D 7.3 – PRELIMINARY VERSION OF EXPLOITATION REPORT AND CPSOSAWARE BUSINESS MODELS

Authors	Anna Olejniczak-Serowiec (RTC), Anna Stróż (RTC), Adam Dąbrowski (RTC), Wojciech Jaworski (RTC), Alessandro Zanella (CRF), Allesandro Cacciatore (CRF), Petros Kapsalas (PASEU), Beatriz Gallego-Nicasio Crespo (ATOS), Neofytos Gerosavva (8BELLS), Efstratios Kontopoulos (CTL)
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 exploitation plan of the project is designed and will be updated within this task based on the partners' activities throughout the duration of the project. Main focus is put on the analysis of the business potential and market analysis. A suitable licensing strategy will be identified for each component. Factors that affect the decision to release individual tools are mainly related to the integration needs of the framework.

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Deliverable Information

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Project Information

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Project Coordinator	Industrial Systems Institute, ATHENA Research and Innovation Center 26504, Rio-Patras, Greece
Partners	1. ATHINA-EREVNITIKO KENTRO KAINOTOMIAS STIS TECHNOLOGIES TIS PLIROFORIAS, TON EPIKOINONION KAI TIS GNOSIS (ISI) - Coordinator 2. FUNDACIO PRIVADA I2CAT, INTERNET I INNOVACIO DIGITAL A CATALUNYA (I2CAT) 3. IBM ISRAEL - SCIENCE AND TECHNOLOGY LTD (IBM ISRAEL) 4. ATOS SPAIN SA (ATOS) 5. PANASONIC AUTOMOTIVE SYSTEMS EUROPE GMBH (PASEU) 6. EIGHT BELLS LTD (8BELLS) 7. UNIVERSITA DELLA SVIZZERA ITALIANA (USI) 8. TAMPEREEN KORKEAKOULUSAATIO SR (TAU) 9. UNIVERSITY OF PELOPONNESE (UoP) 10. CATALINK LIMITED (CATALINK) 11. ROBOTEC.AI SPOLKA Z OGRANICZONA ODPOWIEDZIALNOSCIA (RTC) 12. CENTRO RICERCHE FIAT SCPA (CRF) 13. PANEPISTIMIO PATRON (UPAT)
Website	www.cpsosaware.eu

Control Sheet

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	NAME
Prepared by	RTC
Reviewed by	TAU, ISI
Authorised by	RTC

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List of abbreviations

ADAS	Advanced Driver Assistance Systems
AD	Autonomous Driving
AOSS	Automotive Occupant Sensing System
AV	Autonomous Vehicles
CAGR	Compound Annual Growth Rate
CNCF	Cloud Native Computing Foundation
cobots	collaborative robots
DMS	Driver Monitoring System
ECU	Electronic Control Units
EIMB	Exploitation and Innovation Management Board
EU-OSHA	European Agency for Safety and Health at Work
GNP	Gross National Product
HiL	Hardware-in-the-Loop
HRC	Human-Robot Collaboration
IaaS	Infrastructure-as-a-Service
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
SOC	Security Operations Center
UBI	Usage-Based Insurance
USM	Unified Security Management
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
V2X	Vehicle-to-Everything
WRULD	Work-Related Upper-Limb Musculoskeletal Disorders

1 Introduction

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

The following parts of the report provide overview of the exploitation team and activities, market analysis in terms of commercial and economic potential of the project, product concept and exploitation plan including 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 for 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)	I

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

3 Exploitation activities M1-M18

Exploitation-related activities of the CPSoSaware project in the first half of the project duration concentrated around the definition of the project product concept and preparation of the exploitation framework as a basis for the future project product exploitation activities.

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

- Market analysis including the analysis of market potential and the project product economic potential,
- Potential target end users identification,
- Potential competitors identification,
- Innovation management process definition and project Exploitation and Innovation Management Board appointment,
- Identification of the project products/components with the highest exploitability potential,
- 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 most effective project results 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 D7.1.

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 manufactures. 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, perception engine, provision of services referring to simulation orchestration, containerization, environment setup, driver state monitoring, semantic information fusion framework, V2X simulator, collaborative robotic cell for windshield preparation, posture and anthropometrics recognition, extended reality system with multimodal sensing, and a system for operator's state monitoring.

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.

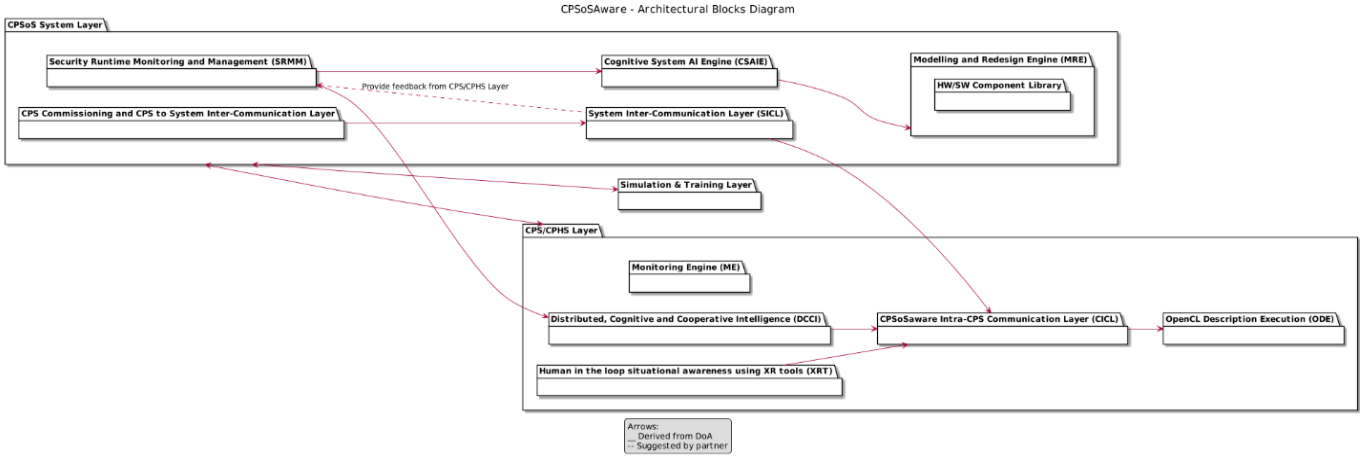

Figure 1. UML diagram - Architectural blocks and sub-blocks Source: Kosmides & Adamopoulou (2020).

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.

For the automotive components, the main areas of interests in market potential analysis are software components, electrical and electronic components, automated vehicles, automotive sensors, vehicle control units, driver monitoring systems, automotive occupant sensing systems, and connected vehicles. Market and economic potential analysis presented below, refers to these areas of interest.

Several development aspects of CPSoSaware components are tested by CRF, who 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.

4.2.1 Market and economic potential analysis in automotive pillar

In the report from McKinsey & Company (Burkacky, Deichmann, & Stein, 2019), a detailed quantitative market analysis was described, with respect to specific domains of automotive market. Two main automotive areas of interest were distinguished – software components and electrical and electronic components. As authors noted in the first paragraph, various submarkets in Automotive are “mutually reinforcing developments”. In the report, 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 is 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 are going to grow with expected CAGR of: 9% for software components; 10% for integration, verification and validation services; 5% for electronic control units/ domain control unit s and 8% for sensors (see Figure 2).

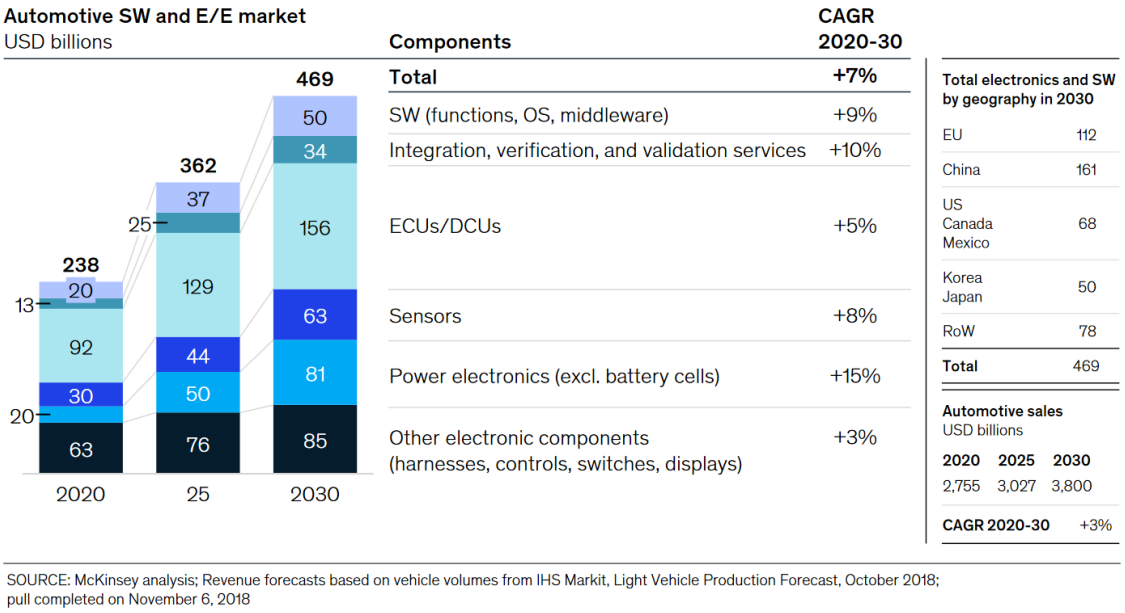

Figure 2. A graphical overview of Automotive submarkets' sizes forecasts for 2020-2030. Source: Burkacky et al. (2019).

For the autonomous/driverless car market, estimates were provided e.g., in Market Overview section of *Autonomous/Driverless Car Market – Growth, Trends, Covid-19 Impact, and Forecasts (2021-2026)* (Mordor Intelligence, 2021) with the valuation of USD 19.46 billion in 2020 and expected growth of 18.06% CAGR in the period 2021-2026.

Authors of McKinsey & Company report (Burkacky et al., 2019) noted that cars from different segments (such as robotaxis vs. premium brands) may differ with respect to the incorporation of certain technological solutions. It seems understandable, as cars with higher automation levels will need more sensors, and presumably more advanced software to integrate the levels of information processing and action. According to the estimates from Burkacky et al. (2019), production of SAE AV Level 3 vehicles will reach 10 million in 2030, while for SAE AV Levels 4 and 5 about 5 million is estimated.

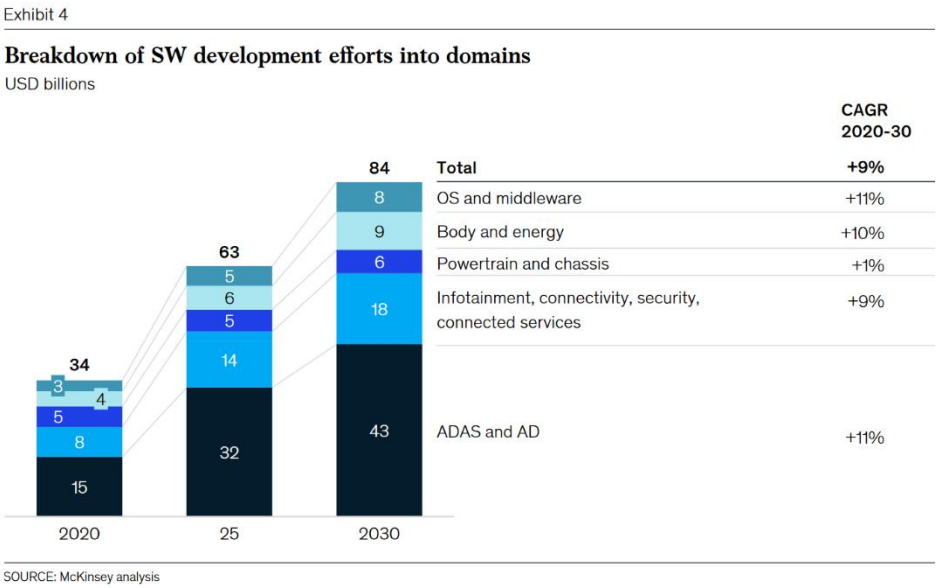

Figure 3. An overview for automotive software subdomains' market estimations. Source: Burkacky et al. (2019).

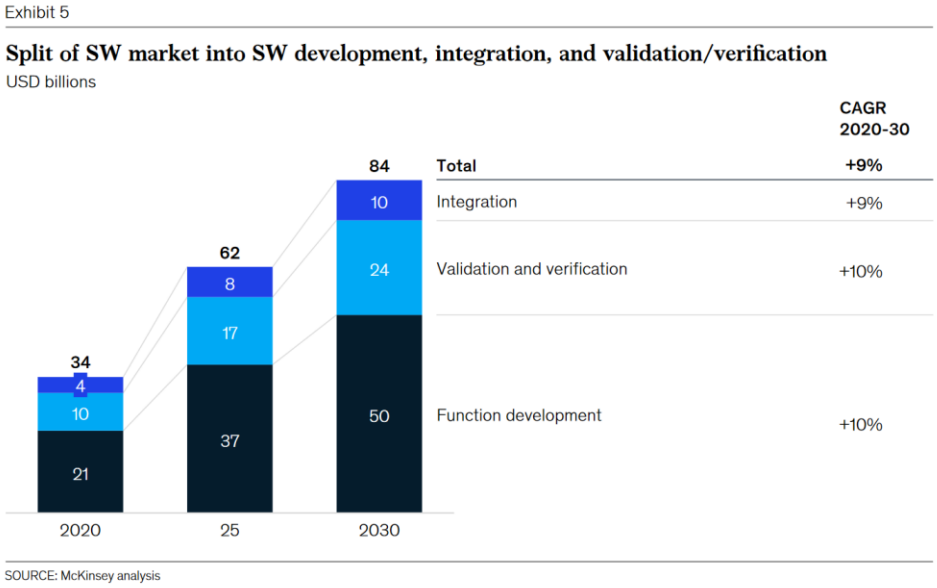

Figure 4. An overview for automotive software-related services market estimations. Source: Burkacky et al. (2019).

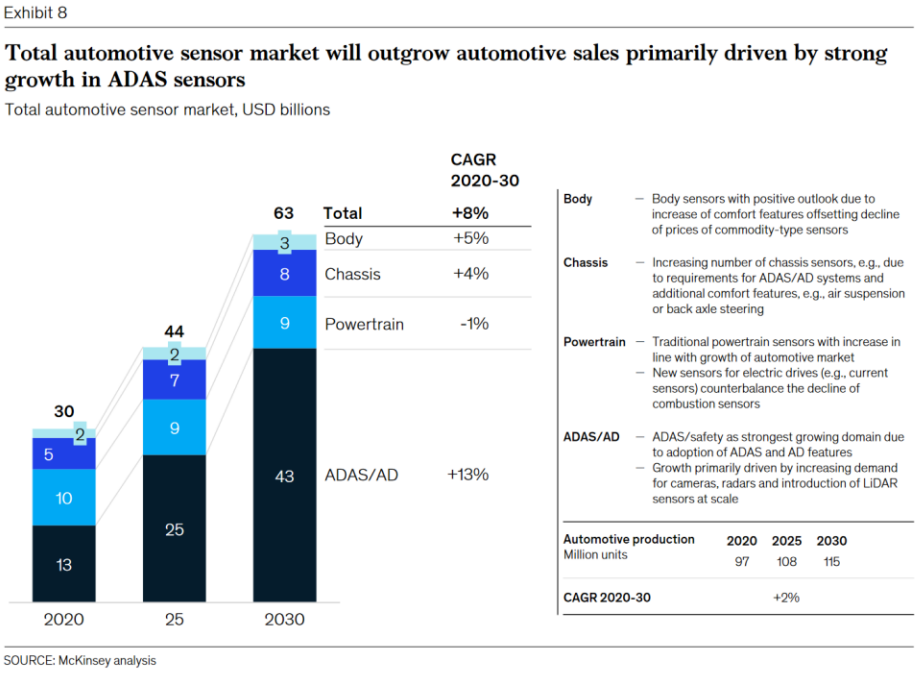

Figure 5. An overview for automotive sensors subdomains' market estimations. Source: Burkacky et al. (2019).

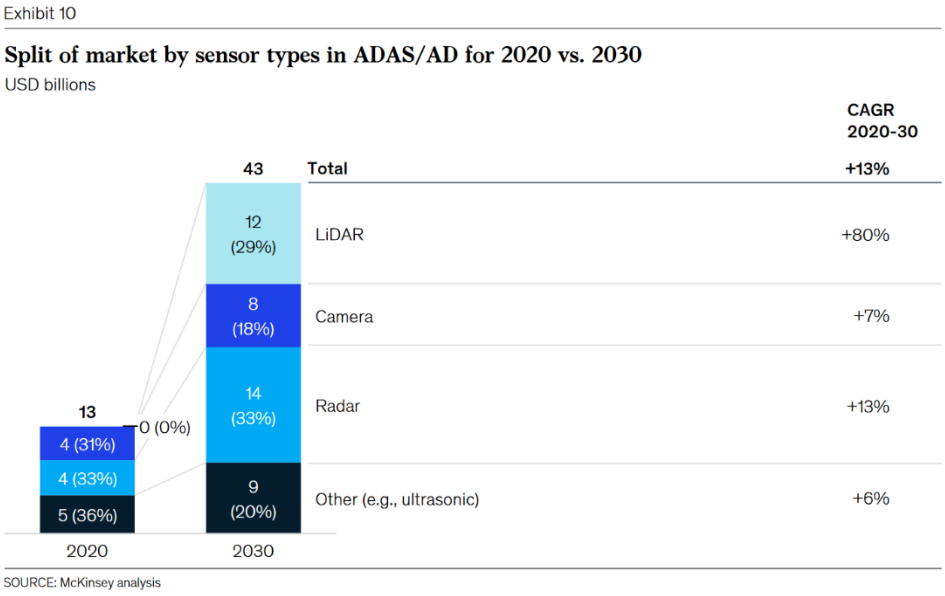

Figure 6. An overview for automotive sensor types' market estimations. Source: Burkacky et al. (2019).

For control units (both electronic control unit and domain control unit), it is expected that the market will grow at a CAGR of 5% to about USD 156 billion in 2030. For ADAS/AD sensors, a close-up was provided with relation to the most popular types of sensors. On Figure 6, a split of market and estimation

of growth is provided. The largest CAGR forecast is for LiDAR sensors, with 80% in the period 2020-2030 (Burkacky et al., 2019).

Yet another market to be considered is Connected Vehicle 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 (2020) analysis (25.2% CAGR), with the estimations of USD 53.9 billion for 2020 and USD 166.0 billion by 2025.

The ADAS Market (advanced driver assistance system) is estimated to be USD 30.0 billion in 2019 and is projected to reach USD 134.9 billion by 2027 (Markets and Markets, 2019). Other estimates for the ADAS market, in Markets and Markets (2020a) analysis a projection of growth was estimated as from USD 27.0 billion in 2020 to USD 83.0 billion by 2030 (11.9% CAGR). Another estimation was presented in Global Market Insights (2020), with USD 35 billion ADAS market size in 2019 and an estimation for 2026 of USD 60 billion (2020-2026 CAGR: 10%). Such a dynamic evolution of the automotive market is connected to the ongoing transport automation processes and emerging safety-related issues, which in turn result in numerous requirements and regulations to be met by automotive industry. When Euro NCAP urged automakers to include driver monitoring systems in vehicles (starting from 2020), the size of the market started growing. In analogous situation, when Euro NCAP urged to install forward collision warning or automated braking system, provider of such systems – Mobileye – was acquired by Intel for a sum of 15.2 billion USD.

According to the Market Research Future (2018), global driver monitoring systems market is expected to reach around 8,100 million USD by 2025, while according to TechSci Research (2019) it was worth 718 million USD in 2018. One of the forecasts by IndustryARC covers the period 2021-2026, with the estimations of more than 9.8% CAGR and USD 2.6 billion in 2026. APAC countries are expected to reach the highest growth within the market (Emergen Research, 2020; IndustryARC). Interestingly, in Market Watch (2021) it was reported that in 2020 35.1% of global Occupant Sensing System market demand was from APAC. Yet another estimate of DMS market was provided in Emergen Research (2020) analysis, with market valuation for 2019 at USD 1.06 billion and forecasts of USD 2.39 billion by 2027 with 10.6% CAGR. In the forecast from The Business Research Company (2021), an anticipation for DMS market was to grow from USD 0.96 billion (2020) to USD 1.06 billion (2021) with 10.4% CAGR, but also to grow further with expectation of USD 1.64 billion (2025) with 12% CAGR. An estimate of Automotive Occupant Sensing System (AOSS) market growth was reported in Market Research Future (2018a) as a forecast of 6.52% CAGR from 2020 to 2027, with an expectation for AOSS market to reach USD 2.4 billion by the year 2025. A similar CAGR estimate for Occupant Sensing System market was provided by Market Watch (2021), with 6.8% CAGR in 2021-2026 period, but with different reach – of USD 1.3 billion by 2026. However, a care should be taken while comparing the estimations, as Occupant Sensing System market, as well as other markets reported herein can be defined differently and therefore their scope may vary as well.

Driver monitoring solution being developed in the project also fits into the usage-based insurance (UBI), where factors observed by DMS, like risky behaviours (e.g. texting and using a smartphone or driving under influence) can affect the UBI. The global automotive UBI market was forecast to grow to 105.12 billion U.S. dollars by 2027, up from 15.62 billion U.S. dollars in 2018 according to Statista (2020). Even in the light of recent economy slowdown due to COVID-19 pandemic, the DMS market development forecasts

remain optimistic, e.g., Japanese car OEM Nissan has recently announced a major cost savings program resulting from global pandemic. It lists a whole lot of defensive measurements, driver assistance systems being one important exception where it remains highly aggressive.

A need to verify safety-related software, such as the software being part of ADAS or AVs, but also security and data protection aspects of the operating systems is reflected in the expected growth of validation and verification submarket, as in the Figure 4. As estimated by Markets and Markets (2019a), the global automation testing market size is expected to grow USD 12.6 billion in 2019 to USD 28.8 billion by 2024, at a CAGR of 18.0% during the forecast period. The project results will not only enhance the development of products, but also provide relevant evidence for their performance.

4.2.2 Potential beneficial impacts in manufacturing pillar

The second use case in the CPSoSaware project is targeted to the automotive manufacturing sector, represented by the CRF (Centro Ricerche FIAT) "World Class Manufacturing Research & Innovation department". 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 on 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 rather than commercializes them.

In this situation the standard revenue stream is coming from the manufacturing costs optimization versus 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 project solutions are implemented mainly of a HRC cell for the assembly of a windshield in production line. The windshield assembly can be made in many specific ways, going from full automation to artisanal, human operated approach. The choice of the specific approach depends on the model of the vehicle and on the Takt Time of the line.

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 collaborative approach with high workload. These kinds of applications are not yet diffused due to limitation 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. In the following paragraphs, a general analysis of the number of applications that could take advantage of the developed concepts is made.

The characteristics of automotive production depend on the desired throughput and big differences are present from cases of low throughput (from mainly manual assembly like for example supercars producing few vehicles per year, to production in the range of 1 vehicle per hour, e.g., some Maserati, Ferrari…), middle throughput (1 vehicle/5-10 minute – Maserati Levante, Maserati Ghibli) or high throughput (1 vehicle/minute – mass production vehicles).

The use of the production line is obviously more convenient and thus the tendency is to make flexible lines with more vehicles produced in the same line. Assembly production lines like those of the supercars are more related to artisanal production methods.

The throughput, besides of the production rate, indicates the time a vehicle is stuck in the workstation, and it is obvious that for example low throughput mean often a "Stop and Go" production, while high throughput means continuous moving production in line.

The difference also generates varying impact on the production methodologies, as a fact:

- High throughput means,
- Shorter, more frequent operations,
- Higher ergonomics issues for the operators related to high frequency operations,
- Low throughput means,
- More time per vehicle,
- Less frequent operations,
- Lower ergonomics indexes (more variable activities, but less automation and thus added manual operations),
- More time per operation resulting in more time to ensure the quality.

The solution identified is always an economic tradeoff between the number of workstations, the amount and type of equipment, the number of operators that saturate the workstation, the ergonomics and safety for the operators, the Takt time and the achieved quality.

Considering a production line, its length can vary according to the Takt time ranging from ~100 to up to 350 workstations (considering only the final assembly). On average, it is possible to consider two operators per workstation, plus a team leader for every six operators. The overall number of operators has to be multiplied by the number of shifts. It has to be considered that, when the operation is nonergonomic, the duration of the shift is shortened in order to get a green ergonomic indicator and thus – for the same workstation – it influences the number of operators which is sufficient to cover this necessity (e.g., if a specific operation needs a turn which is not longer than 4 hours, then there will be two operators per shift for the same operation. Anyway, the operators make the full shift and thus in the remaining part of the shift they perform other activities such as side-line logistics or logistic preparation. In overall, a factory normally employs ~5000 operators per production line and can be made by a multiple number of lines (from 1 to 10 normally; most frequently 2-3 lines).

Considering only a single operation of coordinated manipulation of lightweight (<20 kg), cumbersome parts that involve more than one operator because of the part dimension/weight, we can approximately count more than 10 similar applications per vehicle (see example list below):

- Insertion and fixing of freestanding rear seat,
- Insertion and assembly of headliner upholstery,
- Insertion and assembly of front+rear bumper,
- Assembly of fuel tank (depends on the models),
- Assembly of exhaust gas tubes,
- Dashboard assembly,
- Assembly of large underbody panels,
- Assembly of underbody heat/noise protective shields,
- Headlight beam assembly + similar transversal beams (both plastics and metal),
- Other underbody crossbars,
- Special assemblies like light/soundbars for police or other similar vehicles,
- Roof racks.

The above-listed operations have the characteristic to be “transversal”. Indeed, on car production lines, side trims or glasses usually are small and do not require more operators. On other assembly lines like, for example, light commercial vehicles, even some side trim or glass is large enough to require the intervention of two or more operators, and in an equivalent way two or more robots.

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, wellbeing, satisfaction…), while maintaining the overall production indexes of cost, throughput and other. The main consideration for new investment in the line (besides of Safety related ones) is to obtain a ROI (Return of 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 high 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., 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 European level. Only in Europe there are 226 factories working on engine or final assembly production (see Figure 7 for reference).

The above discussion highlights the estimated impact capability at full technology penetration. The analysis was made considering large part, mid payload, collaborative assembly. The developed technologies, on the other end, 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 distraction 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.

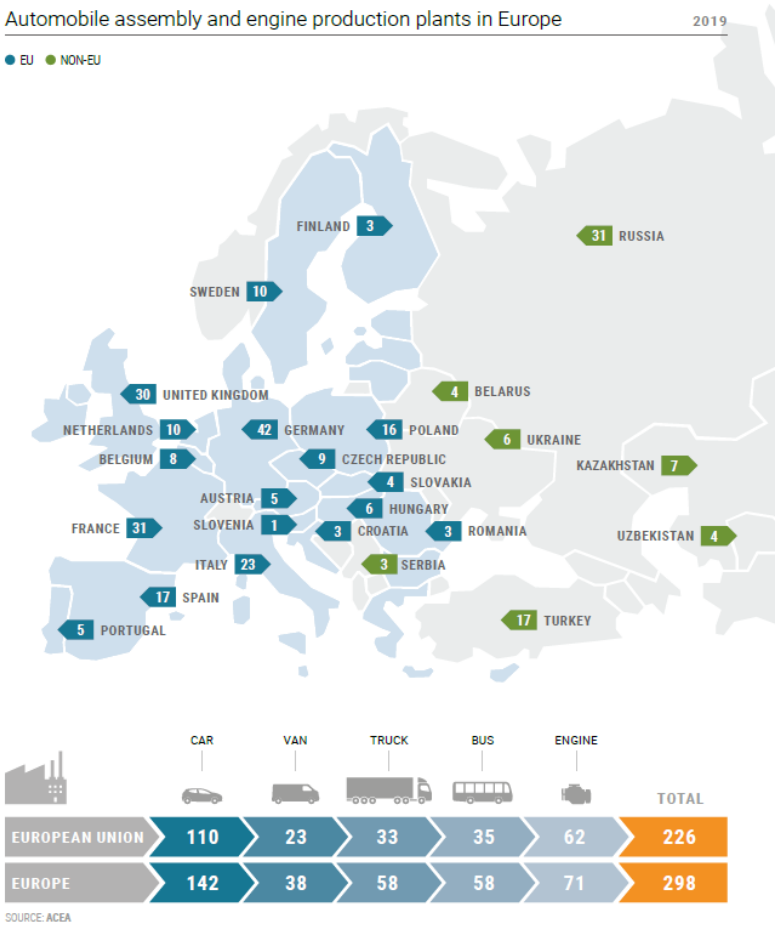

Figure 7. Automobile assembly and production plants in the EU. Source: European Automobile Manufacturers' Association (2020).

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. Beside the effects on workers themselves, MSDs may lead to high costs to enterprises and the 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 permanent disability, with the loss of employment.

The following figure (Figure 8) shows that in the distribution of musculoskeletal diseases in Europe, MSD covers 38.1% of the total.

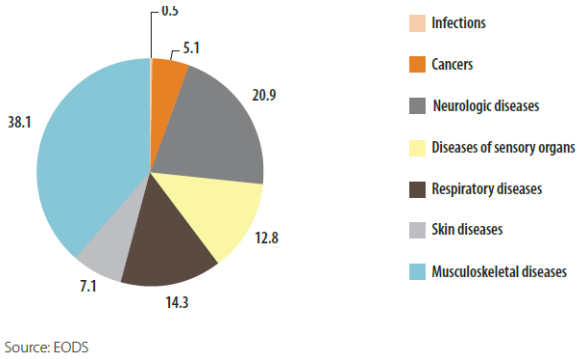

Figure 8. Proportion of occupational diseases. Source: EODS obligatory list, 2005 in EU-OSHA (2010).

Besides of the direct consequences on operator's performance and wellbeing, the decrease of MSD in the plant has also a significant impact on economic and social costs. The true extent of MSDs costs within workplace 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).

Both the previously considered impact of the application of Human-Robot Collaboration and the benefits that can be derived from the introduction of tools improving the ergonomics of operators are relevant when connected to the automotive manufacturing industry. Indeed, 11.5% of the European manufacturing employment is in the automotive sector:

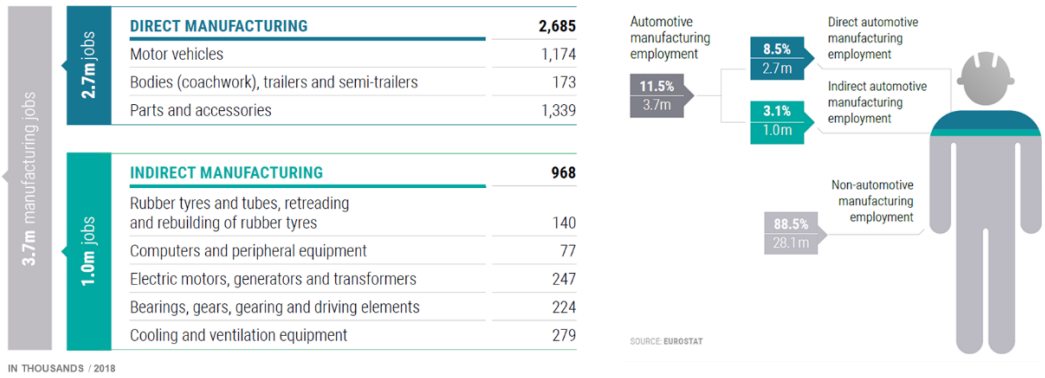

Figure 9. Automotive sector: direct and indirect employment in the EU. Figures extracted and adapted from European Automobile Manufacturers' Association (2020).

A final consideration to be done in relation to the possible penetration of the market of the developments of the CPSoSaware project is related to the direct application to the field of collaborative robots in manufacturing. Besides of the numbers related to the automotive manufacturing sector, the project's developments are concentrated on the application of HRC technology. According to Fortune Insights (2020), the global collaborative robots (cobots) market size was USD 725.8 million in 2019 and is projected to reach USD 11.684,7 million by 2027, exhibiting a CAGR of 42% during the forecast period.

On the other hand, there are still limitations to the cobot's use in the plants for many reasons. One of the main reasons is the complexity in achieving the safety levels required by the existing international standards.

The development of dedicated safety tools and equipment that simplify and optimize the application of the HRC technology will get advantage of the existing cobots market share and will further push the existing HRC market. The following graph (Figure 10) shows the trend for the cobots market size.

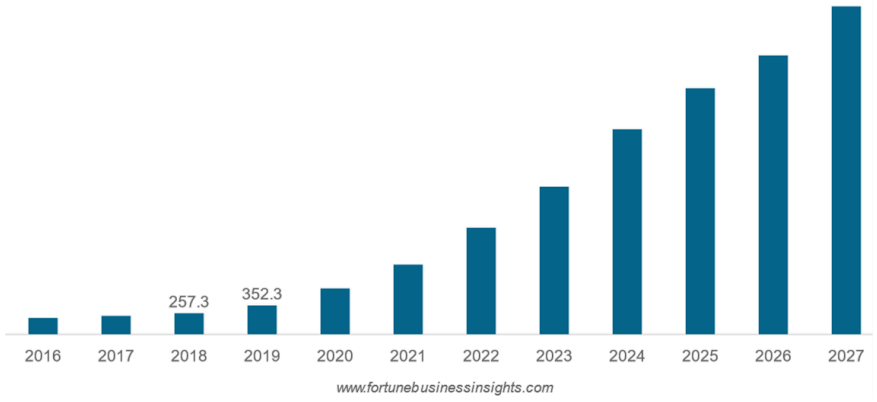

Figure 10. Europe Collaborative Robots Market Size Forecast. Source: Fortune Insights (2020).

4.3 Target end users

Most of CPSoSaware components are meant to prove useful and provide benefit 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 are service providers, including logistic and insurance companies, as well as public authorities. Apart from that, some of the proposed technologies can be utilized as aftermarket product directed towards individual end users – drivers and vehicle owners.

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

4.4 Potential competitors

Competitors' analysis was performed for identified exploitable components as they target various markets. Consequently, the list of potential competitors can be specified differently for each particular component. The following paragraphs include lists of currently identified market competitors presented in a component wise manner.

Security Runtime Monitoring and Management (SRMM)[1]

- 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 Center (SOC) team and a set of applications or external commands that help the correlation and/or investigation processes.
- Qradar by IBM (https://www.ibm.com/downloads/cas/RLXJNX2G): Can be deployed as a hardware, software or virtual appliance, as well as a Software as a Service (SaaS) on the IBM cloud. Provides a user interface for real-time event and view, reports, offenses, asset information, and product management. Offers support for threat intelligence feeds.
- ArcSight Enterprise Security Manager by NetIQ/Microfocus/HPE (https://www.microfocus.com/en-us/products/netiq-sentinel/overview): Allows for scalable and 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

[1] Comprtitors analysis for SRMM component is based on an in-depth analysis performed by González-Granadillo et al. G. González-Granadillo, S. Gonz´alez-Zarzosa, I. Robla, A. Bessani, A. Serckumecka, A. Respicio, M. M. Mironescu, F. Buontempo, I. Gashi, I. Rosa, "Security Information, Event Management and Analytics: Analysis and Trends", 2021.

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 include 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.

Provision of Services referring to simulation orchestration, containerization, environment setup

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 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 multi cloud 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/) 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 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

- 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 state in real-time.

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

- 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 to test 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 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 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.

5 Exploitation strategy

5.1 IPR

Separate deliverable (D7.4) is dedicated to the intellectual property rights management in the CPSoSaware project.

5.2 Standardization

Separate deliverable (D7.5) is dedicated to the standardization-related activities of the CPSoSaware project.

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 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 11 presents the innovation management process in CPSoSaware, and the role of Innovation Management Board.

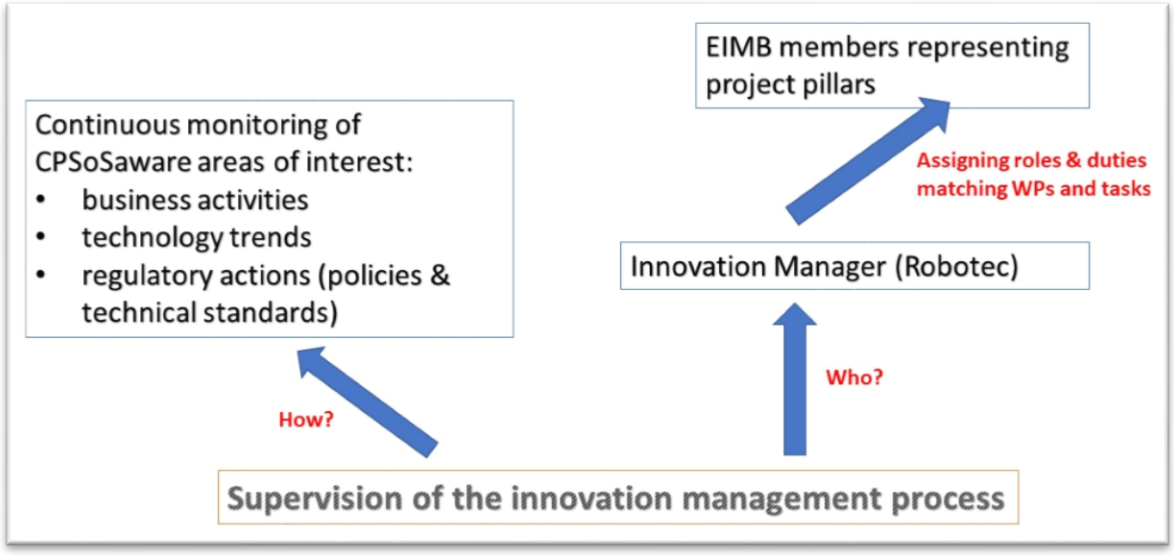

Figure 11. Innovation management process in CPSoSaware.

The key goal for 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).

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:

- Monitoring of technology trends for relevant domains. Each EIMB Partner informs the Innovation Manager and the whole consortium about the technology trends.
- Participation (mainly virtual due to COVID-19) in related events such as webinars, expert peer assist workshops, conferences (also through paper submissions), seminars, workshops, and discussion groups.
- Finding related stakeholders that will be interested in the CPSoSaware solution for instance software suppliers, automotive OEMs in value chain for automotive use case and service providers, solutions providers for manufacturing use case.
- 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.
- Following related market trends and act accordingly.
- Networking and clustering with other relevant H2020 projects and other EU wide associations and initiatives.
- Identifying the relevant initiatives taken on the level of partner countries in order to strengthen the networking potential with the national stakeholders.

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 • Managed operation of cybersecurity and risk management technologies • Additional engineering services – new features, customizations, integrations, support and maintenance
2	Perception Engine	PASEU	• Perception Engine module licensing • Additional engineering services – new features, integrations, support and maintenance
3	Provision of Services referring to simulation	8BELLS	• Licensing • Subscription fees – various service packages

	orchestration, containerization, environment setup		• Additional engineering services – new features, integrations, support and maintenance costs
4	Driver State Monitoring	CTL	• Acquisition of DSM license for professional drivers • Selling individual component to relevant technological institute (ADAS) • Advertisements space for affiliated companies within the DSM application • Option to support the engineering endeavor by donation
5	Semantic Information Fusion Framework	CTL	• Asset sale • License/subscription fees • Generation of reports on-demand • Framework customization on-demand • Framework extension: Development of additional components (e.g., connectors, data integration)
6	V2X Simulator	RTC	• V2X simulation module licensing • Additional engineering services – new features, integrations, support and maintenance
7	Collaborative robotic cell for windshield preparation	CRF	• Direct equipment cost reduction (removal of rotating table equipment and manipulation partner) • Workers' wellbeing improvement at work • Mitigation of risks and accidents • Reduction of costs for Non Value Added Activities • Productivity increasing • Flexibility of workplace management • Internal Knowledge and competences keeping
8	Posture and anthropometrics recognition	CRF	• Workers' wellbeing improvement at work • Mitigation of risks and accidents • Productivity increasing • Flexibility of workplace management • Continuous compliance to ergonomics standards and innovation
9	Extended reality system with multimodal sensing	CRF	Direct revenues: • Application design • Integration support for different plants/application • Reduction of training time Indirect H&S benefits: • Productivity increasing • Flexibility of workplace management • Continuous compliance to ergonomics standards and innovation

10	System for operator's state monitoring	CRF	• Workers' wellbeing improvement at work • Mitigation of risks and accidents • Reduction of costs for Non Value Added Activities • Reduction of costs for sickness and diseases and of absenteeism • Productivity increasing • Flexibility of workplace management • Implement a correct internal job rotation • Knowledge and competences keeping

5.5 Economic potential – Business models

CPSoSaware project relies on a complex product concept, and within each of its parts a series of components is 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. Business model canvas for each of the CPSoSaware components are attached in Annex A – Annex J.

The annexes include business model canvas for the following components:

Table 4. List of CPSoSaware exploitable components/products described with business model canvas.

#	Component name	Developing partner	Business Model Canvas – annex reference	CPSoSaware Architectural Block[2]
1	Security Runtime Monitoring and Management (SRMM)	ATOS	Annex A	System Layer
2	Perception Engine	PASEU	Annex B	System Layer
3	Provision of Services referring to simulation orchestration, containerization, environment setup	8BELLS	Annex C	System Layer
4	Driver State Monitoring	CTL	Annex D	CPS/CPHS Layer
5	Semantic Information Fusion Framework	CTL	Annex E	System Layer
6	V2X Simulator	RTC	Annex F	Simulation and Training Layer
7	Collaborative robotic cell for windshield preparation	CRF	Annex G	CPS/CPHS Layer

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

8	Posture and anthropometrics recognition	CRF	Annex H	CPS/CPHS Layer
9	Extended reality system with multimodal sensing	CRF	Annex I	CPS/CPHS Layer
10	System for operator's state monitoring	CRF	Annex J	CPS/CPHS Layer

6 Conclusions

Exploitation plan of CPSoSaware project will provide initial assessment of the components developed in the project market and commercial potential. Exploitation plan and strategy will be performed and updated throughout the project duration to propose the best use of the project outcomes. In this document, early forecasts of economic potential and revenue streams as well as target end users were introduced. Next steps in WP7 will include continuous market monitoring and exploitation strategy adaptation accordingly. Nonindustrial consortium partners' exploitation potential will also be analyzed in the upcoming steps. The presented document constitutes the first iteration of exploitation report which serves as a guide for further exploitation-oriented actions.

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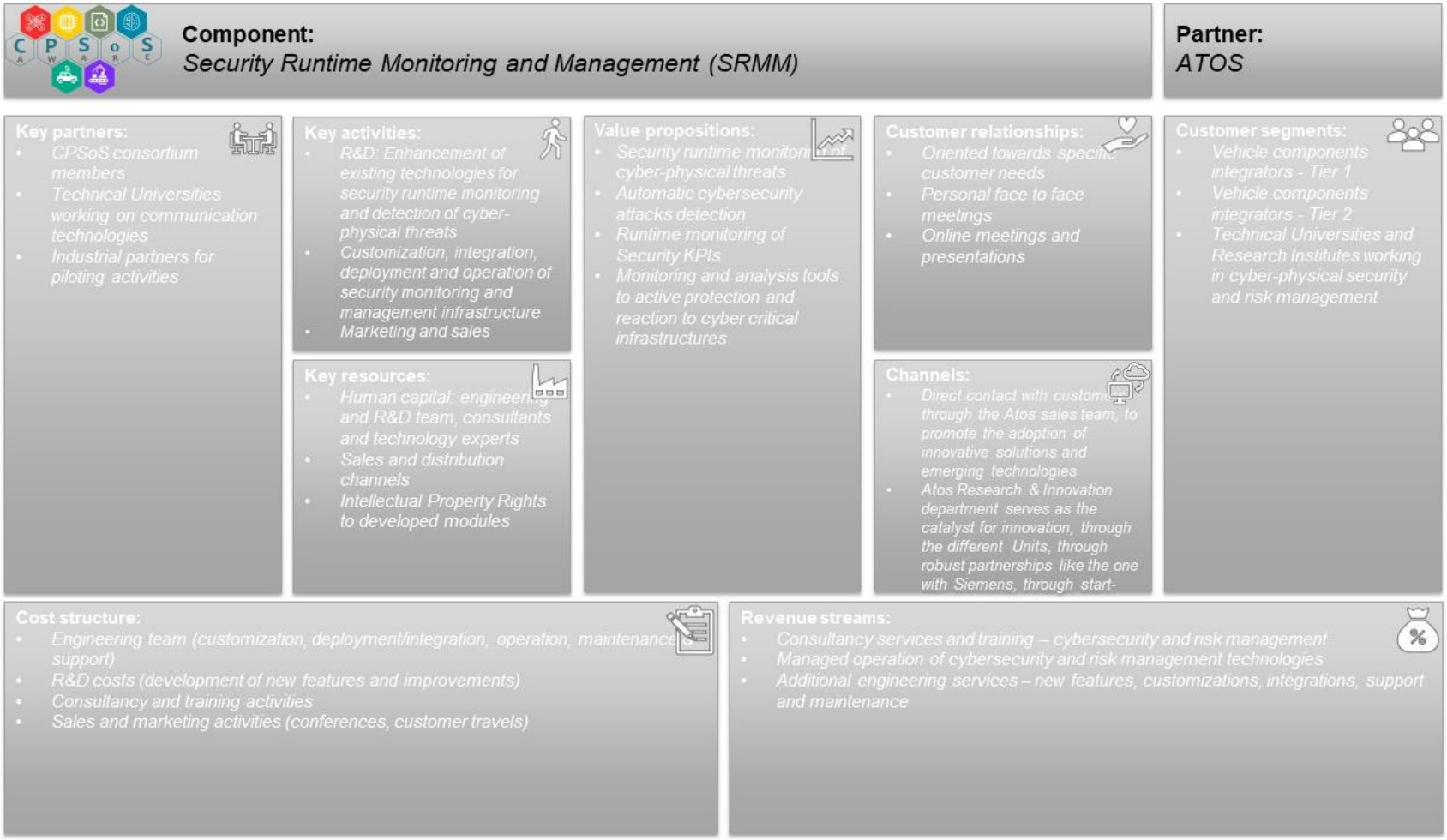
Annex A

Security Runtime Monitoring and Management (SRMM)

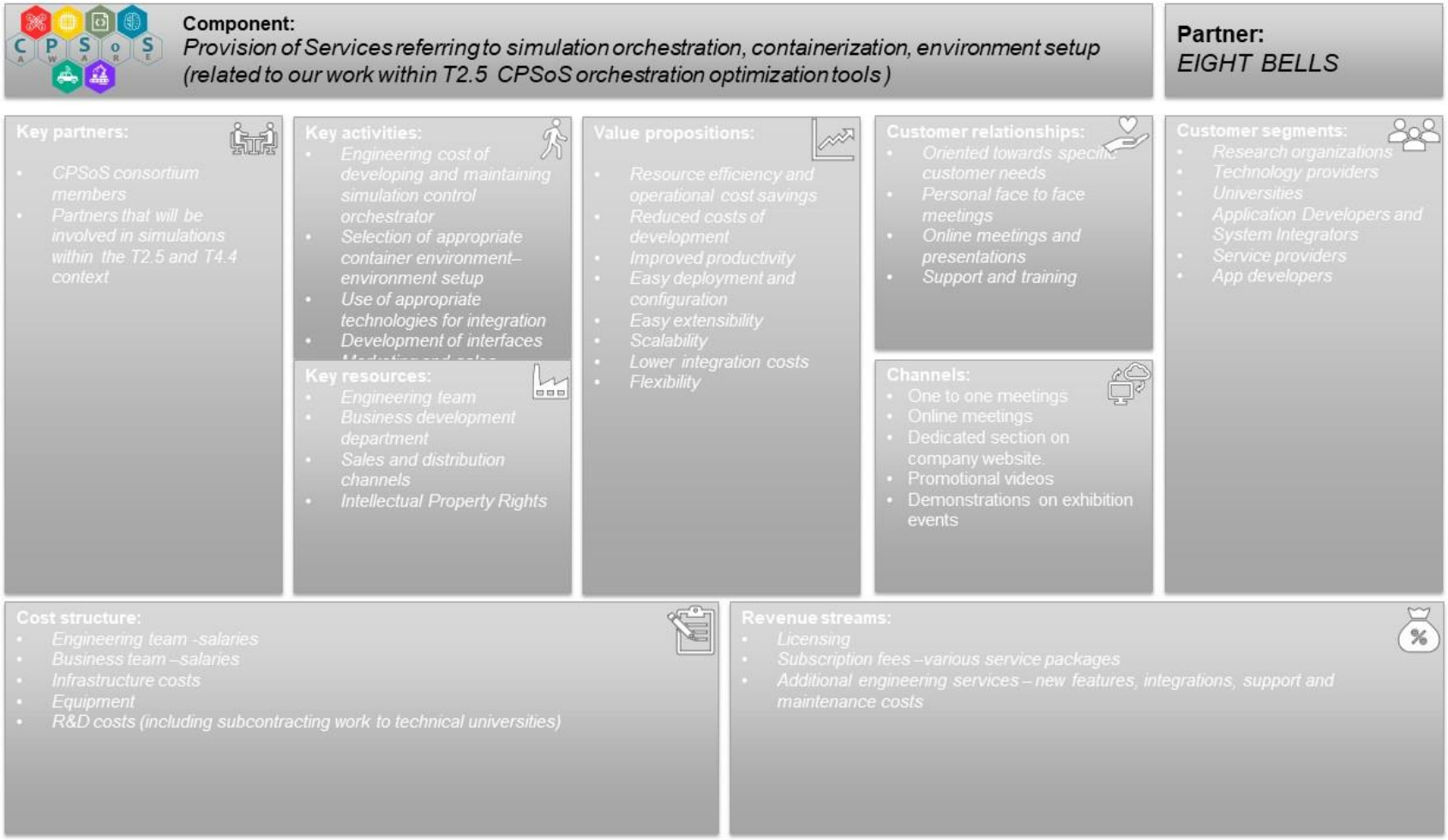
Business Model Canvas



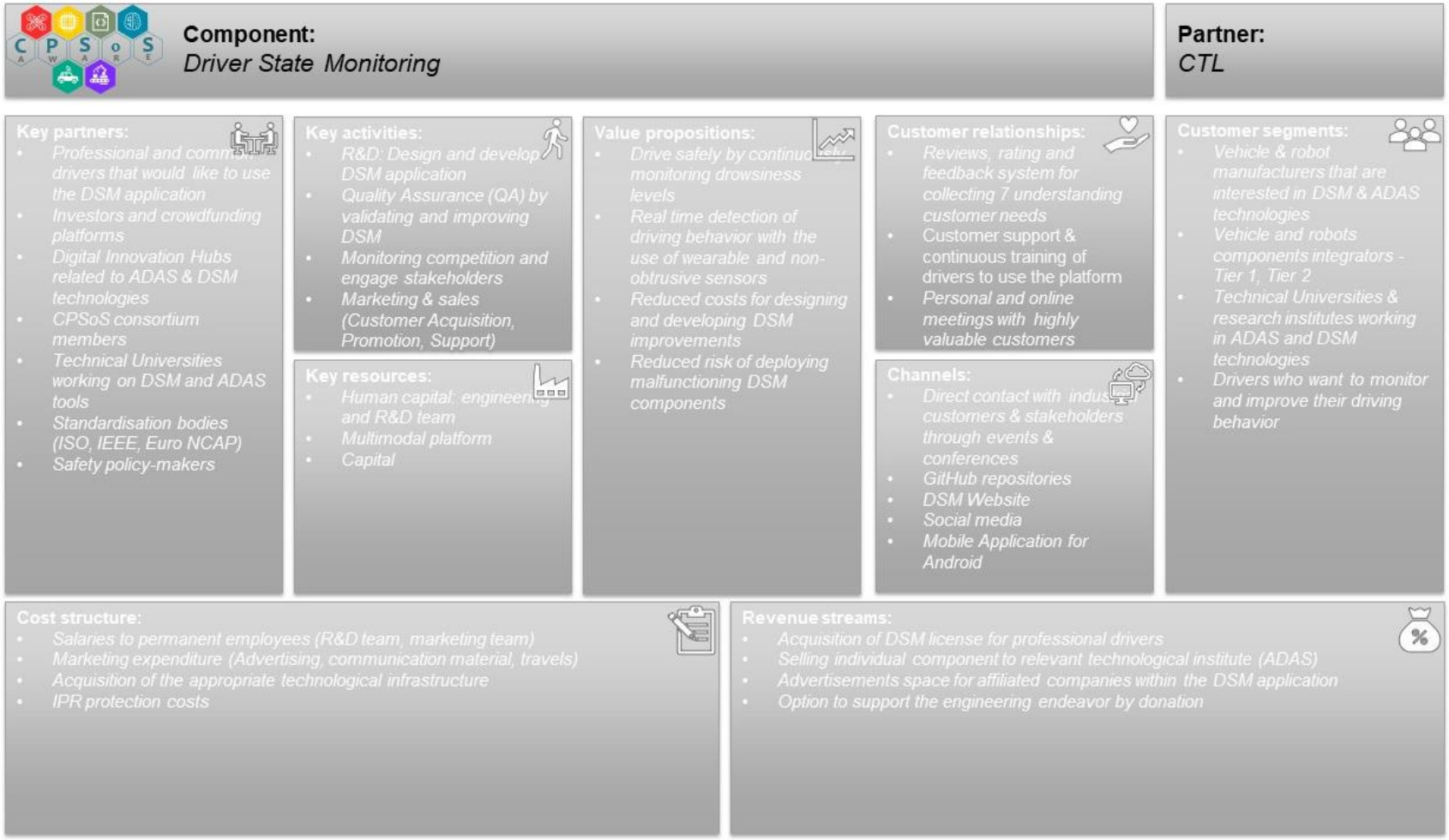
Annex B
Perception Engine
Business Model Canvas

Annex C

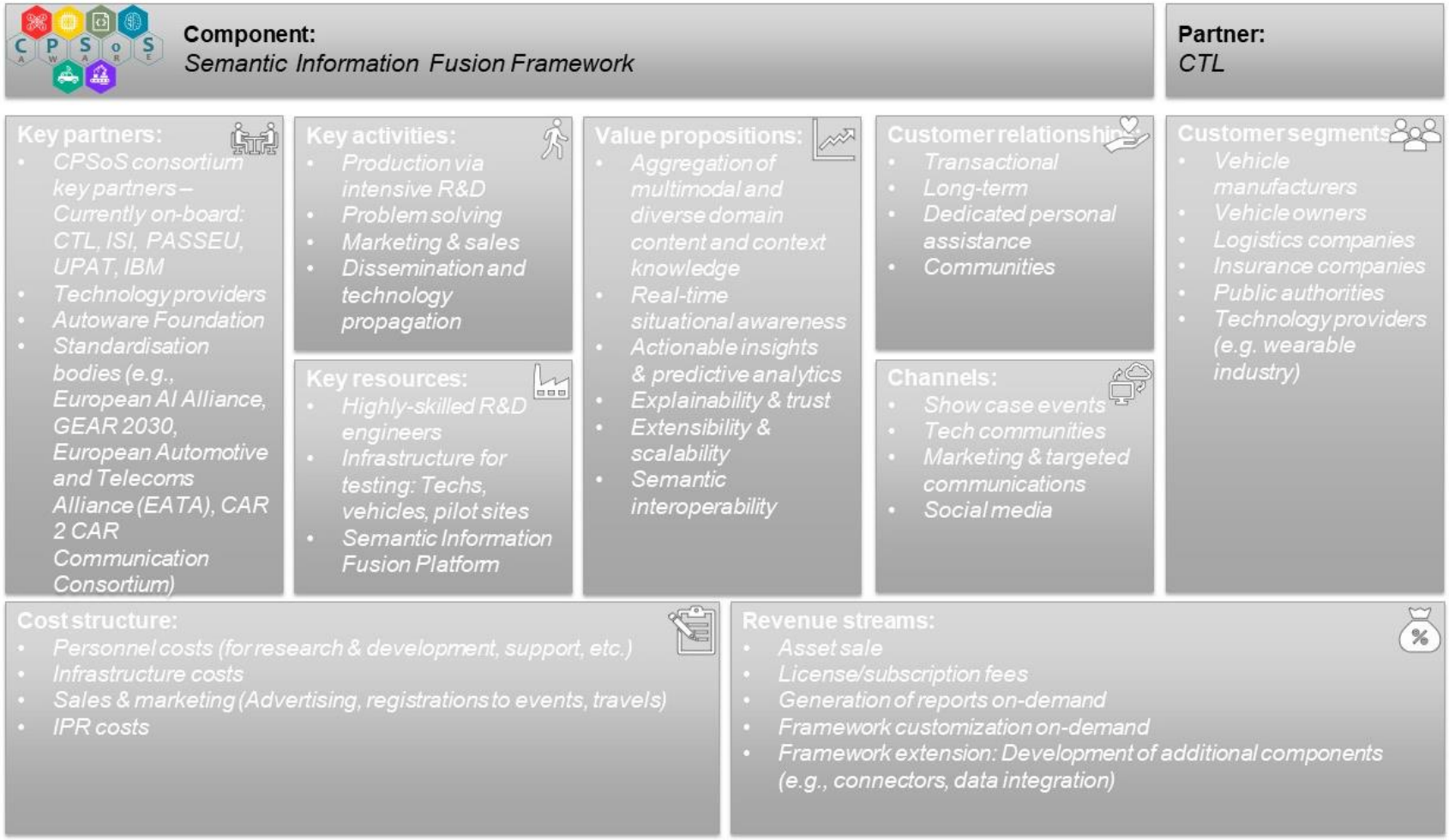
Provision of Services referring to simulation orchestration, containerization, environment setup Business Model Canvas



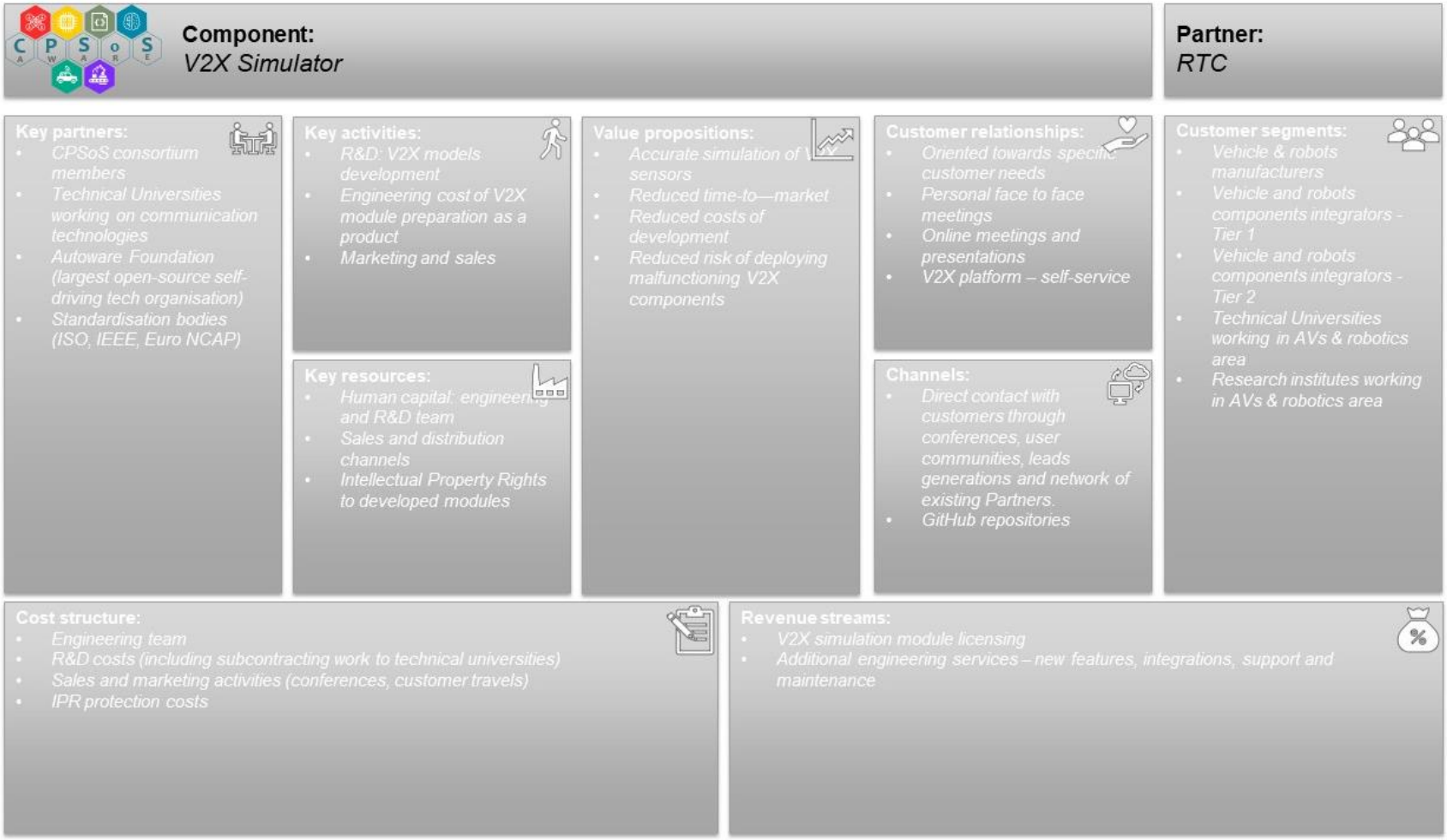
Annex D
Driver State Monitoring
Business Model Canvas



Annex E
Semantic Information Fusion Framework
Business Model Canvas



Annex F
V2X Simulator
Business Model Canvas



Annex G
Collaborative robotic cell for windshield preparation
Business Model Canvas

Component/System:
Collaborative robotic cell for windshield preparation

Partner:
CRF

Key partners:
- *Equipment suppliers and integrators*
- *Standardisation and certification bodies (eg. ISO)*
- *WCM team fro internal dissemination and training*
- *Manufacturing Engineering Department (internal knowledge application and diffusion; assembly standard management)*
- *CPSoSaware consortium members*
- *H&S Manager (Health and Safety Manager)*

Key activities:
- *Demonstrator setup completion*
- *Internal Validation Activity with Manufacturing engineering department of the Project's demonstrator*
- *Application to a standard plant testbench with business case analysis*
- *Diffusion to other plants*

Key resources:
- *H&SM of the reference plant*
- *Integrated manufacturing ICT system compatibility/interfacing*
- *Safe (PLd, CAT3) robot with HG gripper: availability*
- *Standard and legal conformity*
- *ICT team & services*

Value propositions:

Human Robot Collaboration concept in an heavy payload cooperative windshield preparation application in order to:
- *Gain a workcell simplification*
- *Improve safety, work wellbeing and ergonomics*
- *Reduce direct and indirect costs*
- *Improve Process efficiency, Productivity and Product's quality*
- *Increase the feeling of reliability of robots*
- *Reduce ergonomics workload and fatigue correlated aspects*
- *Realize a proactive collaboration with the robotic colleague*

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's promotional videos*
- *Internal newsletter, WCI (World Class Innovation conferences) and website*
- *Dedicated workshops*
- *Direct contact with Manufacturing engineers*
- *Direct contact with Team Leader or Area Manager*

Customer segments:
- *Stellantis Group's Vehicle final assembly plants*
- *Suppliers and allied Vehicle final assembly plants*

Both channels composed by these main stakeholders:
- *Final users (assembly line operators)*
- *Team leaders / Supervisors / Area Manager and Plant Manager*
- *H&S Manager*
- *HR Plant Manager*
- *Occupational doctors*

Cost structure:
- *Collaborative Robot in workcell*
- *IoT/ICT infrastructure*
- *System integration, Safety certification and network implementation*
- *R&D costs*
- *Training courses*

Revenue streams:
- *Direct equipment cost reduction (removal of rotating table equipment and manipulation partner)*
- *Workers wellbeing improvement at work*
- *Mitigation of risks and accidents*
- *Reduction of costs for Non Value Added Activities*
- *Productivity increasing*
- *Flexibility of workplace management*
- *Internal Knowledge and competences keeping*

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*
- *Standardisation bodies (eg. 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
Extended reality system with multimodal sensing
Business Model Canvas

Component/System:
Extended reality system with multimodal sensing

Partner:
CRF

Key partners:
- *Workcell integrator*
- *CPSoSaware consortium members (UPAT, ISI)*

Key activities:
- *XR assisted Training on the job*
- *Self reconfiguration of the information on HMI according to "design operation continuum evaluation"*
- *On-demand and centralized training availability*

Key resources:
- *XR googles*
- *Graphical ergonomics design*
- *Integrated manufacturing ICT system compatibility/interfacing*
- *ICT team & services*

Value propositions:
Using wearable XR tools we make training on job of the operators. The training on the job will be activated only when the management system define it is necessary in order to guarantee an operational design continuum.

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 face to face workshops*
- *Operative on the run tests*
- *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:
Direct revenues:
- *application design*
- *Integration support for different plants/application*
- *Reduction of training time*

Indirect H&S benefits:
- *Productivity increasing*
- *Flexibility of workplace management*
- *Continuous compliance to ergonomics standards and innovation*

Annex J
System for operator's state monitoring
Business Model Canvas

Component/System:
System for operator's state monitoring

Partner:
CRF

Key partners:
- *CPSoSaware consortium members*
- *CRF (WCM dept.) researchers team with high knowledge of the system to guide its customization, installation and training*
- *Standardisation bodies (eg. ISO)*
- *CPSoSaware consortium members (Robotec, Catalink)*

Key activities:
- *Implementation of dedicated ICT network and relative maintenance service*
- *System setup and tuning (customization on plant needs)*
- *Infrastructure installation*
- *Guidelines and protocols for system application*
- *Data and privacy management*
- *Legal agreement with Union*
- *Training for correct use*

Key resources:
- *Assembly line operators*
- *Maintenance operators*
- *Ergonomic specialist*
- *ICT team & services*
- *World Class Manufacturing team for knowledge transfer and training*

Value propositions:
- *Improve and facilities a Safety and Healthy Collaborative Workplace*
- *Process efficiency and Productivity*
- *Improve quality and reduced the defects*
- *Reduced the fatigue correlated aspects and others of ergonomics*
- *Sensors IoT infrastructure*

Customer relationships:
- *The relationship is mainly based on direct contact with the Team Leaders (Blue collars) and the White collars (Area Manager)*
- *Personal face to face meetings*
- *Relationship with colleagues from WCM dept.*

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:
- *Final users (Assembly line operators)*
- *Team leaders / Supervisors / Area Manager and Plant Manager*
- *HR Plant Manager*
- *H&S Manager*
- *Ergonomic Manager*
- *Occupational doctors*
- *Infirmary*

Cost structure:
- *IoT infrastructure (sensors, cameras, beacons, smartphone and smartwatch combos, smart glasses)*
- *System integration and network implementation*
- *Software License*
- *R&D costs*
- *Training courses*

Revenue streams:
- *Workers wellbeing improvement at work*
- *Mitigation of risks and accidents*
- *Reduction of costs for Non Value Added Activities*
- *Reduction of costs for sickness and diseases and of absenteeism*
- *Productivity increasing*
- *Flexibility of workplace management*
- *Implement a correct internal job rotation*
- *Knowledge and competences keeping*