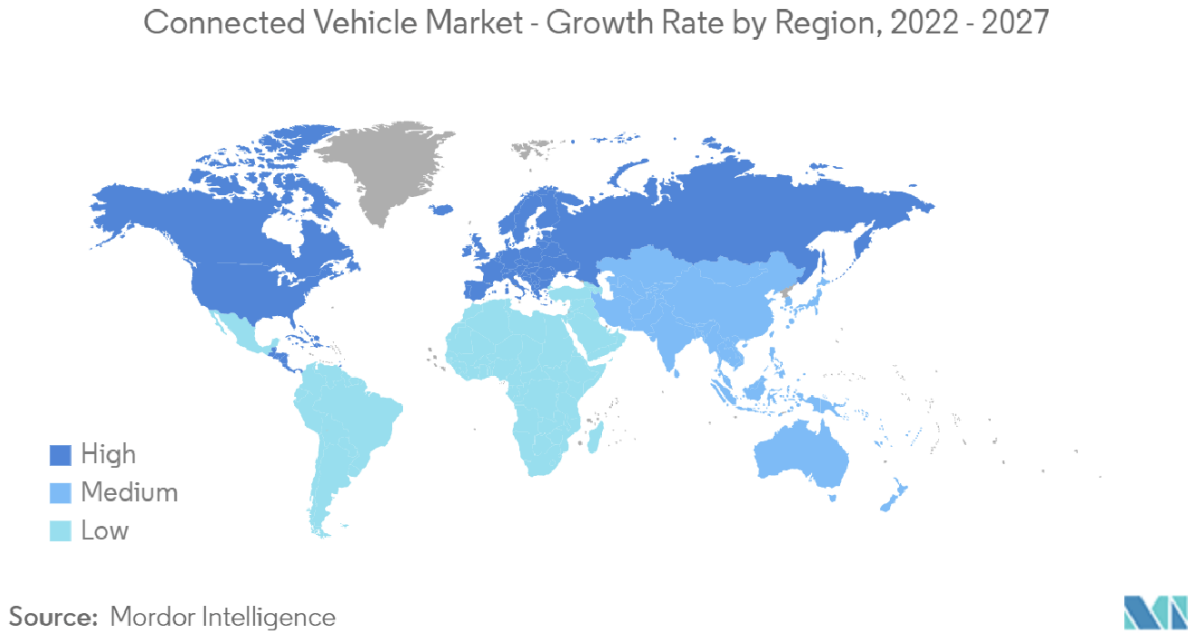


Figure 11. Connected vehicle market growth rate by region. Source: Mordor Intelligence (2022c).

The growing demand for connected vehicles results in numerous partnerships of OEMs and automotive Tier 1 and Tier 2 companies with leading IoT entities to provide connected car features. For example, in February 2021, Ford Motors and Google signed a strategic partnership for the development of connected car service applications; and in August 2021, Robert Bosch GmbH joined with Mahindra & Mahindra for the development of a connected vehicle platform.

The V2X market itself (Market research Future, 2020b) was reported in December 2020 to expect rapid growth at a CAGR of 35% from 2022 to reach the size of 15 billion USD by 2030. Reported to be valued at 2.6 billion USD in 2022, the global automotive V2X is expected by Markets and Markets (2022b) analysts to reach 19.5 billion by 2028 and grow at a CAGR of 39.7% over the 2022 – 2028 period. The analysis provided by Fortune Business Insights (2022a), projects the market to grow even more rapidly in 2022-2029, at a projected CAGR of 45,2%. Similar conclusions can be driven from Precedence Research (2022) report, according to which, the global V2X market will be growing at a CAGR of 45% during the forecast period of 2022 to 2030. Verified Market Research report (2022c) gives a more moderate estimate of 17.3% CAGR between 2023 and 2030, nonetheless leading to an impressive market size of 144.38 billion USD by 2030. Comparably rapid growth is forecasted by Polaris Market Research (2022a), expecting 44.3% CAGR for the 2022-2030 period.

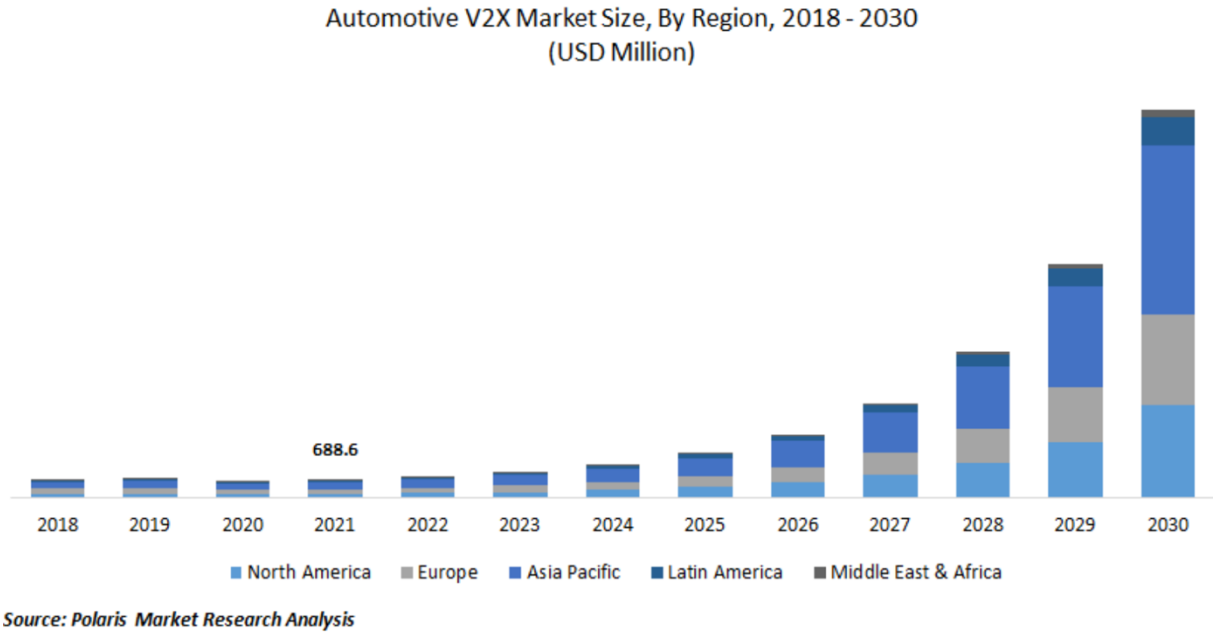


Figure 12. Automotive V2X market size forecast. Source: Polaris Market Research (2022).

The growing demand for V2X solutions is reflected in market trends, i.e., key market players entering strategic partnerships. For instance, in March 2021, Harman International acquired Savari, an automotive technology company based in Silicon Valley, providing vehicle-to-everything (V2X) technologies.

### 4.2.2 Potential beneficial impacts in manufacturing pillar

In the project the developments are applied to a specific case of application of Human-Robot collaboration performed by means of a heavy payload, Safe (Cat3, PLd) robot. The manufacturing use cases are related to the optimization of the productivity/costs of an HRC workcell and the reduction of safety and ergonomics risks. CRF acts in the project as a pilot user of the technologies meaning that it applies the developed solutions. In this situation, the standard revenue stream is coming from the manufacturing costs optimization versus the benefits achieved. As for the benefit, it is important to note that some of the exploitable contents can generate savings and direct Return Of Investments, while other benefits are indirect benefits that do not generate direct savings but rather an improvement of conditions like operator's wellbeing, reduction of musculoskeletal disorders (MSD) or improvement of flexibility.

The specific solution implemented in CPSoSaware by CRF is a collaborative assembly of a windshield, suitable for mid Takt Time (~5 minutes) using a robotic assembly. The simplification of the workcell can generate savings higher than 100k€. This saving is accompanied by a strong improvement of ergonomics for the operator. The reference workcell is a workcell in a specific FCA plant; the diffusion of the concept in similar workcells can reach a limited number of workcells, since the specific solution is limited by the applicable Takt time and by the line architectural solution. The direct diffusion of the concept can thus be limited to ~10-20 plants. Nevertheless, the developed ideas have a potentially strong impact in any

application using HRC in a collaborative approach with a high workload. These kinds of applications are not yet diffused due to limitations to the payload of standard collaborative robots (only 5 models have a payload >16 kg, and only 1 has a payload higher than 40 kg) and to the need to fully control the safety–related aspects. e.

Any solution that can support the assembly operations in substitution of a currently existing one has impact on the overall sustainability of the process. This means that the group of indicators is large with widespread aspects. Normally, the main production indicators are:

- Productivity,
- Personnel health, ergonomics, safety, and satisfaction,
- Quality (including product safety and perceived quality).

Some indicators such as Safety have "no cost". HRC solutions have to improve Operators' sustainability (safety, ergonomics, well-being, satisfaction…) while maintaining the overall production indexes of cost, throughput, and others. The main consideration for new investment in the line (besides of Safety related ones) is to obtain an ROI (Return on Investment) in a given time. Normally the ROI is 1-2 years for standard production (initiatives from the plant) and can be slightly more (up to 5 years for innovative initiatives). Solutions with a great improvement in ergonomics, quality, or other similar indicators can be interesting even though with a slightly longer ROI. The ROI has to be calculated upon direct investment costs and running costs as well as upon other indirect costs that are affected (e.g., the footprint of the workstation that mean larger plants).

It is simple to realize that the full exploitation of the HRC potential can reach thousands of workcells at the European level. Only in Europe, there are 226 factories working on engine or final assembly production (see figure x for reference). The report from Strategic Market Research (2022), predicts the global collaborative market to grow at a CAGR of 15.2% between 2021 and 2030. Straits Research (2022a). estimates a slightly higher CAGR of 18.5% for the forecast period of 2022-2030. The global collaborative robots market is estimated to grow at a CAGR of 21.6% between 2022 and 2027 according to Mordor Intelligence (2022b), and automotive segment is forecasted to drive the market. The report from Grand View Research (2022) estimates a CAGR of 31.5% between 2022 and 2030 and expects the market to reach a value of 11.04 billion USD by the end of the period. The market also points out automotive industry to be the leading drive of the market. Verified Market Research (2022a) goes even higher in its expectations, projecting the market to grow at a CAGR of 40% between 2022 and 2030. According to Markets and Markets (2022c) analysis, the market was worth 1.1 billion USD in 2021 and is expected to grow at a CAGR of 41.5% until 2028, reaching a value of 9.2 USD. Indeed, the collaborative robots market is reported to experience considerable growth due to COVID-19 pandemic, especially in certain industries, like logistics and e-commerce, as well as pharmacy (Markets and Markets, 2022c). A similar forecast is made by Report Linker (2022b), which expects the market to grow at a CAGR of 41.5% between 2021 and 2028. Fortune Business Insights (2022b), expect an even higher, 42.7% CAGR for the period between 2022 and 2028 (see Figure 13). It also expects automotive industry and payload of 11 kg and above to be key market growth drivers.

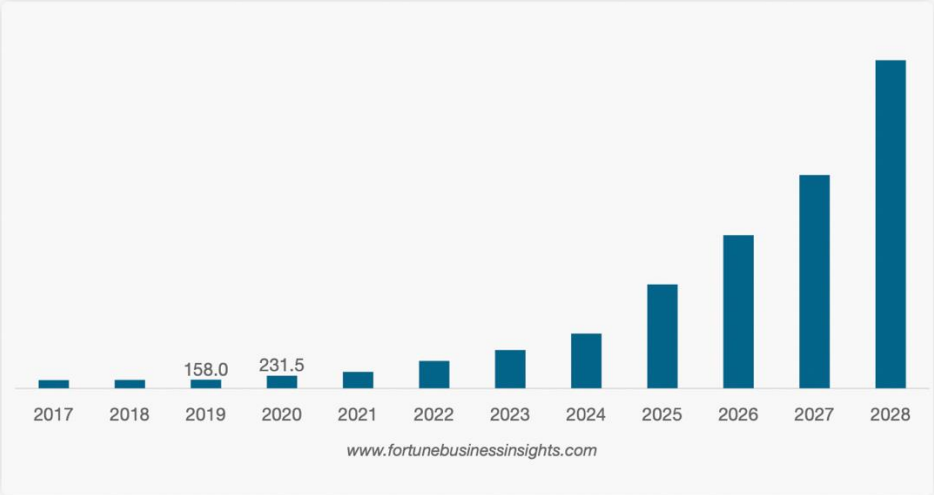


Figure 13. Collaborative robots market forecast. Source: Fortune Business Insights (2022b).

The developed technologies have their strongest impact on the improvement of ergonomics conditions, in particular to active analysis and correction of posture. Indeed, the use of a collaborative robot in the developed concept improves safety and ergonomics by:

- Replacing the manipulator (removing push-pull activities by the operator),
- Adjusting the height of the equipment according to anthropometrics and effective posture of the operator (reduction of MSD – Musculoskeletal Disorders),
- Lifting heavy loads instead of the operator,
- Optimizing position of the operator in the workcell,
- Reducing the spaghetti chart (legs and full body fatigue).

Furthermore, the analysis of distractions from the operators and the generation of warnings will impact the generation of safety risks in the workcell. The quantification and classification of the safety risks is not simple, yet it is important to consider existing quantifications of the MSD.

Musculoskeletal disorders (MSDs) remain the most common occupational disease in the European Union and workers (European Agency for Safety and Health at Work (EU-OSHA, 2010) in all sectors and occupations are exposed to be affected by MSDs. They are also an increasing problem and one of the most important causes of long-term sickness absences. Besides the effects on workers themselves, MSDs may lead to high costs to enterprises and society as a whole. Additionally, new equipment and ways of working can lead to new risks. Nevertheless, they can be prevented using the prevention approach enshrined in EU legislation. Every year millions of European workers in all types of jobs and employment sectors are affected by MSDs through their work. Musculoskeletal disorders (MSDs) cover a broad range of health problems. The main groups are back pain/injuries and work-related upper limb disorders, commonly known as “repetitive strain injuries” (RSI). Lower limbs can also be affected. Lifting, poor posture, and repetitive movements are among the causes and some types of disorders are associated with particular tasks or occupations. Treatment and recovery are often unsatisfactory, especially for more chronic causes. The end result can even be a permanent disability, with the loss of employment.

The following figure (Figure 14) shows that in the distribution of occupational diseases in Europe, MSD covers 38.1% of the total.

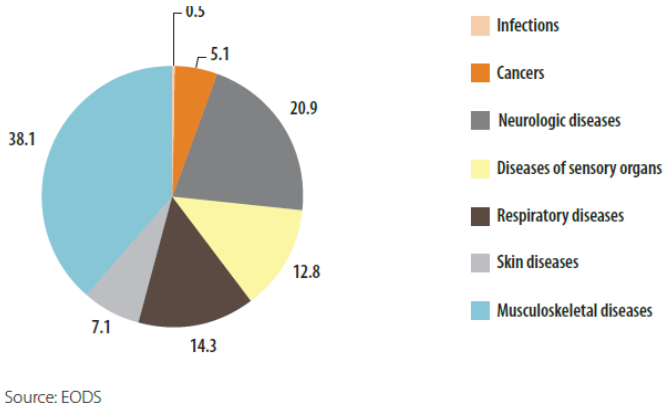


Figure 14. Proportion of occupational diseases. Source: EODS obligatory list, 2005 in EU-OSHA (2010).

Besides the direct consequences on the operator's performance and well-being, the decrease of MSD in the plant has also a significant impact on economic and social costs. The true extent of MSDs costs within workplaces across Member States is difficult to assess and compare. A report from the EU-OSHA (Pinder et al., 2007) mentions, nevertheless, that certain studies have estimated the cost of work-related upper-limb musculoskeletal disorders (WRULD) at between 0.5% and 2% of Gross National Product (GNP). More recent figures, for example from Austria, Germany, or France, demonstrate an increasing impact of musculoskeletal disorders on costs. In France, for example, in 2006, MSDs have led to seven million workdays lost, about 710 million EUR of enterprises' contributions (EU-OSHA, 2010).

The Insights Partners (2022) assess the global occupational health market to be worth 4.4 billion USD in 2021 and forecast it to grow at a CAGR of 32% during 2021 to 2028, and consequently reach 5.5 billion USD value.

The global workplace safety market was valued at 13.1 billion UDS in 2021, according to Reports Value (2022), and is projected to grow at a CAGR of 12.8% between 2022 and 2028, reaching a value of 30.4. billion USD by the end of the period. Markets and Markets (2022e) expects the market to rise from 14.2 billion in 2022 to 26.7 billion by 2027 at a CAGR of 13.5% with Europe being the market growing at the highest CAGR (Report Linker, 2022c). Future Market Insights (2022b) expects a more moderate CAGR of 6.4% for the industrial and workplace safety market, valued at 5.9 billion USD in 2021, to reach 8 billion USD by 2026, and 11.6 billion USD by 2032. The analysis points out the presence of the detecting sensors market growth as a key trend driven by industrial machine safety requirements. One of the key drivers of the workplace safety market pointed out in the analyses is the growth of the industrial safety market. Polaris Market Research (2022b) forecasts the market to grow at a CAGR of 6.7% in the period of 2022 – 2030, from 5.98 billion USD in 2021, and 6.32 billion USD in 2022 to 10.63 billion USD at the end of the forecast period. Figure 15 presents the expected trend in the industrial safety market size.

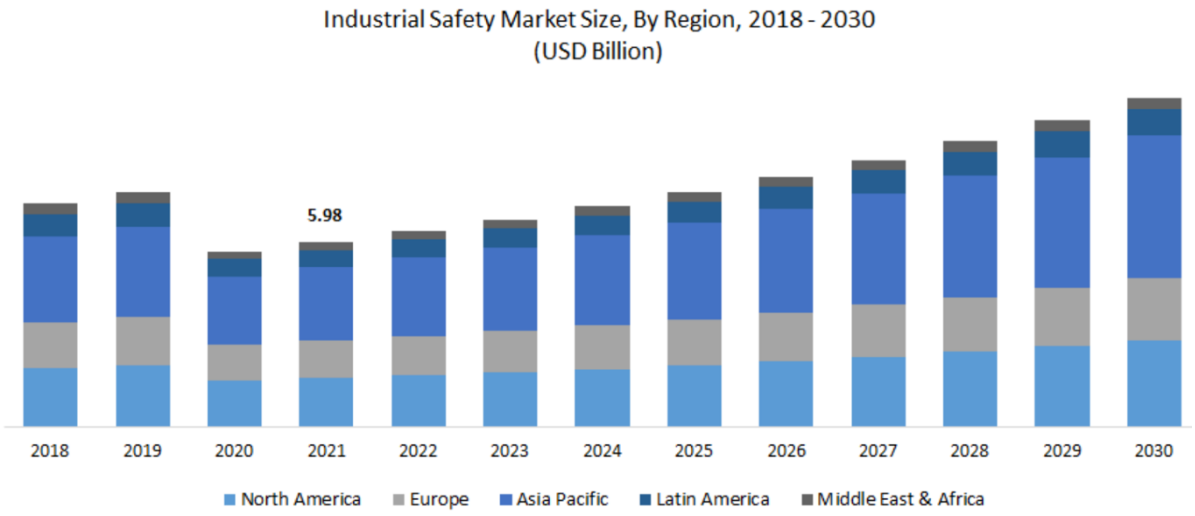


Figure 15. Industrial safety market size forecast. Source: Polaris Market Research (2022b).

Similarly, Markets and Markets (2022d) report projects the global industrial safety market to grow at a CAGR of 6.8% and reach a value of 8.8 billion by 2027. Meticulous Market Research (2022) expects the market to grow at a CAGR of 10.5% between 2022 and 2029 and reach a value of 15.76 billion USD. The analysis published by Research and Markets (2022), expects the market to reach 9.5 billion USD by 2028, rising at a CAGR of 6.9%. Figure 16 presents the expected trend with an account of the type of industrial safety.

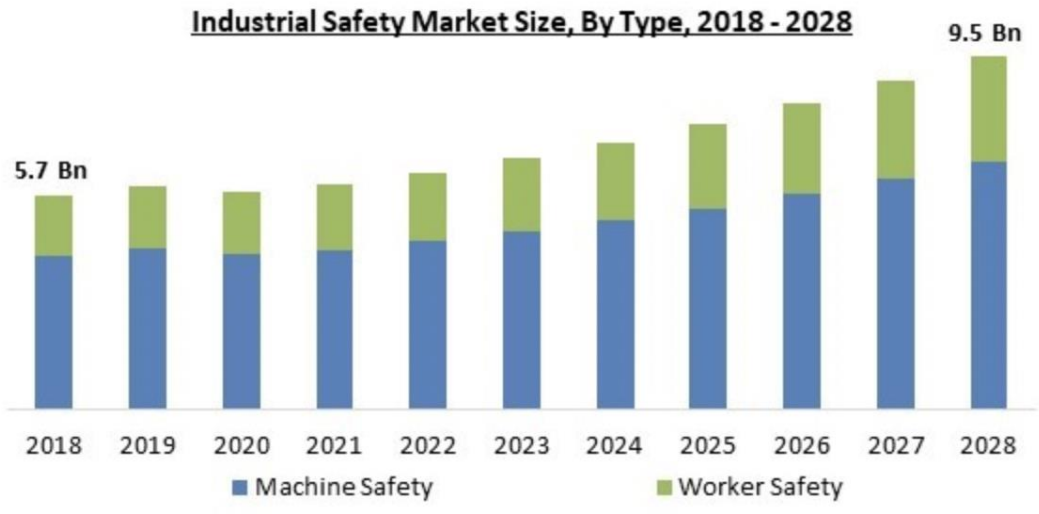


Figure 16. Industrial safety market size forecast by type. Source: Research and Markets (2022).

Verified Market Research (2022b) recently published a report, according to which the global industrial safety market is to grow at a CAGR of 7.86% from 2023 to 2030 and reach the value of 9.3 billion USD by the end of the period.

## 4.3 Target end users

Most of CPSoSaware components are meant to prove useful and provide benefits for car or more broadly vehicle manufacturers and integrators (Tier 1 and Tier 2). Some of them also fit robot manufacturers' and integrators' (Tier 1 and Tier 2) needs. Moreover, they are useful tools for universities and research institutes.

Other technology providers like wearable industry stakeholders, application developers, and systems integrators are also on the targeted end users list for a set of CPSoSaware components. Yet another group of end users is service providers, including logistics and insurance companies, as well as public authorities. Apart from that, some of the proposed technologies can be utilized as aftermarket products directed toward individual end users – drivers and vehicle owners.

Target end users for each of the components are specified in Annex A to Annex M within this document.

## 4.4 Potential competitors

Competitors' analysis was performed for selected of the identified exploitable components as they target various markets. The results of competitors analysis (performed in mainly in the first half of the project duration, proved a basis for assessing the project results potential, impact and supported defining the added value they should bring to effectively find their place among the state-of-the-art solutions). Consequently, the list of potential competitors can be specified differently for each of the selected components. The following paragraphs include lists of market competitors presented in a component-wise manner.

Security Runtime Monitoring and Management (SRMM)[3]

- RSA Netwitness Platform by RSA/EMC/Dell (https://www.rsa.com/en-us/products/threat-detectionresponse/siem-security-information-event-management): Provides a graphical interface for the Security Operations Centre (SOC) team and a set of applications or external commands that help the correlation and/or investigation processes.
- ArcSight Enterprise Security Manager by NetIQ/Microfocus/HPE (https://www.microfocus.com/en-us/products/netiq-sentinel/overview): Allows for scalable and

[3] Competitor analysis for SRMM component is based on an in-depth analysis performed by González-Granadillo et al. González-Granadillo, Gustavo, Susana González-Zarzosa, and Rodrigo Diaz. 2021. "Security Information and Event Management (SIEM): Analysis, Trends, and Usage in Critical Infrastructures" Sensors 21, no. 14: 4759. https://doi.org/10.3390/s21144759

versatile SIEM architecture, delivering real-time forensics, comprehensive application, and database traffic/content monitoring, advanced rule and risk-based correlation for real-time as well as historical incident detection and automatic reaction.

- McAfee Enterprise Security Manager by McAfee/Intel (https://www.mcafee.com/enterprise/enus/products/siem-products.html): Provides end-point monitoring, network forensics, user and entity behaviour analytics, and response capabilities. Can be deployed in an appliance, software, or virtual instance supporting scalable decentralized architectures.
- LogRhythm Next GEN SIEM Platform by LogRhythm (https://logrhythm.com/solutions/security/siem/): Offers both: commercial solutions (i.e., Alienvault Unified Security Management – USM) and open source SIEM solutions. (i.e., OSSIM). Includes a web-based graphical interface for administration, reporting, and security event management.
- Splunk Enterprise Security by Splunk (https://www.splunk.com/en us/resources/videos/splunk-forsecurity-vs-siem.html): Analyzes data and behaviour of people and processes within a network across a company's logs, packets, and end-points. Focuses on advanced threat detection. Provides strong OT monitoring capabilities.
- USM & OSSIM by AlienVault/ AT&T Cybersecurity (https://cybersecurity.att.com/products/ossim): Market-leading platform in Operational Intelligence. Offers data collection, indexing, and visualization capabilities for security events monitoring. Uses advanced security analytics, which includes both unsupervised machine learning and user behaviour capabilities.
- SolarWinds Log and Event Manager by SolarWinds (https://www.solarwinds.com/security-event-manager): Provides centralized log collection and normalization, automated threat detection and response, intuitive visualization and user interface, as well as real-time correlation and log searching to support investigation.

Homezone Perception Engine

- Perception Engine - Perception Engine is a start-up backed up by Nagoya University, initiated in 2019. It focuses on developing and deploying sensing and detection systems for advanced robotics systems such as autonomous driving vehicles. They support their clients from hardware selection, system setup, to model training and deployment on computing devices. Perception Engine is also continuously involved in the development and improvements of Open-Source projects such as Autoware. Atomic Engine is their sensing, pre-processing and perception framework for 2D, and 3D sensor data. It is designed to accelerate, automate and simplify the object detection, tracking and fusion tasks. It can be used online and offline. Proton Engine is their calibration service for multiple sensors. Proton can estimate the relative position between coordinate systems of cameras, lidars, and radars. When using cameras, it can also calculate the camera intrinsic parameters and the distortion parameters using our one-shot technology. Accurate calibration is required to obtain optimum results on higher levels of perception and localization[4].

[4] Perception Engine - パーセプションエンジン [access: 13.01.2023].

- Aruvii - A fast and robust 3D LiDAR Perception Engine for intelligent sensing in indoor and outdoor spaces. Converts raw 3D point-cloud data to usable 3D insights in real-time for smart manufacturing and robotics applications.

MOZART Systems Orchestrator

No direct competitor was identified in the market, nonetheless there are companies and related tools that partly could be considered as competitors of our component, and we list them below.

- UBITECH (https://ubitech.eu/) based in Greece: Their software: Maestro https://themaestro.ubitech.eu is an advanced developer framework for cloud orchestration and infrastructure automation. It is a full-scale software solution that gives the ability to the user to design, deploy, and manage the cloud Built with IaaS (Infrastructure-as-a-Service) abstraction and moreover to create easy-to-manage, easy-to-scale workflows with Docker Compose applications. It comes with advanced off-the-shelf features to support extensive monitoring, security enforcement, elasticity management, and operational analytics.-native containerized components in both public and private cloud environments
- SZTAKI (https://www.sztaki.hu/en): is a Hungarian research institute, governed by the Eötvös Loránd Research Network. Their software: Occopus https://occopus.readthedocs.io/en/latest/index.html, is an open-source and easy-to-use hybrid cloud orchestration tool and management framework for heterogeneous multi-cloud platforms). Occopus is capable for managing flexible computing infrastructures and services in a single or multi-cloud system. It is actually a framework that provides features for configuring and orchestrating distributed applications (so called virtual infrastructures) on single or multicloud systems. Occopus can be used by application developers and devops to create and deploy complex virtual infrastructures as well as to manage them at deployment time and at runtime. https://link.springer.com/article/10.1007/s10723-017-9421-3

OTHER RELATED TOOLS widely used in the market:

- Kubernetes (https://kubernetes.io/) is an open-source container management platform, and orchestration system for containers originally derived from Google's in-house Borg software, now governed by the Cloud Native Computing Foundation (CNCF) and developed by Google, Red Hat, and many others. Being open-source, Kubernetes is capable of automating the deployment, management, and scaling of containerized applications. Kubernetes orchestrates and manages the lifecycle of heterogeneous containerized applications (such as services and batch jobs) in either virtualized or physical clusters. It provides a default scheduler that assigns each container group (or pod) to available cluster resources filtered by user-defined requirements and ranked based on individually defined application affinities. Docker swarm is a container orchestration tool, meaning that it allows the user to manage multiple containers deployed across multiple host machines. It can package and run applications as containers, find existing container images from others, and deploy a container on a laptop, server, or cloud (public cloud or private).
- Morpheus by Bertram Labs (https://morpheusdata.com/hybrid-cloud-management/control-shadow-it/) is a unified multi-cloud orchestration platform aimed at connecting developers to self-

service infrastructure. Morpheus supports authentication and role mapping via identity management integration to Active Directory, Azure AD, SAML, OKTA, etc. including SSO and MFA. Users can build service catalogs, complex multi-cloud structures, and access stack visualization tools. Users can also govern and control access to cloud resources using multi-tenant policies

- Nomad by HashiCorp (https://www.nomadproject.io): is a simple, flexible, and easy to use workload orchestrator to deploy and manage containers and non-containerized applications across on-prem and clouds at scale. Nomad can run a diverse workload of Docker, non-containerized, microservice, and batch applications. Nomad enables developers to use declarative infrastructure-as-code for deploying applications. Nomad uses bin packing to efficiently schedule jobs and optimize for resource utilization. Nomad is supported on macOS, Windows, and Linux. While Kubernetes is specifically focused on Linux containers, Nomad is more general purpose. Nomad supports virtualized, containerized and standalone applications, including Docker, Java, IIS on Windows, Qemu, etc.

Driver state monitoring

Numerous entities in the market provide driver state monitoring, and this type of vehicle-safety measure is gaining increasingly lots of interest due to emerging standards and regulations. The solution developed within CPSoSAware project, however, is a nonembedded solution, based on smartphone, which broadens up the targeted market by including vehicle owners, not only the newly-produced vehicles.

- Veoneer (https://www.veoneer.com/en/driver-monitoring-systems): Their DSM system detects distracted and drowsy drivers by accurately measuring eye and head position, driver attention and fatigue. No information could be retrieved regarding the technologies and equipment necessary to deploy their solution (i.e., external devices inside the car).
- PathPartner (https://www.pathpartnertech.com/products/driver-monitoring-solution/): Their DSM utilizes cameras within the cabin of the car and provides identification of the user, monitoring of drowsiness level and emotion recognition.
- Jabil (https://www.jabil.com/industries/automotive-electronics-components/advanced-driver-assistance-monitoring-systems.html): Offers a Camera Platform optimized to support Driver Monitoring System software.
- HARMAN (https://car.harman.com/solutions/adas/driver-and-occupant-monitoring-system): Their solution uses camera sensors to capture the driver's most important first-order biometric features, such as gaze, head position and pupil diameter, among many other key facial features.
- Cipia (https://cipia.com/): Their Driver Sense solution is an advanced driver monitoring system (DMS) tracking drivers and their states in real-time.

CASPAR - Semantic Information Fusion Framework

- Oxford Semantic Technologies (https://www.oxfordsemantic.tech/): They are the company behind RDFox, the first market-ready high-performance knowledge graph and semantic reasoning engine for data intensive applications. They have been collaborating with BMW on a semantics-enabled framework for autonomous vehicles.

- Bosch (https://www.bosch-mobility-solutions.com/en/mobility-topics/automated-mobility/): They are researching the application of knowledge representation and semantic technologies to enable autonomous driving.
- Toyota Technological Institute (https://www.toyota-ti.ac.jp/english/): They are developing resources and tools that will be used for developing Advanced Driver Assistance Systems.

V2X simulator

As far, as there are some existing tools offering similar functionality, they are not that easy to integrate and they are not really well optimized. CPSoSAware creates something new that would be easy to plug into existing solutions. This modular solution was created in such a manner that it would be easily integrated with existing software solutions.

- DANLAW (https://www.danlawinc.com/v2xtesttools/): The MxDrive extension to MxSuite delivers the functionality required for testing in a fully modeled test harness (MIL) and in a bench test fixture (HIL). Routes' specification is possible both manually and programmatically. Infrastructure transmissions (e.g., MAPs and SPATs) can be configured. Test equipment is time-synchronized using generated GPS transmissions.
- dSPACE (https://www.dspace.com/en/inc/home/products/sw/impsw/v2xsolution.cfm): The V2X Solution gives access to V2X communication from Simulink and enables graphical analysis of V2X-specific data in ControlDesk.
- Cohda Wirelesss (https://cohdawireless.com/cohda-wireless-announces-advanced-c-v2x-software-development-kit/): The C-V2X SDK includes a virtual simulation tool called vsim developed for Cohda that allows testing applications through simulated drives that provide playback capability for actual drive tests.
- Allion's (https://www.allion.com/automotive/cv2x-validation/): C-V2X Scenario Simulations is a scenario testing based on the Standards (T/CSAE) 53-2017 released by China Society of Automotive Engineers (China-SAE). It provides 16 scenarios and customized scenarios (as of 16.06.2021) that allow ADAS performance testing under different circumstances.
- SEA Datentechnik (https://www.sea-gmbh.com/v2x/v2x100/): S.E.A. provides turn-key test solutions for the test of V2X components, V2X-related systems, and apps. Open-loop and closed-loop test solutions are available. The S.E.A. V2X test systems are designed as a modular concept of building blocks with interfaces based on National Instrument hardware and software, S.E.A. V2X, c-V2X communication interfaces, and GNSS simulation products from M3 systems.
- VECTOR i Rohde & Schwarz (https://www.vector.com/us/en-us/products/products-a-z/software/canoe/option-car2x/): The option .Car2x is suitable for the application and function development of ECUs that receive their information on the basis of V2X application messages. CANoe .Car2x offers a range of functions designed to configure and run traffic scenarios so that the functions of the ECU can be tested. This allows you to stimulate the Car2x control unit according to the situation and test the implemented functions in a targeted manner.
- Aimsun Next (https://www.aimsun.com/de/articles/simulating-connected-vehicles-v2x-framework-aimsun-next/): extensible V2X Framework in Aimsun Next are designed to support innovative new systems based around connected vehicles design and testing traffic management systems, in-car information tools, and autonomous vehicle controls.

- Anritsu (https://www.anritsu.com/en-us/test-measurement/products/mx725000a): The LTE V2X PC5 Communication Software for cellular V2X (C-V2X), is designed to test V2V and V2I communications functions via an ITS-band PC5 interface.
- SCALABLE (https://www.scalable-networks.com/products/exata-network-emulator-software/): Their wireless simulation includes urban environments, vehicle mobility, fading, shadowing, path loss and interference, and models of 802.11p, LTE, Thread, Bluetooth and 5G provide the answer. The tools reveal details about network performance at every layer of the stack, to locate problems in various environments and scenarios.
- NORDSYS GmbH (https://www.nordsys.de/en/v2x/v2x-products): Their waveBEE® system includes development platforms, onboard units, road side units (ITS stations), V2X environment generators for field tests, analysis and validation systems, HiL test benches for V2X ECUs with test scenario generation and traffic simulation.

CPS connected Extended Reality System in HRC application; Posture and anthropometrics recognition; System for operator's state monitoring

More and more vendors provide extended reality systems and related services, however, the key value of the currently developed solution is the fact that it is tailored and optimized for HRC applications in manufacturing environment, making it of a unique value to the targeted market. Posture and anthropometrics recognition, System for operator's state monitoring also make use of using established methodologies in a new niche to boost workcell safety.

# 5 Exploitation strategy

The CPSoSAware project exploitation framework was defined in a way which defines the exploitation strategy for the project results from the disclosure of background IP, through research, technical and commercial assessment, to definition of the exploitable components, and support for the developing partners in their academic and commercial exploitation. The CPSoSAware exploitation framework is presented in Figure 17.

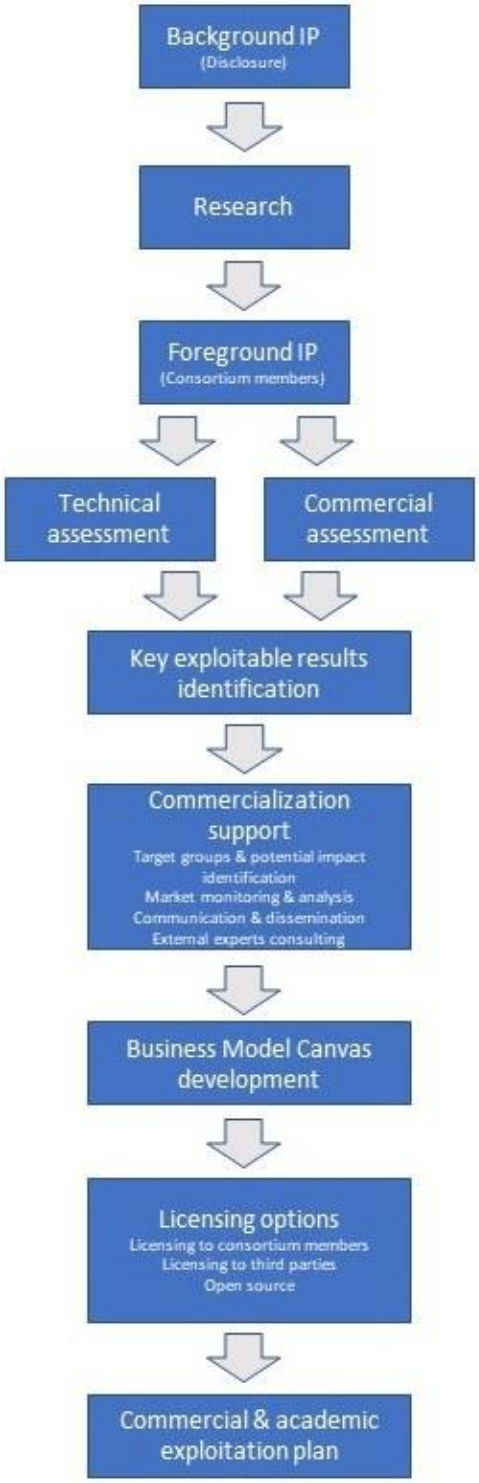


Figure 17. CPSoSAware exploitation framework.

The CPSoSAware project has produced number of exploitable results oriented towards human-cantered autonomous design in automotive and manufacturing environment with human operator/driver safety as a common theme. The components represent three layers of CPSoSAware architectural design: the system layer, the simulation and training layer, and the CPS/CPHS layer. Altogether, they form a complex system of systems encompassing various aspects of operation continuum, from human-robot interaction interface to runtime monitoring and security provision. The system with its various components operating jointly, was tested within two pilots of the projects – the manufacturing pilot provided by CRF in the FIAT factory in Turin, and the automotive use case provided by PASEU in their Langem facilities. The operational tests described in the deliverable D6.5 prove the overall system to be a strong strategy towards the assumed goal of increasing operator/driver safety in the initially targeted domains. As far as the CPSoSAware components can and are viewed as a single unified product, for the sake of market outreach and increasing their exploitation potential, each of the components can be also viewed as self-standing product.

## 5.1 IPR

The CPSoSAware IPR management encompasses the definition of the measures and methodologies for the management of the Intellectual Property Rights (IPR), so as to ensure adequate exploitation of project outcomes. For the protection of the results, CPSoSaware recognizes the most popular routes including trademark, patent, copyright, license and confidential information, while it also keeps a living IPR repository in order to keep track of the results and the corresponding owners. Regarding the IPR management process the project identifies the background, sideground and foreground results along with the corresponding licenses for each of the developed components. Separate deliverable (D7.9 (Kosmides et. al., 2023)) is dedicated to the intellectual property rights management in the CPSoSaware project, where all these aspects are presented in a detailed manner together with the identified licensing strategies.

## 5.2 Standardization

The CPSoSAware standardization activities concentrated on the identification of the existing standards and guidelines relevant to CPSoSaware in order to conform the project development to up-to-date norms and guidelines and ensure a high-quality outcome with an increased exploitation potential. Separate deliverable (D7.10; Zanella et. al., 2023) is dedicated to the standardization-related activities of the CPSoSaware project, in which the outcomes of standardization activities are reported.

## 5.3 Innovation management

To achieve best exploitation results, Exploitation and Innovation Management Board was appointed. The board consists of Innovation Manager and Board members representing both project pillars on behalf of industrial and research partners. Table 2**Błąd! Nie można odnaleźć źródła odwołania.** presents the list of partners constituting the board.

Table 2. Exploitation and Innovation Management Board members.

| Exploitation and Innovation Management Board (EIMB) | | | |
|---|---|---|---|
| # | Role | Partner | Appointed member |
| 1 | Innovation Manager | ROBOTEC.AI Spolka Z Ograniczona Odpowiedzialnoscia (RTC) | Michał Niezgoda |
| 2 | Innovation Vice-manager | | Anna Olejniczak-Serowiec |
| 3 | EIMB member | Catalink Limited (CATALINK) | Pavlos Kosmides |
| 4 | EIMB member | Centro Ricerche FIAT SCPA (CRF) | Alessandro Zanella |
| 5 | EIMB member | Athina-Erevnitiko Kentro Kainotomias Stis Technologies Tis Pliroforias, Ton Epikoinonion Kai Tis Gnosis (ISI) | Aris Lalos |
| 6 | EIMB member | University Of Peloponnese (UoP) | Gergios Keramidos |

Figure 18 presents the innovation management process in CPSoSaware, and the role of Exploitation and Innovation Management Board.

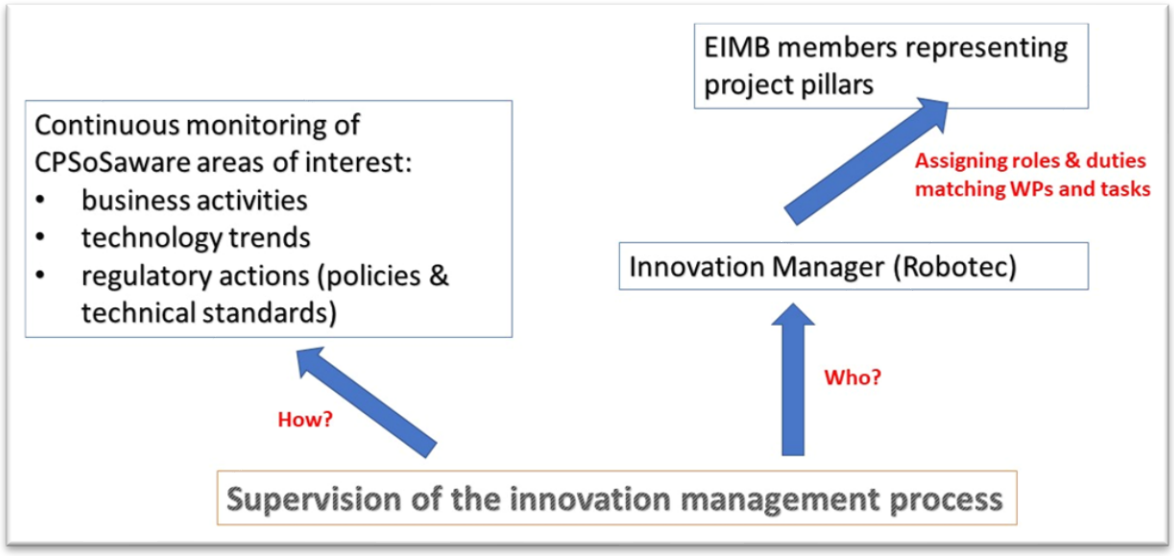


Figure 18. Innovation management process in CPSoSaware.

The key goal for the CPSoSaware innovation management process is to monitor the outcomes of the technical processes and match them to business opportunities present or arising in the market.

The concept of CPSoSaware innovation management is based on the following pillars:

- Supporting innovation capacity and integration of new knowledge to exploitable results. In order to achieve this, project partners are including a wide range on measures aiming at fostering generation of ideas, based on inputs coming both from inside and outside of the project.
- Bridging the gap between research and business. This pillar refers mainly to activities like looking for shorter time-to-market, fitting the end-user needs, creating added value in broader terms (both Partners & society).

Exploitation and Innovation Management Board activities are linked to following tasks within the project: T7.2 Exploitation and Market outreach, T7.3. Standardization.

Specific activities of the CPSoSAware Exploitation and Innovation Management Board (EIMB) encompass a wide range of tasks oriented towards exploitation of project results and strengthening networking potential and interproject cooperation. The activities included monitoring of technology trends for relevant domains, participation in related events, finding related stakeholders that will be interested in the CPSoSaware solution, following related market trends and act accordingly, networking and clustering with other relevant H2020 projects and other EU wide associations and initiatives, and seeking appropriate tools and platforms for matchmaking provided from the EU for matching projects innovations with potential industry stakeholders taking into account EU paradox problem. Below, some of the results of the EIMB activities are summarized.

- In total, CPSoSAware partners participated in a number of events identified as being useful in terms of project products dissemination and enhancing their outreach. The partners also organized or organized some of such events with the goal of increasing awareness of the CPSoSAware solutions. The events participation encompassed both European and International level as well as national level events in the partners countries of origin. Detailed list of events with relevant descriptions is provided in the deliverable D7.7 (Papachristopoulou, 2023).
- The business and research environment of the CPSoSAware project was monitored through the project with the aim of identifying relevant stakeholders that might be interested in the project's solutions. One of the effects of this activity was the Commercial Advisory Group (CIAG) to the project formation. The CIAG consisted of seven external experts representing their organizations. The organizations list included significant stakeholders from industry as well as academic and research environment of the project (Huawei, Inertia, Comau, Kentom, National and Kapodistrian University of Athens, Aristotle University of Thessaloniki, and Vrije Universiteit Brussel. The CIAG served as and advisory body of the CPSoSAware project in the domains of exploitation and market outreach, standardization and IP protection. The main event involving the CIAG was a dedicated workshop dedicated to the discussion of project results and possible ways to boost their potential. The workshop and its results are described in section 5.5 of this documents as well as in the deliverables D7.9 (Kosmides et. al., 2023) and D7.10 (Zanella et. al., 2023).
- The EIMB monitored the emerging market trends and informed the consortium members, so that they could act accordingly. The most outstanding market trend during the project lifespan was the emergence of EuroNCAP testing protocol for ADAS systems, defining the recommended functionality testing and thresholds to be followed. The recommendations were immediately implemented into the project activities, which resulted in major update of the initially planned CPSoSAware DMS

application testing methodology (as described in the deliverable D6.1; Jaworski et al., 2020 and D6.4; Kasprzak et. al., 2021), and conducting the test according to the latest protocol (as described in the deliverable D6.5).

- CPSoSAware project consortium partners were involved in networking and clustering activities with other relevant H2020 project within the EC initiative called Horizon Results Booster. The initiative aims to bring a continual stream of innovation to the market and maximize the impact of public funded research within the EU. Within the initiative, CPSoSAware project partners had an occasion to cooperate with various H2020 project, including TEACHING, DIH4CPS, HiPEAC, SMART4ALL and ADEPTNESS. CPSoSAware project partners were also involved in the works related to the cooperation with OntoCommons, a project dedicated to the standardization of data documentation across all domains related to materials and manufacturing. The detailed description of the initiatives and activities in included in the deliverable D7.7 (Papachristopoulou, 2023). CPSoSAware EIMB members also participated in the EuroNCAP Occupant Status Monitoring Working Group meetings and works, providing a direct link between safety testing authorities and the CPSoSAware consortium.

## 5.4 Economic potential – Revenue streams

CPSoSaware project exploitation strategy includes market possibilities analysis and target end users identification (see: 4.3) as well as business models development for to-be-commercialized project outcomes covering potential revenue streams identification. Table 3 presents expected revenue streams after tools (components) release:

Table 3. List of CPSoSaware exploitable components/products' expected revenue streams.

| # | Component name | Developing partner | Revenue streams |
|---|---|---|---|
| 1 | Security Runtime Monitoring and Management (SRMM) | ATOS | • Consultancy services and training – cybersecurity and risk management<br>• Managed operation of cybersecurity and risk management technologies<br>• Additional engineering services – new features, customizations, integrations, support and maintenance |
| 2 | Homezone Perception Engine | PASEU | • Homezone Perception Engine module licensing<br>• Additional engineering services – new features, integrations, support and maintenance |
| 3 | MOZART Systems Orchestrator | 8BELLS | • Licensing<br>• Subscription fees – various service packages<br>• Additional engineering services – new features, integrations, support and maintenance costs |
| 4 | Driver State Monitoring | CTL | • Acquisition of DSM license for professional drivers<br>• Selling individual component to relevant technological institute (ADAS) |

| | | | |
|---|---|---|---|
| | | | • Advertisements space for affiliated companies within the DSM application<br>• Option to support the engineering endeavor by donation |
| 5 | CASPAR - Semantic Information Fusion Framework | CTL | • Asset sale<br>• License/subscription fees<br>• Generation of reports on-demand<br>• Framework customization on-demand<br>• Framework extension: Development of additional components (e.g., connectors, data integration) |
| 6 | V2X Simulator | RTC | • V2X simulation module licensing<br>• Additional engineering services – new features, integrations, support and maintenance |
| 7 | CPS connected Extended Reality System in HRC application | CRF | • Direct revenues:<br>  • Application design<br>  • Integration support for different plants/application<br>  • Reduction of training time<br>• Indirect H&S benefits:<br>  • Productivity increasing<br>  • Flexibility of workplace management<br>  • Continuous compliance to ergonomics standards and innovation |
| 8 | Posture and anthropometrics recognition | CRF | • Workers' wellbeing improvement at work<br>• Mitigation of risks and accidents<br>• Productivity increasing<br>• Flexibility of workplace management<br>• Continuous compliance to ergonomics standards and innovation |
| 9 | System for operator's state monitoring | CRF | • Workers' wellbeing improvement at work<br>• Mitigation of risks and accidents<br>• Reduction of costs for Non Value-Added Activities<br>• Reduction of costs for sickness and diseases and of absenteeism<br>• Productivity increasing<br>• Flexibility of workplace management<br>• Implement a correct internal job rotation<br>• Knowledge and competences keeping |
| 10 | Data Storage and Transformation Engine | IBM | • Subscribing to the service from IBM Cloud<br>• Purchasing storing space as part of using the service and storing the data |

| | | | |
|---|---|---|---|
| 11 | Cooperative Awareness System (CAS) | ISI | • Software as a Service to Tier II automotive sector<br>• Additional engineering services (new features, integrations, support and maintenance costs)<br>• Selling individual components to relevant technological institutes and industrial companies<br>• IPs |
| 12 | Quantum Resistant Hardware Security Token | ISI | • Consulting services<br>• Framework licenses<br>• Staff training<br>• Academic education services<br>• Engineering services<br>• Follow-on support & technical service |
| 13 | PoCL-Remote (TC2.2.2): Distributed Edge Offloading Software Runtime | TAU | • Reduced total cost for cyber physical systems<br>• More intelligent small form factor wireless products<br>• Support services provided for the software stack |

### 5.5 Economic potential – CIAG meeting

CPSoSaware project developed a series of components identified as interesting to reach the market. To sum up, thirteen comp.onents have been identified, all them being the subject of the current report. To further boost the process of reaching the market, Commercial Interest Advisory Group (CIAG) meeting was organized.

The CPSoSAware CIAG consists of nine members representing the industry, as well as leading industrial research organizations. The members of the CIAG group are:

- Prof. George Alexandropoulos, Assistant Professor, leader in NOESYS Research Group, in the Department of Informatics and Telecommunications, of National and Kapodistrian University of Athens (NKUA).
- Dr. Pouria Khodashenas, Principal Researcher 5.5G / 6G at Huawei | Green & Digital Transformation Specialist Industry 4.0 & CCAM / CA.
- Mr. Athanasios Athanasiadis, Athanasios has more than 5 years of experience in Automotive industry with responsibilities in the Automotive SW Test & Validation. During the past 2 years he has been working on an ADAS project Kenotom, where they develop software for embedded systems in the automotive sector.
- Prof. Dimitris Vrakas, Assistant Professor, Dept. of Informatics, Aristotle University of Thessaloniki, Greece.
- Dr. Mihai Marin-Perianu, managing director of Inertia. Inertia is specialized in the development of miniaturized wireless devices that can sense, process and communicate motion, vibration and orientation features of interest.
- Mr. Gian Paolo Gerio, Development Chapter Manager. Comau is a leading company in the industrial automation field, at a global level. Combining innovative engineering solutions with

easy to use, open automation and enabling technologies, Comau helps companies of all sizes – and across a wide range of industrial segments – leverage the full potential of digital manufacturing. Comau's competency stems from over 45 years of field proven-experience and a strong presence within every major industrial country.

- Prof. Bram Vanderborght, Vrije Universiteit Brussel, Faculty of Applied Sciences, Department of Mechanical Engineering. Robotics & Multibody Mechanics (R&MM).

The meeting was held in the form of online webinar on November, the 18th 2022. The meeting was devoted to the challenges of CPSoSAware components exploitation, standardization, and IPR issues. During the meeting, each component was briefly presented and then the discussion followed. On top of that, the CIAG members were given access to a dedicated survey, in which they could provide further comments. The survey also contained a series of standardization related questions. The standardization and IPR-related parts are described and presented in Deliverable 7.9 and 7.10 respectively.

After the presentation, each component was evaluated with regard to its market potential by the CIAG members (three members voted in the survey). The related question and the results are presented Figure 19.

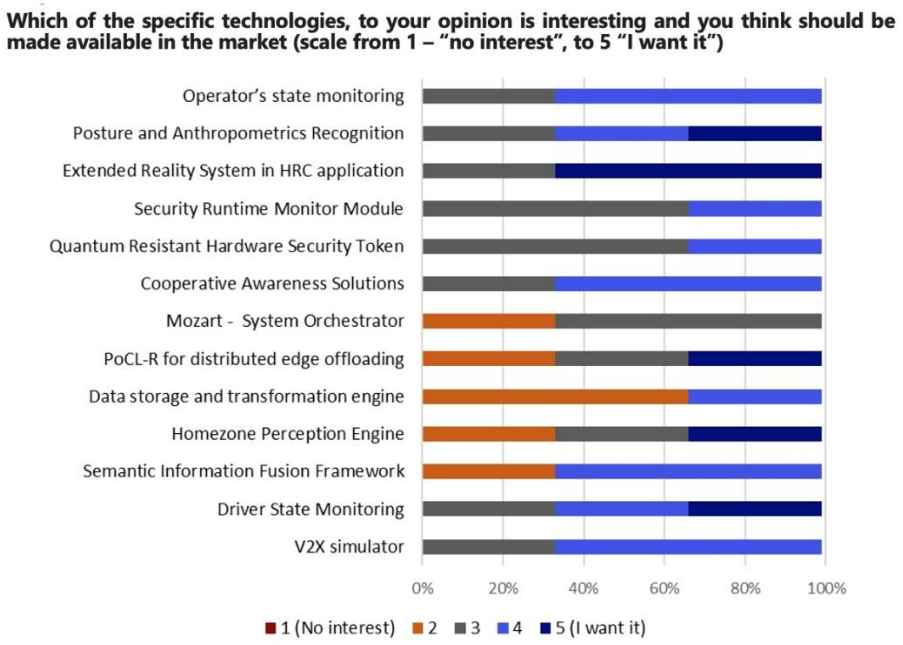


Figure 19. CIAG interest in the proposed CPSoSAware components.

Although some of the proposed components did not yet manage to gain high interest from the CIAG members, they were assessed to have market potential and the CIAG members proposed some further steps toward increasing the market interest volume. Table 4 provides the overview of the proposed steps to take the components developed within the CPSoSAware project further toward the market.

Table 4. Next steps to enhance market potential of CPSoSAware components as proposed by the CIAG members.

| | |
|---|---|
| V2X simulator | The solution can be used in other domains outside of automotive, e.g., safety scenarios in the industrial domains that might need this sort of situational awareness (human-robot interactions maybe?) |
| | The simulation models might be extended with other technologies of wireless communication in the future. |
| Cross-layer cognitive optimization tools & methods for the lifecycle of dependable CPSoS | The cooperative module for cooperative localization will be tested and implemented in a real environment with different vehicles transmitting their position with the cooperative localization approach in the following months or years. |
| | A combination of the information coming from PDI with this module inside of a car - that is processing data of the surrounding of the car – is a relevant step forward for the component. |
| Driver State Monitoring Android Application | Extension for Android Auto, which will require the use of an external camera or trying to commercialize this as a separate app on the market, both for Android and iOS phone owners will be useful to boost market potential. |
| Homezone Perception Engine | The next steps will be dealing with time synchronization between various on road vehicles and going beyond the Wi-Fi capture to start with, as the means of heading from the simulation level toward a real-life scenario. |
| PoCL-Remote (TC2.2.2): Distributed Edge Offloading Software Runtime | The quality of service negotiation mechanism between this protocol and transport means needs to be thought through. |
| | Open-source software is challenging to commercialize as such. Consultancy services for customizations/extensions/adaptations seem to be good options today. |
| MOZART Systems Orchestrator | It is planned to integrate the corresponding simulation standards in order to mitigate the complexity of the tools and to scale the process of configuration to take it up to the next level. |

| | | |
|---|---|---|
| | Scalability and ease of integration of other simulation tools or new versions of the existing simulation tools in the framework might be a potential take on further improvements. | |
| | The tool needs a more specific targeted business case definition to enable successful market entering. | |
| Quantum Resistant Hardware Security Token | The development seems relevant for any SoC-based technology that needs built-in, advanced security, so the business scenarios should not be limited to the automotive domain. The safety & security as well as the defense markets are prime examples. | |
| CPS connected Extended Reality System in HRC application | Overall the technologies were assessed to have a clear potential to help human operators to perform their tasks easier, better, and with fewer risks. | The approach of an external CPS network is used only for functional sensors, which are those that can be supporting the function and the operation of the operator but are not directly related to the safety of the operation. For safety, there are much tougher requirements not only as to latency but also reliability that need to be considered in order to take the component further |
| Posture and anthropometrics recognition | | |
| Operator's State Monitoring | | It needs to be considered, whether the solution could pose some issues with respect to privacy regulation. |

The recommendations and advices provided by the CIAG members will be implemented into the partner's plans on how to further improve the developed component and increase its' exploitation potential.

## 5.6 Economic potential – Business models

CPSoSaware project relies on a complex product concept, and within each of its parts a series of components are developed. For the purpose of project product exploitation, the components can be viewed as separate products. CPSoSaware exploitation planning and business models follow this approach thus referencing to each of the components developed as a separate standalone product. The business model canvas for each of the CPSoSaware components is attached in Annex A – Annex J.

The annexes include business model canvas for the following components:

Table 5. List of CPSoSaware exploitable components/products described with business model canvas.

| # | Component name | Developing partner | Business Model Canvas – annex reference | CPSoSaware Architectural Block[5] |
|---|---|---|---|---|
| 1 | Security Runtime Monitoring and Management (SRMM) | ATOS | Annex A | System Layer |
| 2 | Homezone Perception Engine | PASEU | Annex B | System Layer |
| 3 | MOZART Systems Orchestrator | 8BELLS | Annex C | System Layer |
| 4 | Driver State Monitoring | CTL | Annex D | CPS/CPHS Layer |
| 5 | CASPAR- Semantic Information Fusion Framework | CTL | Annex E | System Layer |
| 6 | V2X Simulator | RTC | Annex F | Simulation and Training Layer |
| 7 | CPS connected Extended Reality System in HRC application | CRF | Annex G | CPS/CPHS Layer |
| 8 | Posture and anthropometrics recognition | CRF | Annex H | CPS/CPHS Layer |
| 9 | System for operator's state monitoring | CRF | Annex I | CPS/CPHS Layer |
| 10 | Data Storage and Transformation Engine | IBM | Annex J | System Layer |
| 11 | Cooperative Awareness System (CAS) | ISI | Annex K | CPS/CPHS Layer |
| 12 | Quantum Resistant Hardware Security Token | ISI | Annex L | CPS/CPHS Layer |
| 13 | PoCL-Remote (TC2.2.2): Distributed Edge Offloading Software Runtime | TAU | Annex M | System Layer |

## 5.7 Economic potential – current market outreach

The consortium partners embarked on a mission of further increasing the project results exploitation beyond the project lifespan. To this end, they continue their efforts in the project's results communicating to the industrial, research, and academic world through the participation in workshops, conferences and events. The list of events and peer-reviewed journals, to which CPSoSAware partners' submissions are already accepted can be found in the deliverable D7.7 (Papachristopoulou, 2023).

Consortium partners are also in contact with wolfSSL community focused on providing lightweight and embedded security solutions with an emphasis on speed, size, portability, features, and standards compliance.

[5] Reference to CPSoSaware architectural blocks as defined in deliverable D1.3. (Kosmides & Adamopoulou, 2020)

The wolfSSL products are successfully used in both open source and commercial projects, among others, many types of network applications and devices, including smart devices on automobiles, IP phones, mobile phones, routers, printers, and credit card scanners.

CPSoSAware also is in touch with the Autoware Foundation. The Autoware Foundation is a non-profit organization supporting open-source projects enabling self-driving mobility. Autoware is the world's leading open-source software project for autonomous driving. Autoware is built on Robot Operating System (ROS) and enables commercial deployment of autonomous driving in a broad range of vehicles and applications. The CPSoSAware V2X simulation is on its way to be used within the Autoware framework.

## 5.8 Exploitation potential – beyond commercial use

CPSoSAware project produced not only a set of components, but also a vast amount of knowledge and methods, all of which have identified exploitation potential not only in terms of commercialization and market outreach, but also in terms of further advancement of the development of human-oriented HMIs. The consortium partners aim at spreading the idea and enabling advancement in the area outside the project consortium and timespan. To this end, certain steps were taken, especially led by the consortium research and academic partners with the support of all consortium partners.

To achieve this goal, consortium partners were taking part in numerous conferences, workshops and events, as well as published numerous peer reviewed papers. These activities significantly enhance the project products visibility and awareness outside of the consortium. The list and relevant information on the activities which already took place, as well as those that are planned to happen in the nearest future can be found in the deliverable D7.7 (Papachristopoulou, 2023).

Another way, in which project products are exploited is the open source sharing of the databases collected within the project. The data can useful for both research and industrial entities, which in turn increases awareness of CPSoSAware products in general and can result in further interest in the proposed solutions. The project datasets can be accessed through such platforms as Zendo, GitHub, Keggle, or IEEE dataport. The datasets' descriptions together with relevant links can be found in the deliverable D7.7 (Papachristopoulou, 2023).

The project products are also planned to be exploited for further research towards continuous improvement in the field of human oriented HMIs and their safety in the context of automotive, manufacturing and beyond, as well as for academic and teaching purposes. This part of the exploitation is most strongly supported by the research and academic members of the consortium. Educational orientation of the consortium partners with the use of project data and outcomes already results in several academic publications, i.e. master and doctoral theses. The list of these works can be found in the deliverable D.7.

# 6 Conclusions

The CPSoSAware project developed thirteen components primarily oriented toward the automotive and manufacturing industry with a common theme of the leading role of human-robot interaction and its safety. The products form a unique cyber phisical system when threated jointly, but also offer a range of functionalities as separate products. Each of them has its own exploitation potential as a means of potential benefits for targeted customers. The exploitation plan of the CPSoSaware project provides an initial assessment of the components developed in the project with regard to their market and commercial potential. In this document, forecasts of economic potential and revenue streams as well as target end users were introduced. The document also includes business model for each of the modules developed within the project, as well as initial thoughts on the potential next steps toward increasing the current market potential of the considered components.

At the time this report is being issued, all the consortium partners are still making intensive efforts towards the project's results exploitation. Consequently, the list of exploitation activities presented within this report shall be considered initial and is expected to grow significantly within the upcoming months and years providing through exploitation of project's efforts and direct translation of its results into living market and research products laying ground for further innovations.

The activities planned to take place after the end of the project encompass the whole range of exploitation related activities, including further project results dissemination ad well as ongoing market outreach. The foreseen exploitation, is planned to take place both directly through the consortium partners' activities, as well as indirectly via the use of CPSoSAware results for teaching and for advancing next innovations by third party stakeholders. To enhance the later type of exploitation, the open source results dissemination was approached.

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# Annex A
# Security Runtime Monitoring and Management (SRMM)
# Business Model Canvas

**Component:**
*Security Runtime Monitoring and Management (SRMM)*

**Partner:**
*ATOS*

**Key partners:**
- *CPSoS consortium members*
- *Technical Universities working on communication technologies*
- *Cybersecurity-intensive companies for 3rd party integrations*
- *Industrial partners for piloting activities*

**Key activities:**
- *R&D: Enhancement of existing technologies for security runtime monitoring and detection of cyber-physical threats*
- *Customization, integration, deployment and operation of security monitoring and management infrastructure*
- *Marketing and sales*

**Key resources:**
- *Human capital: engineering and R&D team, consultants and sales specialists with multi-vertical vision, as well as technology experts*
- *Sales and distribution channels*
- *Intellectual Property Rights to developed modules*

**Value propositions:**
- *Security runtime monitoring of cyber-physical threats*
- *Automatic cybersecurity attacks detection*
- *Runtime monitoring of Security KPIs*
- *Monitoring and analysis tools to active protection and reaction to cyber critical infrastructures*
- *Possibility to have lightweight versions for constrained systems with autonomous detection capabilities*
- *Delivery with pre-configured detection rules*
- *Distributed detection capabilities*
- *Multi-segment application: Incident Response, Managed Detection and Response and Extended Detection and Response*
- *Possibility of using it at CPS (IoT) and CPSoS (Edge and Cloud) levels*

**Customer relationships:**
- *Oriented towards specific customer needs*
- *Personal face to face meetings*
- *Online meetings and presentations*

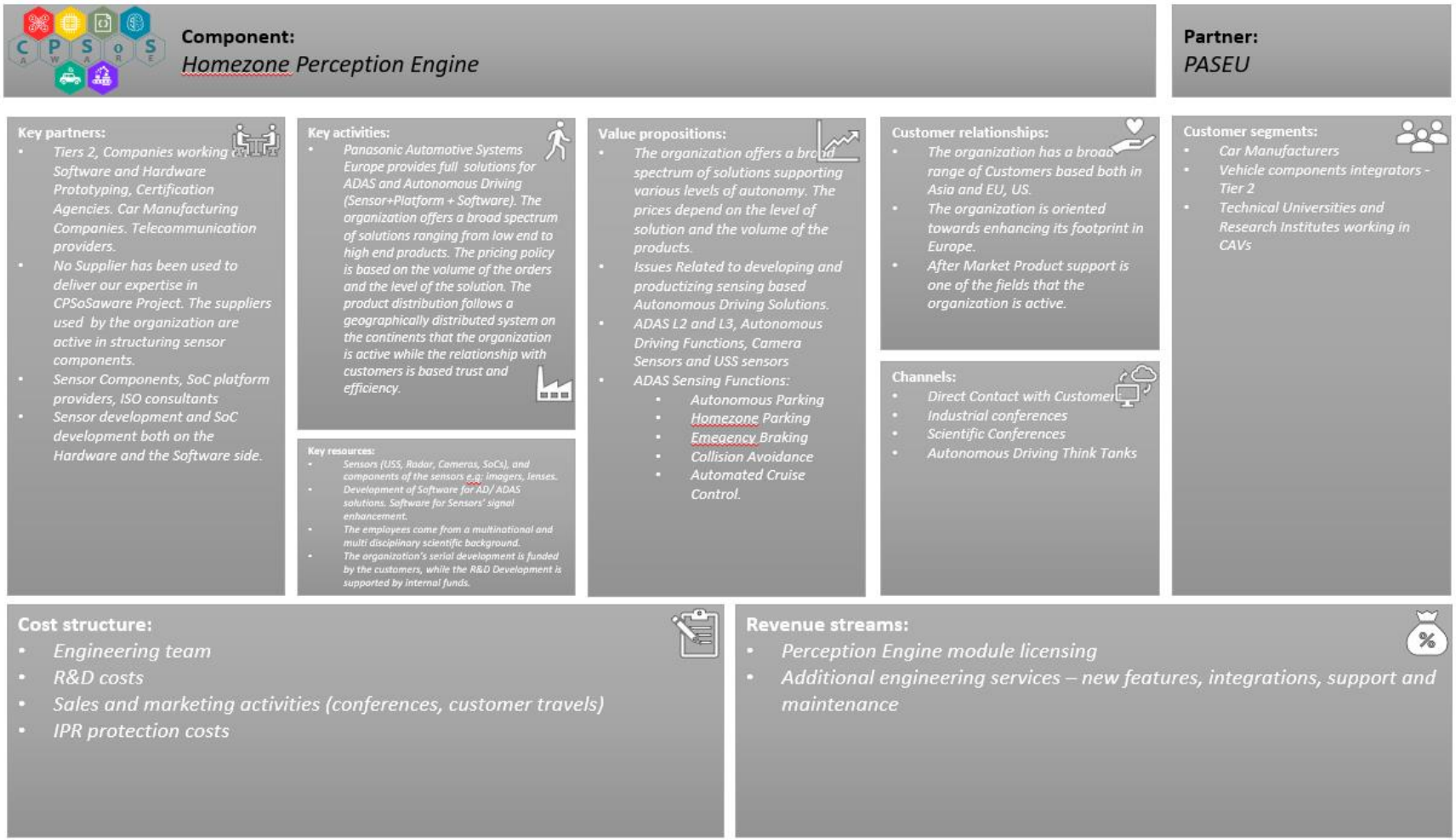
**Channels:**
- *Direct contact with customers through the Atos sales team, to promote the adoption of innovative solutions and emerging technologies*
- *Atos Research & Innovation department serves as the catalyst for innovation, through the different Units, through robust partnerships like the one with Siemens, through start-ups*

**Customer segments:**
- *Large companies with special focus on Vehicle components integrators – both Tiers 1 and 2*
- *SMEs*
- *Technical Universities and Research Institutes working in cyber-physical security and risk management*

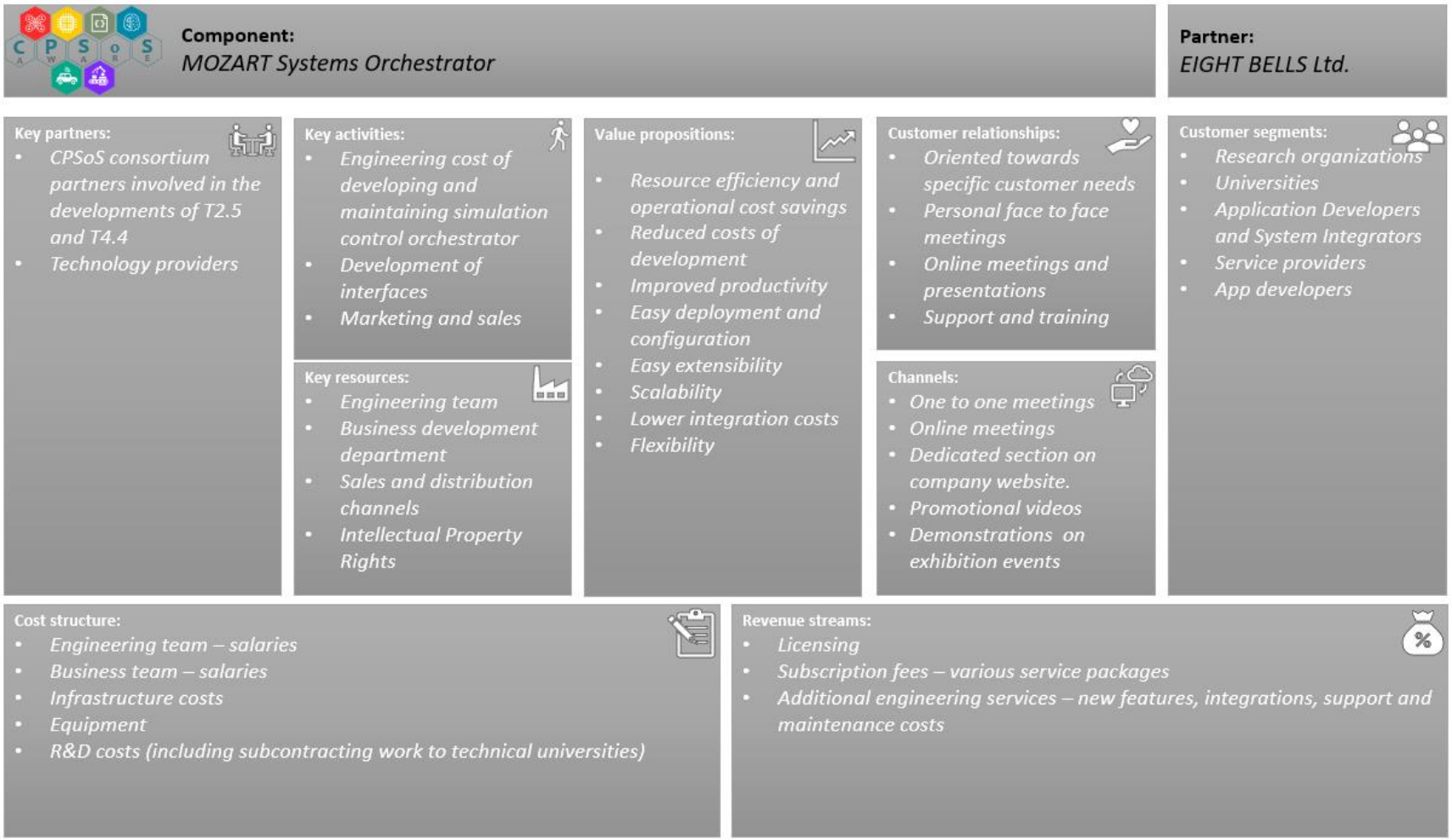
**Cost structure:**
- *Engineering team (customization, deployment/integration, operation, maintenance & support)*
- *R&D costs (development of new features and improvements)*
- *Consultancy and training activities*
- *Sales and marketing activities (conferences, customer travels)*

**Revenue streams:**
- *Consultancy services and training – cybersecurity and risk management*
- *Managed operation of cybersecurity and risk management technologies*
- *Additional engineering services – new features, customizations, integrations, support and maintenance*

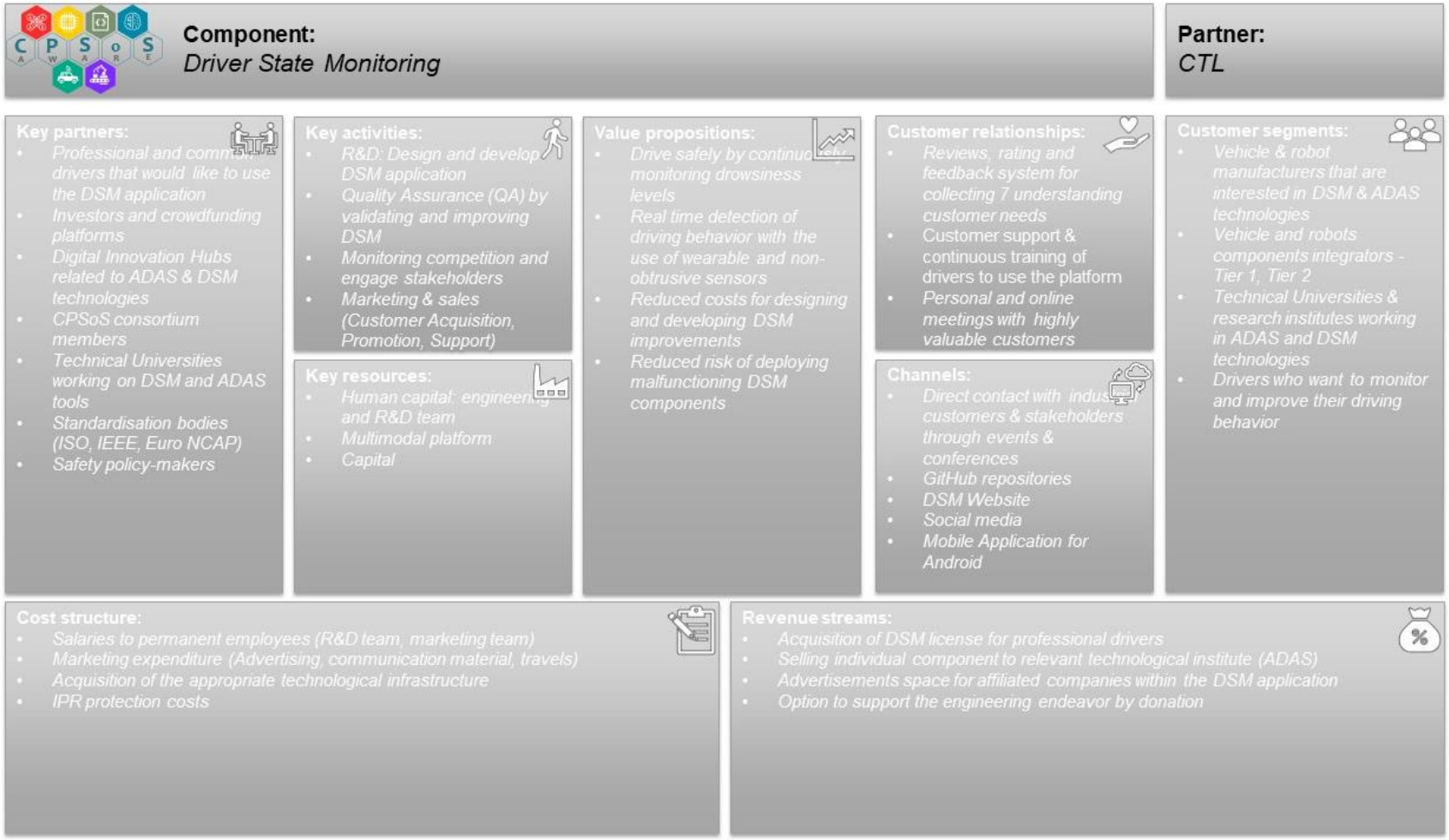
# Annex B
# Homezone Perception Engine
# Business Model Canvas



# Annex C
# MOZART - Systems orchestrator
# Business Model Canvas



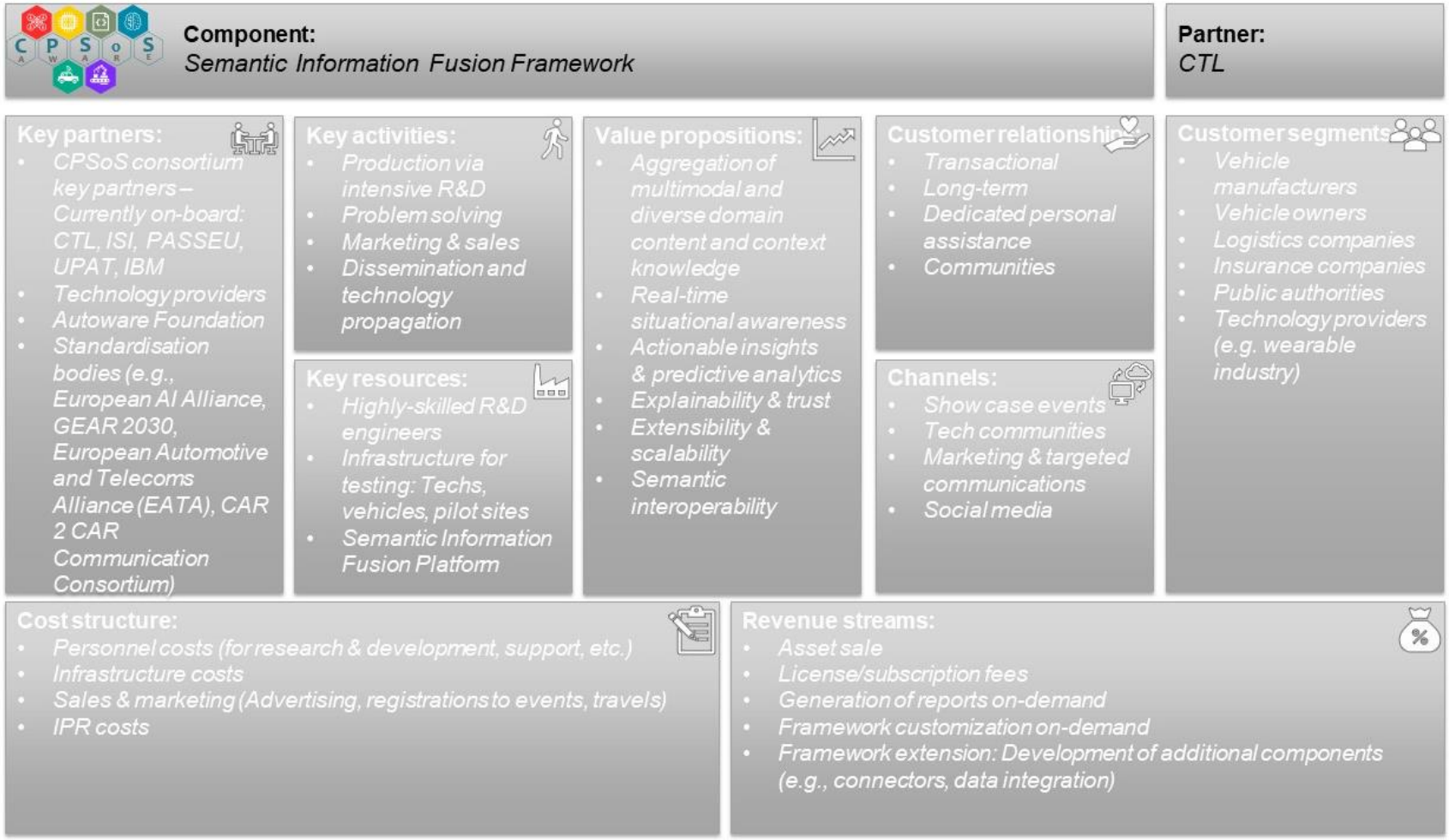
# Annex D
# Driver State Monitoring
# Business Model Canvas



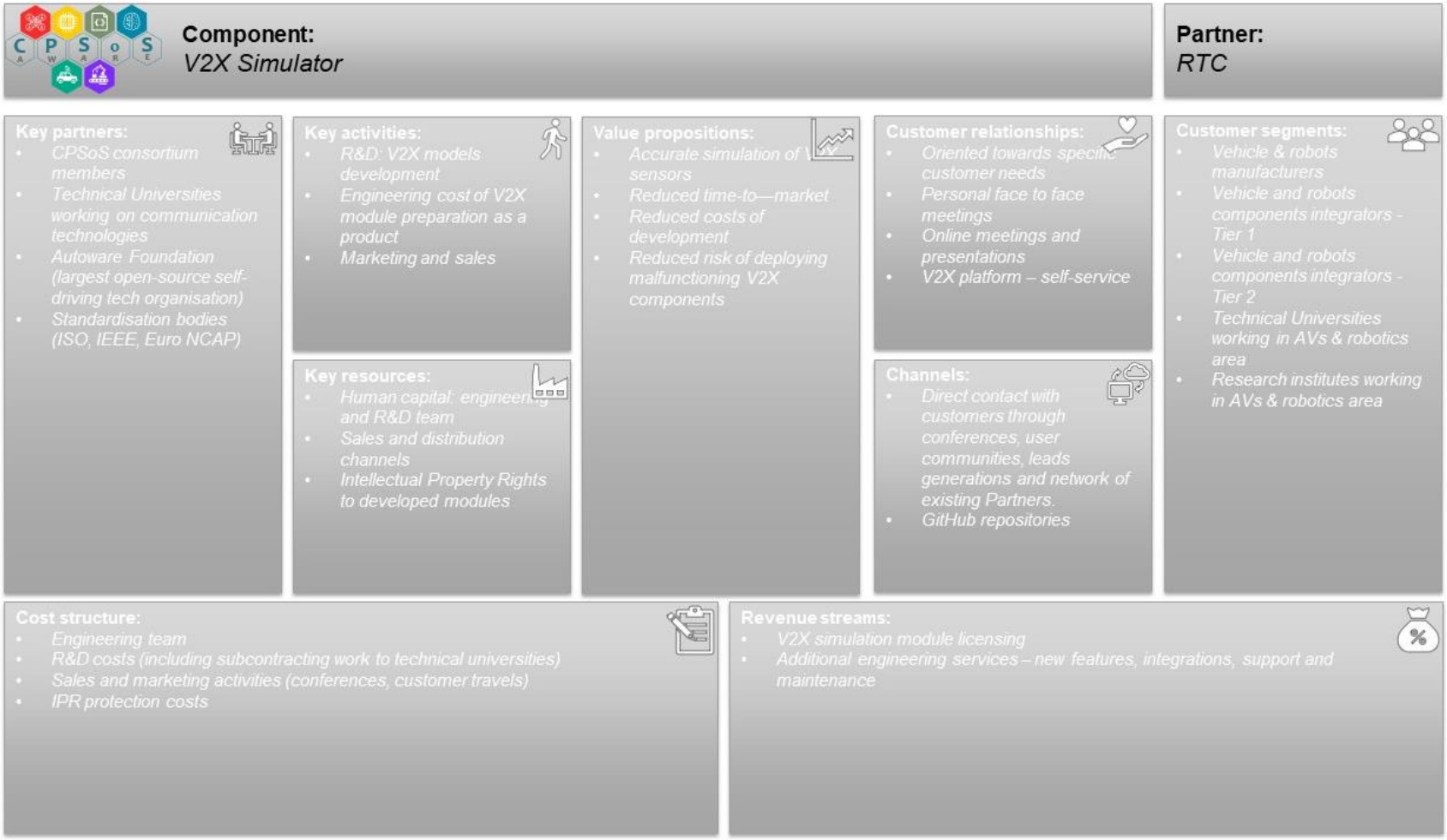
Annex E

CASPAR - Semantic Information Fusion Framework

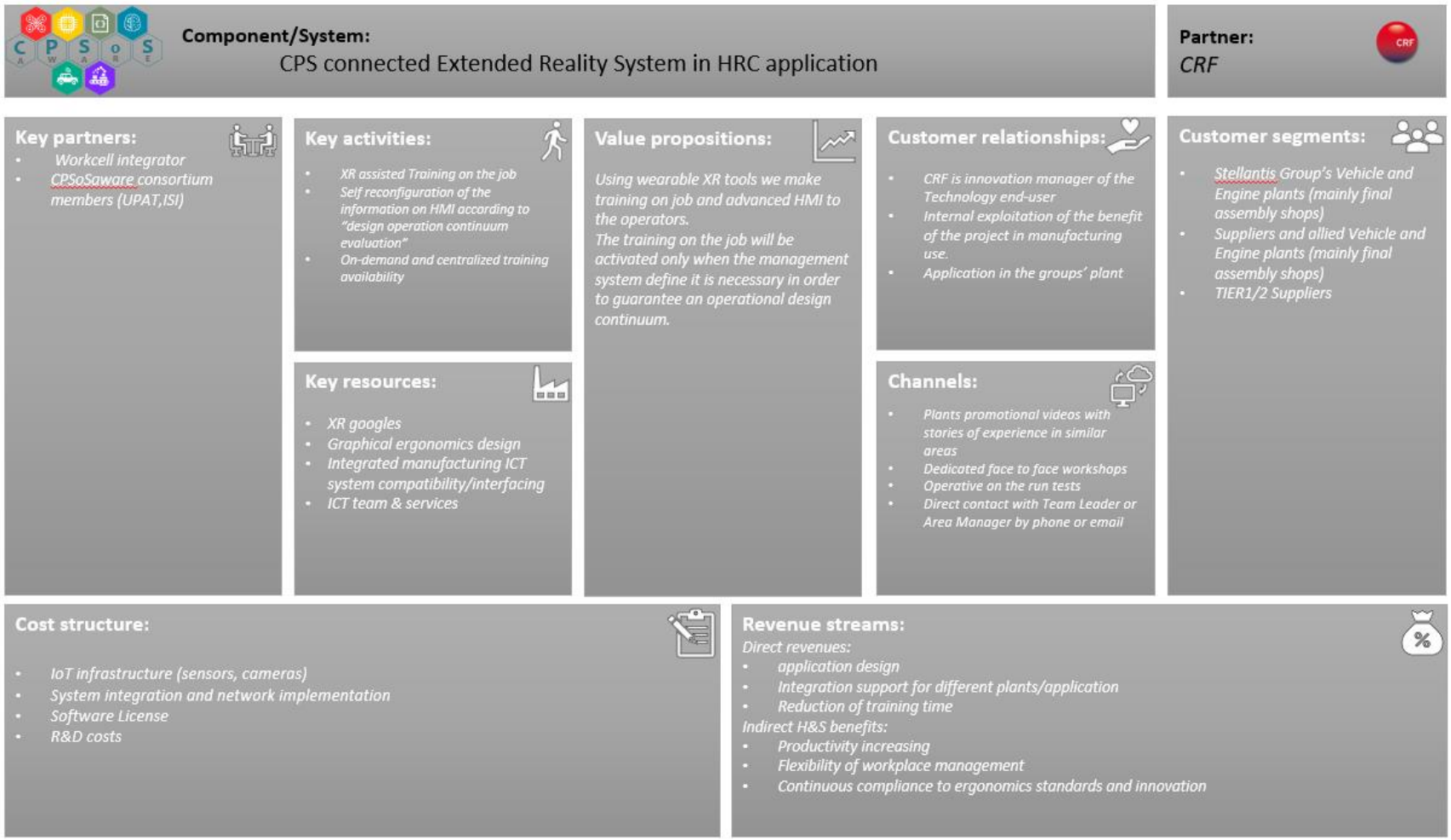
Business Model Canvas



# Annex F
# V2X Simulator
# Business Model Canvas



# Annex G
# CPS connected Extended Reality System in HRC application
# Business Model Canvas



# Annex H
# Posture and anthropometrics recognition
# Business Model Canvas

**Component/System:**
*Posture and anthropometrics recognition*

**Partner:**
*CRF*

**Key partners:**
- *Vision system developed/integrator*
- *Workcell integrator*
- *Standardization bodies (e.g. ISO)*
- *CPSoSaware consortium members (UPAT,ISI)*

**Key activities:**
- *Operator's reliable anthropometric recognition*
- *Data & Privacy management system*
- *Workplace organization (for cameras placement-blind spot avoidance)*
- *Video system integration*

**Key resources:**
- *Cameras and vision system*
- *Actively adjustable workplace (e.g robot…)*
- *Integrated manufacturing ICT system compatibility/interfacing*
- *Standard and legal conformity*
- *ICT team & services*

**Value propositions:**
- *Vision system for the detection of operator's anthropometrics parameter in order to perform a proactive ergonomics optimization of the equipment*

**Customer relationships:**
- *CRF is innovation manager of the Technology end-user*
- *Internal exploitation of the benefit of the project in manufacturing use.*
- *Application in the groups' plant*

**Channels:**
- *Plants promotional videos with stories of experience in similar areas*
- *Dedicated workshops face to face*
- *Direct contact with Team Leader or Area Manager by phone or email*

**Customer segments:**
- *Stellantis Group's Vehicle and Engine plants (mainly final assembly shops)*
- *Suppliers and allied Vehicle and Engine plants (mainly final assembly shops)*
- *TIER1/2 Suppliers*

**Cost structure:**
- *IoT infrastructure (sensors, cameras)*
- *System integration and network implementation*
- *Software License*
- *R&D costs*

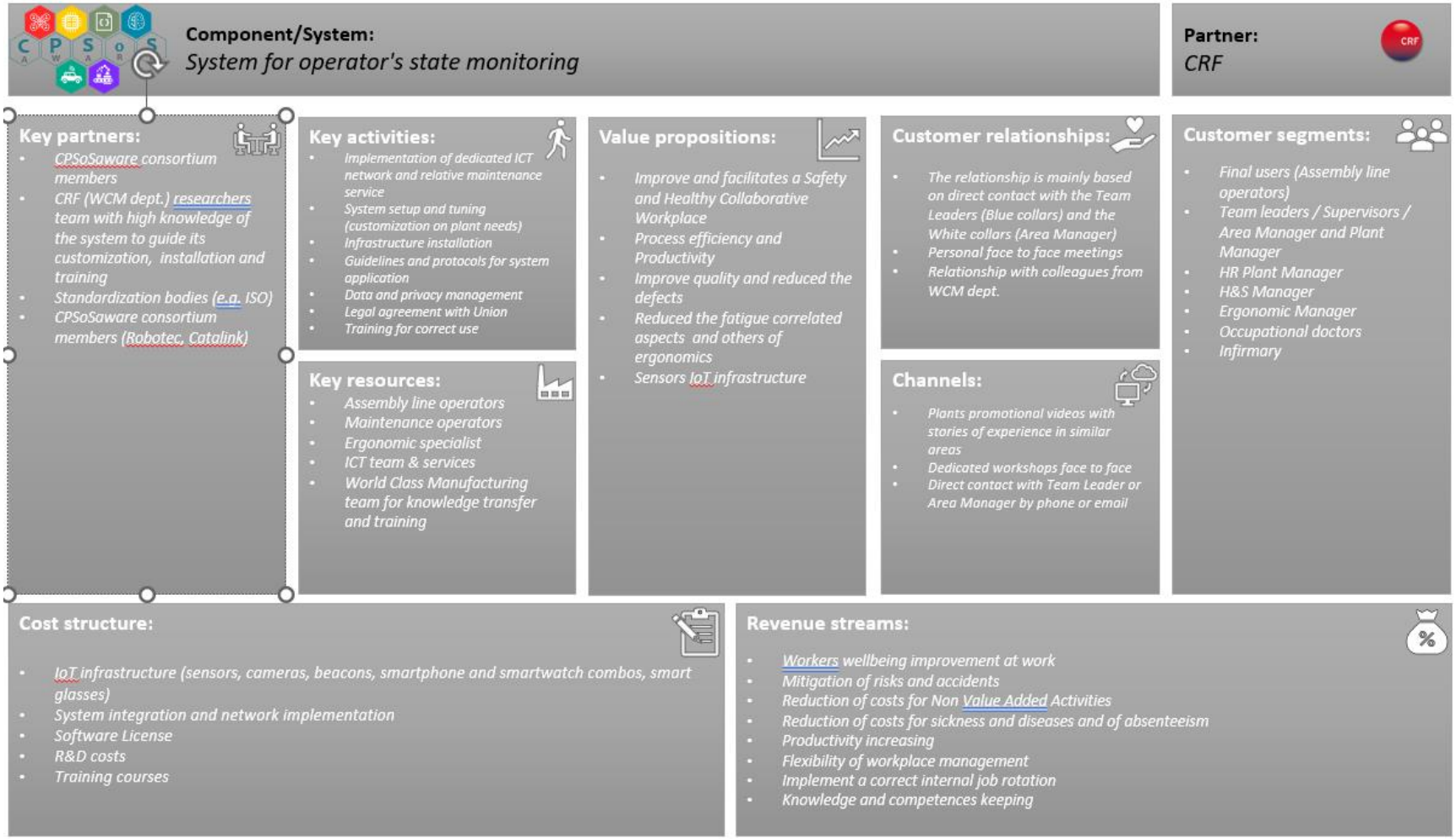
**Revenue streams:**

*Indirect H&S benefits:*
- *Workers' wellbeing improvement at work*
- *Mitigation of risks and accidents*
- *Productivity increasing*
- *Flexibility of workplace management*
- *Continuous compliance to ergonomics standards and innovation*

Annex I

System for operator's state monitoring

Business Model Canvas



# Annex J
# Data Storage and Transformation Engine
# Business Model Canvas

**Component:**
*Data Storage and Transformation Engine*

**Partner:**
*IBM*

**Key partners:**
- *CPSoS consortium members*
- *Costumers with the need for storing data arriving from the variety of sources and sensors in different fornats and /or transform the data between different formats*
- *Collaborations between companies that should manage a shared data storage*

**Key activities:**
- *R&D: Integrate the system with the IBM cloud*
- *Offer our system as SaaS in IBM Cloud*

**Key resources:**
- *Access to SQL Database*
- *Engineering team for deploying the system over the cloud*

**Value propositions:**
- *Adaptable Data storage infrastructure*
- *Suits for storing a variety of data schemes with easy data transfornation*
- *Can be used simultaneously by multiple end-users to upload, transforn and share their data*
- *Hierarchic modulization allows the viewing and storing of only relevant and informal data*

**Customer relationships:**
- *The service could be purchased as one of the services offered by IBM Cloud*
- *Documentation describing the service and usage cases*

**Channels:**
- *The service could be purchased as one of the services offered by IBM cloud*

**Customer segments:**
- *Open the service to IBM cloud clients*
- *Recording message exchange flow between digital parts of a digital system*
- *Suggest the service for bug detecting or AI forecasts of experiments and technological processes involving multiple data sources and data schemes.*

**Cost structure:**
- *The cost of the SQL data storage*
- *As the client ask for more data to store, the payment should be higher*

**Revenue streams:**
- *Subscribing to the service from IBM Cloud*
- *Purchasing storing space as part of using the service and storing the data.*

# Annex K
# Cooperative Awareness System (CAS)
# Business Model Canvas

**Component:**
*Cooperative Awareness System (CAS)*

**Partner:**
*ISI*

**Key partners:**
- *Tier II automotive*
- *CONTINENTAL*
- *Companies working on hardware prototyping*
- *Car manufacturing companies*
- *Investors and crowdfunding platforms*
- *Technical universities*
- *Standardization bodies (ISO, IEEE, EuroNCAP)*
- *Autoware Foundation*
- *Safety Policy Makers*

**Key activities:**
- *Development of new algorithms*
- *Design and develop solutions for ADAS and autonomous driving and engage stakeholders*
- *Sales and marketing*

**Key resources:**
- *Test vehicles*
- *Simulators and test equipment*
- *Engineering team*
- *Semsors*
- *Development of software for AD/ADAS solutions. Software for sensors signals enhancement*

**Value propositions:**
- *We provide a broad spectrum of solutions supporting various level of autonomy*
- *Issues related to developing sensing solutions*
- *Non GPS based navigation*
- *Efficient scene analysis*
- *Drive safely by continuous monitoring of the driver's state*
- *Cooperative Energy-efficient localization and motion planning for connected vehicles*

**Customer relationships:**
- *Training sessions*
- *End-user support*
- *Personal face to face meetings*
- *Online meetings and presentations*

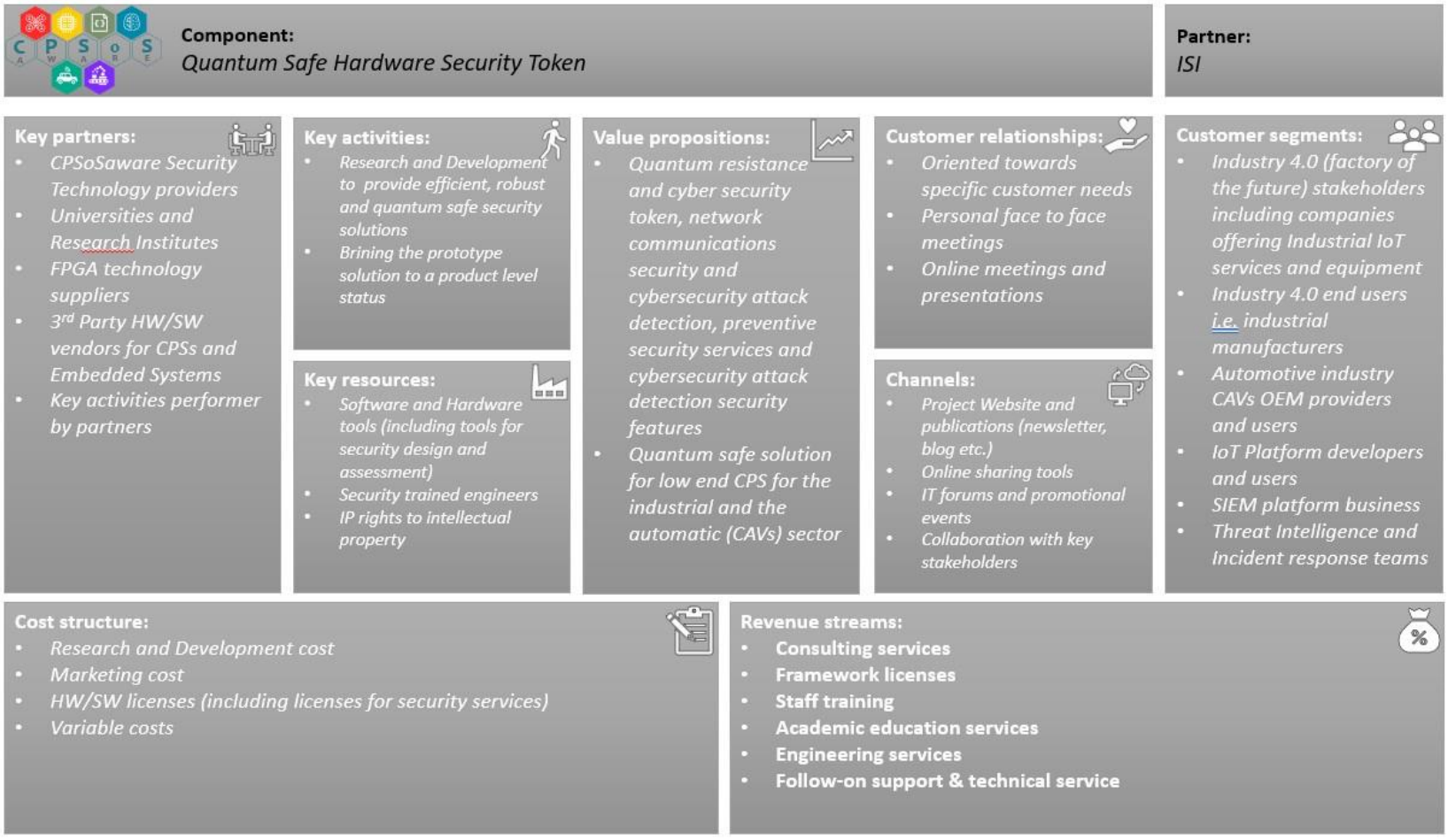
**Channels:**
- *Partner industrial sale netw*
- *Academic Network*
- *Direct contact with consumers*
- *Github repositories*
- *Promotional videos*
- *Demonstration on exhibition events like industrial and scientific conferences*

**Customer segments:**
- *Authorities:*
  - *Regional governments*
  - *Vehicle sharing companies*
- *Transport operators*
- *End users*
- *Facilitators*
- *Vehicle manufacturers*
- *Technology providers (e.g., wearable industry)*
- *Application developers and system integrators*
- *Technical universities and research institutes*

**Cost structure:**
- *Platform maintenance*
- *Engineering team*
- *Research and development costs*
- *Infrastructure and equipment costs*
- *Sales and marketing activities (e.g., conferences, travels)*
- *IPR protection*

**Revenue streams:**
- *Software as a Service to Tier II automotive sector*
- *Additional engineering services (new features, integrations, support and maintenance costs)*
- *Selling individual components to relevant technological institutes and industrial companies*
- *IPs*

# Annex L
# Quantum Resistant Hardware Security Token
# Business Model Canvas



# Annex M
# PoCL-Remote (TC2.2.2): Distributed Edge Offloading Software Runtime
# Business Model Canvas