

ECSEL Research and Innovation actions (RIA)



AMASS

**Architecture-driven, Multi-concern and Seamless Assurance and
Certification of Cyber-Physical Systems**

**Exploitation Results and Final Market
Megatrends Analysis
D8.4**

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TABLE OF CONTENTS

Executive Summary.....	5
1. Introduction	6
2. Updated Domain Specific Market Analysis.....	7
2.1 Market Size and Share	7
2.2 Market “Megatrends” and Needs: Survey Results.....	9
2.3 Market Trend Survey	11
3. SWOT Analysis Summary.....	14
3.1 Aerospace / Space	14
3.2 Automotive.....	14
3.3 Railway.....	15
4. Updated Individual Exploitation Plan by Individual Partners	16
4.1 Tecnia Research & Innovation (TEC).....	17
4.2 Honeywell (HON).....	22
4.3 Schneider Electric (TLV).....	24
4.4 ANSYS medini Technologies AG (KMT).....	26
4.5 Mälardalen University (MDH).....	29
4.6 Eclipse Foundation Europe (ECL).....	32
4.7 Infineon (IFX)	34
4.8 AIT Austrian Institute of Technology GmbH (AIT)	36
4.9 Fondazione Bruno Kessler (FBK).....	38
4.10 Intecs (INT).....	40
4.11 Assystem Germany (B&M)	42
4.12 GMV Aerospace and Defence, S.A.U. (GMV)	44
4.13 RINA (RIN).....	46
4.14 Thales Alenia Space (TAS).....	48
4.15 Universidad Carlos III de Madrid (UC3)	50
4.16 Rapita Systems (RPT)	53
4.17 The REUSE company (TRC)	56
4.18 OHB Sweden AB (OHB).....	58
4.19 Masaryk University (UOM)	60
4.20 Kompetenzzentrum – Das virtuelle Fahrzeug Forschungsgesellschaft mbH (VIF)	62
4.21 Alliance pour les technologies de l'Informatique (A4T)	64
4.22 Commissariat à L'énergie Atomique et aux Energies Alternatives (CEA).....	66
4.23 Clearsy SAS (CLS)	69
4.24 Alten Sverige Aktiebolag (ALT)	71
4.25 Lange Aviation (LAN)	74
4.26 Thales Italia SpA (THI).....	76
4.27 RISE Research Institutes of Sweden (SPS)	78
4.28 Comentor AB (COM).....	80
4.29 Alstom Transport SA (ALS).....	82
5. Conclusions	84
Abbreviations and Definitions	85
References.....	87
Appendix A: Domain specific market trend analysis survey	88
Appendix B: AMASS SWOT analysis survey	97



Appendix C: Overall Strategy for Exploitation.....	100
Appendix D: Exploitation Opportunities and Results	101
Appendix E: Intellectual Property Register	107

List of Figures

Figure 1.	Embedded systems market size and European share	7
Figure 2.	Direction of each trend from all AMASS partners across different domains, on the scale -1 (highly applicable to all respondents, negative trend) to +1 (highly applicable to all respondents, positive trend)	12
Figure 3.	Direction of each trend from all AMASS partners from Automotive, Aerospace and Multi domains, on the scale -1 (highly applicable to all respondents, negative trend) to +1 (highly applicable to all respondents, positive trend)	13

List of Tables

Table 1.	Trends and expectations of the industrial markets addressed by AMASS.....	7
Table 2.	Exploitation Opportunities and Results.....	101
Table 3.	Intellectual Property Register	107



Executive Summary

This document, deliverable D8.4 of the AMASS project, describes (a) the final of trends and market needs that AMASS intends to address, (b) a SWOT analysis summary and (c) updated plans from individual partners. D8.4 is an update from deliverable D8.3 [2].

The market trend report in Section 2 has been prepared by collating results from a survey of the project partners' understanding and market information across various domains, particularly addressing the trends and changes in technology and market needs. Key market needs identified by AMASS partners include model-based technologies, formal methods, agile, and continuous integration.

The SWOT analysis summary in Section 3 has been prepared by collating results from a survey of the project partners' understanding. This highlights the strengths, weaknesses, opportunities and threats (SWOT) of the AMASS technology that each project partner is developing.

The AMASS exploitation strategy was heavily focused on the industrial partners' exploitation of their own technologies, through their introduction into commercial products or service offerings. The project involves different industry sectors and different parts of the supply chain within these industries, and individual partners have adjusted their exploitation plans to address this. This document includes updated versions of the initial exploitation plans, a progress update on exploitation activities and market challenges, and a plan for exploitation after completion of the AMASS project.



1. Introduction

AMASS will create and consolidate a *de-facto* European-wide assurance and certification open tool platform, ecosystem and self-sustainable community spanning the largest CPS vertical markets. Its aim is to lower certification costs in the context of rapidly changing market needs and product features developed to address these needs. This will be achieved by establishing a novel holistic and reuse-oriented approach for architecture-driven assurance (fully compatible with standards such as AUTOSAR and IMA), multi-concern assurance (compliance demonstration, impact analysis, and compositional assurance of security and safety aspects), and seamless interoperability between assurance/certification and engineering activities along with third-party activities (external assessments, supplier assurance, etc.).

This document is deliverable D8.4 (Exploitation Results and Final Market Megatrends Analysis), released as part of AMASS WP8 (Exploitation, Dissemination and Standardization). This deliverable provides an update of overall market trend analysis and individual partner exploitation plans. An exploitation plan of each partner is a “living document”, in that it will be updated according to progress on technical development and the current status of the exploitation activities (T8.2) undertaken by the consortium.

Results from a survey on market trends are presented in Section 2, which is modified from what was presented in D8.3 [2]. Appendix A: Domain specific market trend analysis survey includes the template used for the survey on market trends. A new SWOT analysis summary is presented in Section 3 and the survey template used in this exercise is attached in Appendix B. Section 4 of this document contains an update of each project partner’s exploitation activities up to m33, including any updates on their exploitation plans, as outlined in D8.3 [2]. Section 5 presents the main conclusions of this report.

The overall exploitation plan remains unchanged since the original version produced as deliverable D8.2 [1], shown in Appendix C. There is also a log of “exploitation Opportunities and Results” record attached in Appendix D, where AMASS partners record exploitation opportunities and results throughout the duration of the project.

The AMASS Intellectual Property Register is attached in Appendix E, where AMASS partners state and claim their background IP and foreground IP. This is a way to eliminate issues for not clear on who owns which IP. If no claim of IP, any work done would be considered as contribution to the open source platform in AMASS project. To avoid doubts, the open source definition is explained in D7.7 [4] section 4.

2. Updated Domain Specific Market Analysis

2.1 Market Size and Share

A 2013 report from a workshop on Cyber-Physical Systems¹ estimated the global Embedded Systems at \$850 billion. The global Aerospace, Automotive, and Medical domains were estimated at \$472 billion. Europe was estimated to produce 30% of the embedded systems, with the European share of the global Aerospace, Automotive, and Medical domains at \$141 billion. The European markets have created many employment opportunities, the auto/aero/medical/embedded domains are a current growth area with a reported increase of 50,000 jobs per year globally. Figure 1 below shows the market share of the European Embedded systems markets.

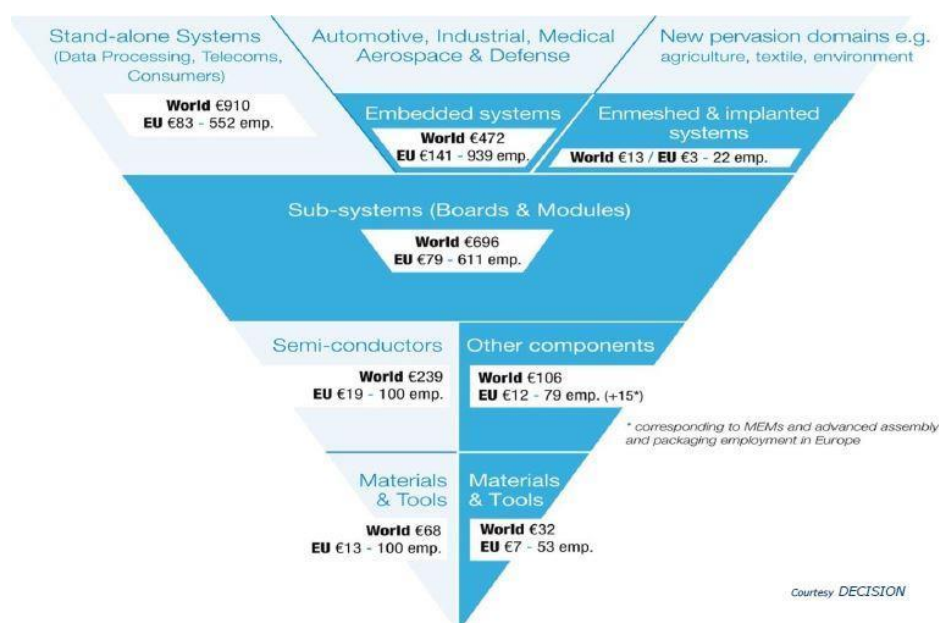


Figure 1. Embedded systems market size and European share

A summary of market research data is provided in Table 1. This data was collected from several market reports, predictions and AMASS partners' feedback. The raw data shown in this table is available in references [3].

Table 1. Trends and expectations of the industrial markets addressed by AMASS

Market	Figures	Current trends	Expectations
Industrial Automation	<ul style="list-style-type: none"> • ~\$200B revenue market. • European share ~38% of the market. • 28.4% EU GDP. 	<ul style="list-style-type: none"> • Smart factory concept deployed. • Growing use of computers and Industrial Internet. • Market led by USA, but with European countries (e.g. Germany) and companies (e.g. ABB, Siemens) among the main players. 	<ul style="list-style-type: none"> • Industry 4.0. • ~\$250B revenues by 2018. • Significant growth of market for sub-systems (e.g. PLC) and applications (e.g. for automotive).
Automotive	<ul style="list-style-type: none"> • Europe: total turnover of €839B (6.9% EU GDP), 23% of worldwide car 	<ul style="list-style-type: none"> • ISO 26262 as the functional safety standard. • Recent issues with assurance 	<ul style="list-style-type: none"> • From 800M to 1.6B vehicles worldwide. • Increasing complexity:

¹ "Cyber-Physical Systems: Uplifting Europe's Innovation Capacity", K. Rouhana.



Market	Figures	Current trends	Expectations
	<ul style="list-style-type: none"> production; > 20M vehicles/year. Automobiles: 10 million SLOC (source lines of code) and 1-10 networks. 75-80% functions embedded. 	<ul style="list-style-type: none"> including safety, security, and reliability. Smart Connected Cars: intelligent sensing to include functions to increase safety. Connected vehicles: V2V, V2I. AUTOSAR as the standard architecture for new vehicles. 	<ul style="list-style-type: none"> hundreds of millions of SLOC and tens of internal and external networks. Almost every passenger vehicle sold in 2020 will have V2V systems, ultimately leading to autonomous driving.
Railway	<ul style="list-style-type: none"> In many countries, ERTMS investments have brought considerable benefits, in terms of increased capacity, maintenance costs savings, multi-supplier opportunities, reliability or speed. As demonstrated by its worldwide success, ERTMS has emerged as “the” global signalling standard. Continuous communication-based signalling system, such as ERTMS, reduces the headway between trains, enabling up to 40% more capacity on currently existing infrastructure. 	<ul style="list-style-type: none"> ERTMS deployment. ERTMS is becoming the reference signalling system in Europe with a “Corridor approach” – whereby investments are coordinated amongst different countries. Together with railway stakeholders, the European Commission has established a list of six priority Corridors for the deployment of ERTMS. A European ERTMS Deployment Plan has been defined, creating a legal obligation to equip ERTMS Corridors since July 2009. 	<ul style="list-style-type: none"> Whilst one of the key objectives of ERTMS is to achieve interoperability on the European railway network, the standard has also been designed and is fit for use by the railways worldwide. One of the key advantages of ERTMS is that it “opens” the supply market (the product may be delivered by different suppliers) and that the ERTMS suppliers represent the largest part of the global signalling market. It is expected that ERTMS will gradually become the standard of choice for an ever-growing number of railway companies worldwide.
Aerospace	<ul style="list-style-type: none"> Thousands of sensors per aircraft. 7-12% of aircraft costs are related to CPS. 60-70% of avionics development costs are related to verification. 75-80% functions embedded. 	<ul style="list-style-type: none"> Introduction of new systems and features (e.g., unmanned aerial vehicles) has increased the need for new assurance approaches. Compositional development and certification (IMA) as a standardised practice. Use of large and complex networks. 	<ul style="list-style-type: none"> Tens of thousands of sensors. Air traffic will double in the next 15 years. Expected demand for over 30,000 new aircraft in the next 20 years.
Space	<ul style="list-style-type: none"> More than \$26B revenue during the next 10 years. Minimum presence of CPS architectures in flight solutions. New constellations market started with constellations over 600 satellites foreseen. 	<ul style="list-style-type: none"> Main challenges are related to the increase of performance / weight ratio, high reliability and product long life in challenging environments. Certification and in-flight validation of reconfigurable HW. Increase of the usage of non-Space COTS solutions. Increase in the autonomous missions for science. 	<ul style="list-style-type: none"> In-flight reconfiguration to be extended for all domains. Cost reduction of over 40% requested to maintain reliability figures for constellations. Upgraded COTS to be used as main components for space solutions. 2 orders of magnitude increase in data processing and data transmission needs by 2020.
Application	<ul style="list-style-type: none"> \$10B value worldwide. 	<ul style="list-style-type: none"> Wide variety of tools used. 	<ul style="list-style-type: none"> OSLC as standard tool



Market	Figures	Current trends	Expectations
Development Software	<ul style="list-style-type: none">• 25% development time reduction and 40% time-to-market reduction thanks to information sharing.	<ul style="list-style-type: none">• Tool qualification as a basic need.• Emergence of new tools for supporting system assurance and certification activities.• Creation of open-source communities for building such tools.• Eclipse as the market leader.	<ul style="list-style-type: none">interoperability mechanism, and development of further OSLC specifications.• Wider use of open-source tools.• Market growth because of the increasing use of software and the need to deal with increasing system complexity.

Europe is a market leader for high complexity and mixed-criticality systems and controls in the Embedded automotive, industrial, medical, aerospace and health industries. These industries face a common need to produce higher reliability, dependability, mixed-criticality and production complexity in their products to maintain this competitive advantage. The main competitors to the European Embedded market are the USA and Asia.

2.2 Market “Megatrends” and Needs: Survey Results

2.2.1 Time to market & competitiveness

In an increasingly competitive market, with an ever-increasing speed of innovation, partners must pursue easier, faster, and more efficient ways to build and assure safety and security of critical systems to remain competitive. A key part of this relies on *fast and reusable certification*.

Cost (cost of product manufacturing) pressures are increasing, with new products expected to exceed current ones in both features and quality, yet without price increase. The customer expectation is that new products are incrementally built based on prior product development, despite advances in modular and off-the-shelf components. Thus, the certification/safety process of systems still struggles as a result of “incremental certification” issues.

2.2.2 Reuse challenges

The trend and need are *to increase reuse-geared development and certification processes* as a major means to reduce costs. As noted above, the challenge with reuse is not necessarily with the reuse itself but with *reuse of certification and assurance artefacts*, especially where artefacts are cross-domain. A safety artefact for aerospace, for instance, might not be able to be applied directly “as is” in the railway or automotive domains, for example.

2.2.3 Open solutions & reuse

There is a trend to move from closed, proprietary systems to *more open CPS*. Open here includes: open source, open interfaces/API, and collaborative solutions from multiple partners integrated together.

Open solutions can help to provide incremental and off-the-shelf components for incremental developments. For many new technologies (cloud, big data, mapping software, Internet of Things (IoT), automotive, etc.) large actors and small start-up companies are choosing to collaborate, to share the cost of creating new platforms, in open source format, and thus to develop their products and solutions using these open source platforms.

2.2.4 Security

Open solutions, and particularly IoT, have created *enhanced security concerns*, stimulated by the increased communication in open networks with its associated risks of hacking, availability, and reliance on 3rd parties to support the infrastructure.



Combined safety and security engineering methods are needed and being developed. One challenge is when *safety and security are in conflict*. Safety is often achieved by simplicity, whereas security is often achieved by layers of complexity.

2.2.5 Rising complexity

Systems are becoming ever more complex, due to *increased customer demand for functionality, new capabilities, the expectation of increased automation, and the opportunities to introduce expert systems/intelligence within systems*.

The impact of that trend on safety-critical systems development makes it harder to ensure that software and systems are adequately tested, certified, and safe.

There is an increased *recognition of risks due to increasing complexity*: larger code bases, more cooperating systems, and distributed/multi-core systems are simply harder to develop robustly, and it is harder to justify the safety of these systems.

In the aerospace industry, as a way to understand when testing is sufficient, there is an increased emphasis on coverage analysis, especially at the integration-level. Data/control coupling coverage analysis is becoming more important, in addition to normal, structural, coverage analysis. This is due in part to complexity and in part to the increased operational testing emphasis, as required by ARP-4754A, which is now mandatory. This may propagate to other industrial domains.

Other examples where this trend in increased complexity is having a big impact include collaborative and autonomous vehicles and distributed control systems in “Industry 4.0”, where both the level of control over testing and the number of ways for reaching a failure are growing dramatically.

2.2.6 New development practices

The software development process and practices are developing. New methodologies like agile approaches (common in many industries) are gradually making their own way into safety-critical software development. *Model-based development techniques, formal methods, object-orientation, and new simulation techniques are also seeing increased use* and are having an impact on the way we deal with reliable software in safety-critical systems.

In the aerospace industry, there has been a *progressive reduction of the emphasis on product-specific certification, in favour of process-specific certification*. The number of experts in favour of goal-based assurance and certification in contrast to other schemes is increasing.

2.2.7 Automation of labour-intensive activities and intelligent control

Many *labour-intensive tasks are being progressively minimized through automation*. Manual activities, which may previously have been off-shored to lower labour cost countries, are now increasingly being performed by machines.

The increased automation of testing processes, for example, is a major trend. Companies are investing in automation solutions so that during the second and subsequent times that testing activities are performed, there is a very low cost to achieve results because of reduced need for repetition of manual effort. This allows re-use of testing and automatic generation of some safety/certification artefacts.

New technology *applications with autonomous vehicles and intelligent functionality* in aircraft, drones, etc., interactive robotics, autonomous transport systems, IoT, massive automation, connected vehicles, aircraft navigation/planning, displays, are all leading to a stronger interplay of safety and security engineering.

One challenge that this brings is the testing and certification of autonomous behaviours. This requires new ideas, tools, methods, and engineering solutions to efficiently tackle both safety- and security-related risks within systems.



2.2.8 Increasing product lifespans

In many industries, such as aerospace and railway, *the lifespan of products is long and increasing*: 30 years is typical and 30 to 50 years expected.

Given the rate at which technology is developing, tools, methods and documentation that are used for the original product need to be available throughout the product lifespan. This is so that incremental development and bug-fixes, for example, can be performed cost effectively.

2.2.9 Cross-domain and cross-country standardization

To handle increased product complexity with no extra effort, there are moves by the aerospace certification authorities, including the FAA, under "overarching properties" to further streamline the certification, and ideally to better *harmonise practices between different airworthiness authorities* - especially as there's now more commercial aviation development in Russia, China, and Japan.

2.2.10 Changes in certification and safety

There is an *increased focus on system-level safety risk management*, allowing for reduction in regulatory oversight when data exists showing that risks are low (but see the findings of the Haddon-Cave report² into the NIMROD loss, which may be at odds with this view). Meanwhile, civil standards are increasingly being applied to military systems too. More and more projects are starting under DO-178C rather than DO-178B, and starting to use the associated Object-Oriented (OO) and model-based supplements.

2.3 Market Trend Survey

The ten market trends listed in Section 2.2 above were identified in D8.2 [1]. 14 months after this, a survey (Appendix A) was conducted by members of the AMASS consortium to provide opinions on each trend, relating to the market sector or sectors in which each member works.

The following questions were asked as part of the survey: "*How applicable is this trend to your organisation?*", "*Do you see a positive or negative direction for this trend, or no change?*", "*Please give an example and a brief description on how your company is adapting/preventing impact to this trend*".

Answers to the question "*How applicable is this trend to your organisation?*" were given based on a scale of 1–5 where 1 is *not applicable* and 5 is *highly applicable*. Answers to the question "*Do you see a positive or negative direction for this trend, or no change?*" were given as 1 for a negative trend, 0 for no change and 1 for a positive trend).

20 out of 28 partners completed the survey. Results were classified into the following categories based on the market sectors or sectors that each partner considered themselves as working in predominantly: aerospace (3 respondents), automotive (5 respondents), railway (2 respondents), space (2 respondents), energy (1 respondent), and multiple sectors (7 respondents, many/all of which from universities and research institutes).

A weighted average of trends across domains was calculated by, for each partner, multiplying values for the question "*Do you see a positive or negative direction for this trend, or no change?*" by a weight determined by the partner's answer for the question "*How applicable is this trend to your organisation?*". These values were summed and divided by the sum of the weights. The final value gives results on the scale -1 (*highly applicable* to all respondents, negative trend) to +1 (*highly applicable* to all respondents, positive trend), across partners working in all domains (Figure 2) or just partners working in the Auto, Aerospace and Multi domains (Figure 3).

² https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/229037/1025.pdf

The positive trends are considered to represent a *level of concern* to the consortium, i.e. they might impact on the cost or influence on product or service direction.

Results from the survey show that:

- Across all domains:
 - All trends were assessed to have a positive direction overall.
 - Trend 6 “New development practices” and trend 7 “Automation of labour-intensive activities and intelligent control” present the greatest *level of concern*.
- In the Automotive domain:
 - Trend 10 “Changes in certification and safety” was assessed to have a negative direction.
 - Trend 4 “Security” and trend 6 “New development practices” present the greatest *level of concern*.
- In the Aerospace domain:
 - Trend 6 “New development practices” and trend 9 “Cross-domain and cross-country standardization” are mostly concerned.
- In Multi domains (partners working in multiple domains, including universities and research institutes):
 - Trend 3 “Open solutions & reuse” and trend 7 “Automation of labour-intensive activities and intelligent control” present the greatest *level of concern*.

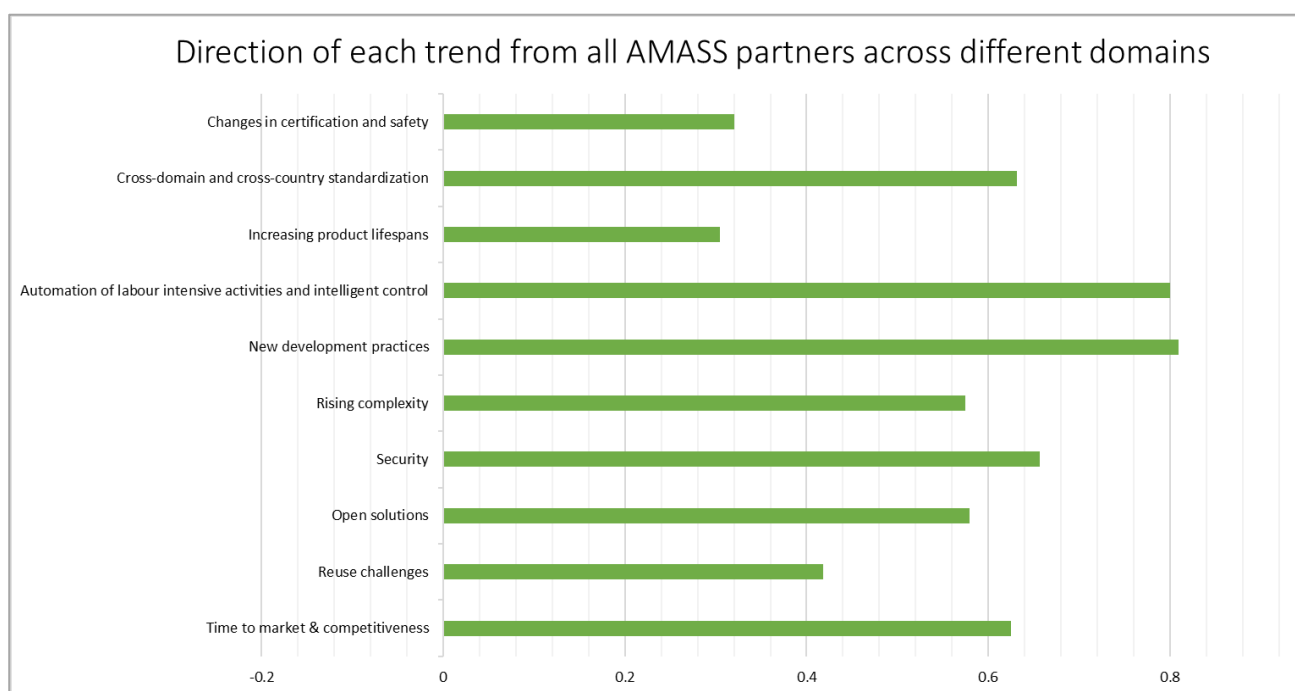


Figure 2. Direction of each trend from all AMASS partners across different domains, on the scale -1 (highly applicable to all respondents, negative trend) to +1 (highly applicable to all respondents, positive trend)

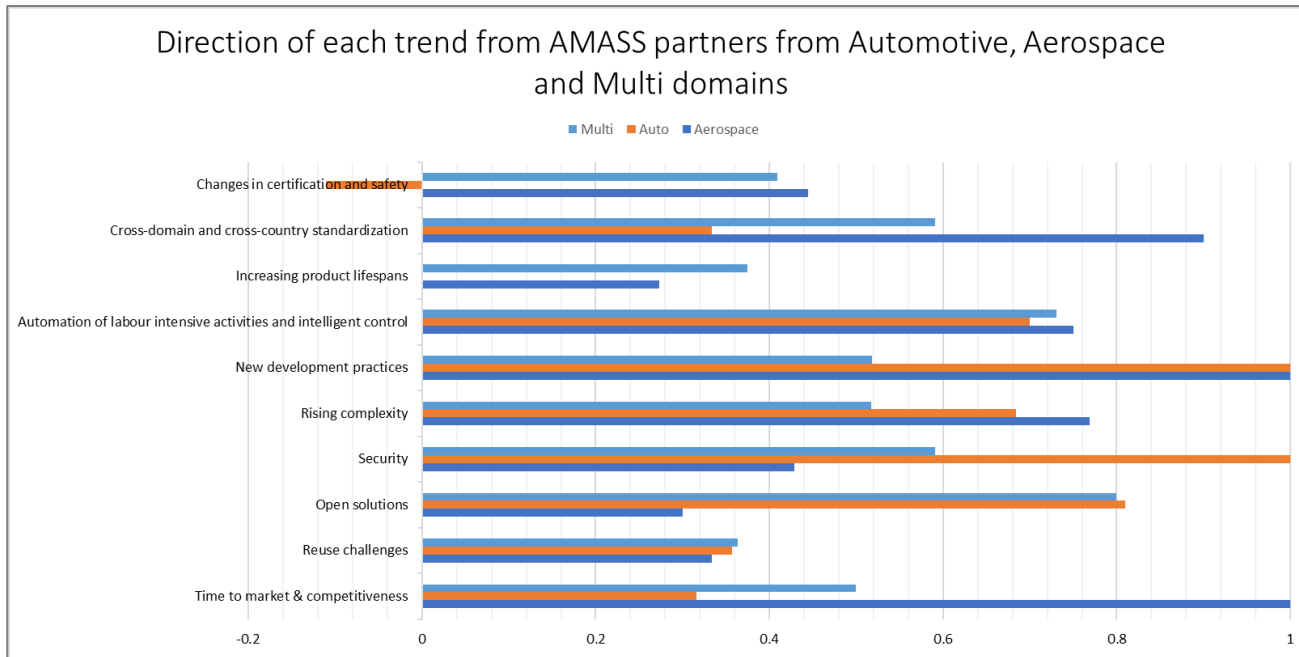


Figure 3. Direction of each trend from all AMASS partners from Automotive, Aerospace and Multi domains, on the scale -1 (highly applicable to all respondents, negative trend) to +1 (highly applicable to all respondents, positive trend)

Answers to the question “Please give an example and a brief description on how your company is adapting/preventing impact to this trend” were collated. This highlighted some of the following common approaches that AMASS partners are using to address market trends:

- Investing in research on metamodels, tools, methodologies to determine the best approach for our developments, such as **model-based techniques**, introduction of **formal methods**, etc.
- Working closely with industry to develop a **continuous integration**, e.g. more tightly integrated test environments to support the need for continuous integration and faster development cycles.
- Researching solutions to enable controlled **flexibility** regarding development processes.
- Adopting “**Agile**” methodology, where “Agile” increases software quality and reduces time-to-market. However, the development of safety critical CPS can hardly take advantage of agile methods due to the lack of support from safety standards.



3. SWOT Analysis Summary

AMASS SWOT analysis is a study undertaken by all AMASS partners to identify its internal strengths and weaknesses, as well as its external opportunities and threats. We have asked all AMASS partners to make a summary analysis of external and internal factors either on the AMASS core technology or a specific part of it. The survey template used in this exercise is attached in Appendix B. A summarised analysis of the results received is presented in the rest of this section by different domains.

3.1 Aerospace / Space

Strength

Its framework contains a complete set of tools that can be used throughout the product life cycle. The web-based nature also supports a collaborative approach. AMASS's tools use proven principles and are employed using widely-adopted technology. All open source software and results of the AMASS tools are publicly available.

AMASS can decrease development time and cost, and has a low adoption cost. It also improves system design and requirements quality. Finally, it can find semantic defects that can be missed by manual reviews.

Weaknesses

Too many user interactions with the configurations of the immature tools, which can be unstable. Solutions do not contain KPIs (key performance indicators). No comprehensive user manual and low dissemination.

Opportunities

Software to help specify requirements is becoming more common and AMASS may create a standard way to define requirements, allowing other companies to engage in verification services. Extend semantic analysis to cover other domains. Support hand-written source code and formal verification tools.

AMASS Tools can be used for software engineering/QA and improving integration with external tools.

Threats

Maintenance and tool support after the project. Companies already have similar verification capabilities, which are simple and well established.

3.2 Automotive

Strength

AMASS is open source, easily accessible from its Web interface and has a low adoption cost. It offers seamless interoperability with external tools and a reduction in manual work by representing information from multiple sources. It applies to many domains and connects design, assurance and certification into the same framework. It uses automated model bases and applies multi-concern co-analysis, while other tools only analyse safety and security.

Weaknesses

The low maturity and low testing may discourage adoption from industry. The Guidelines and Rule Database are incomplete and difficult to learn. The interoperability is not seamless, and the workflow is not adapted to modern development methodologies. It does not include a mechanism to exchange information between buyer and supplier and lacks backwards compatibility.



Opportunities

Industry is becoming more interested in tools that support reuse of existing processes and products (as AMASS does), as they decrease time and cost. Cybersecurity threats are becoming more recognised. The chance to develop an extended standardised rule database. Creation of industrial-grade tools.

Threats

No roadmap and future tool maintenance. Often, changes are expensive and time consuming. Adoption. Competitors may extend their tool coverage and customers may be discouraged by low TRL, thus use “turn-key solutions” while it is being developed.

3.3 Railway

Strengths

AMASS is open source and has lots of interfaces with different tools. Automation of reading and traceability of complex safety-related CPS argumentation. Less time spent on documentation and the tool contains guidance and verification features. The framework encompasses design assurance and assessment phases and a common framework allows effective use of cross-domain and multi-concern assurance.

Weaknesses

Many functionalities complicate the process when used in a specific industrial use. Low maturity and a poor user interface. Dissemination and training in the industry is limited. The integration of needs from different domains presents some difficulty.

Opportunities

The tool has the potential to increase reusability and decrease life cycle cost via automation of repetitive tasks. It can improve the safety and security assurance process.

Threats

Sharp learning curve combined with technologies that may become outdated may affect adoptability. It requires the acceptance of safety authorities. Separate domains may develop and use their own tools. No future maintenance is planned.

4. Updated Individual Exploitation Plan by Individual Partners

This section contains an updated exploitation plan, progress updates, and a list of challenges to market entry from each AMASS partner.

All the AMASS partners have provided their updated exploitation plans up to m33:

1. Tecnia Research & Innovation (TEC)
2. Honeywell (HON)
3. Schneider Electric (TLV)
4. ANSYS medini Technologies AG (KMT)
5. Maelardalen Hoegskola (MDH)
6. Eclipse Foundation Europe GmbH (ECL)
7. Infineon (IFX)
8. AIT Austrian Institute of Technology GmbH (AIT)
9. Fondazione Bruno Kessler (FBK)
10. Intecs (INT)
11. Assystem Germany (B&M)
12. GMV Aerospace and Defence, S.A.U. (GMV)
13. RINA (RIN)
14. Thales Alenia Space (TAS)
15. Universidad Carlos III de Madrid (UC3)
16. Rapita Systems (RPT)
17. The REUSE company (TRC)
18. OHB Sweden AB (OHB)
19. Masaryk University (UOM)
20. Kompetenzzentrum – Das virtuelle Fahrzeug Forschungsgesellschaft mbH (VIF)
21. Alliance pour les technologies de l'Informatique (A4T)
22. Commissariat à L'énergie Atomique et aux Energies Alternatives (CEA)
23. Clearsy SAS (CLS)
24. Alten Sverige Aktiebolag (ALT)
25. Lange Aviation (LAN)
26. Thales Italia SpA (THI)
27. RISE Research Institutes of Sweden (SPS)
28. Comentor AB (COM)
29. Alstom Transport SA (ALS)



4.1 TecNALIA Research & Innovation (TEC)

4.1.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

TECNALIA is an applied research technological centre whose main goal has been clear from the outset: to transform knowledge into Gross Domestic Product (GDP), to improve people's quality of life, by generating business opportunities for companies.

TECNALIA aims at changing radically the ways of transforming knowledge into results. Our claim "Inspiring Business" means identifying and developing business opportunities through applied research. This is based on the four different types of activities we develop:

- Privately Funded Projects: TECNALIA is a strategic partner for the development of new products or processes, or for the improvement of existing ones. We design and develop flexible R&D&I projects adapted to the needs of each organisation, with a clear focus towards the generation of value and the market, promoting the competitive future of businesses and society at large.
- Technology Transfer: TECNALIA VENTURES is responsible for the comprehensive commercialization of the most relevant and state-of-the-art technology developed by TECNALIA itself, in the form of intellectual property, know-how or participation in technology-based companies. An essential bridge between R&D&I and a competitive business position.
- Technological Services: Over 50 years of experience providing technological services for the evaluation and diagnosis of materials, processes, and products. We have a highly-qualified technical staff with access to extensive laboratory facilities.
- Strategic Consultancy in Technology and Innovation: Consultancy in technology-based innovation strategies, pursuing business growth and diversification. Our technological know-how allows us helping our clients to identify and undertake new business ideas, detecting opportunities, and transforming them into successful results.

In this sense, the exploitation of the results coming from the AMASS project is oriented to the two first types of activities in the list above: Privately funded projects and Technology Transfer.

By participating in AMASS, TECNALIA extends its competence in applied software service engineering. More concretely, the AMASS results will be applied in the following ways to improve our business:

- Use and adjust project results (methods and tools) to improve existing products by TECNALIA and generate new ones, to be capable of developing safety-critical systems, especially for the automotive, aeronautics and energy sectors.
- Improve some of the products by TECNALIA in relation to the safety-assurance and certification of embedded systems. In this sense, results from AMASS will improve OpenCert³, the modular & harmonized assurance tool platform hosted at Eclipse/Polarsys. The primary goal of this tool is to provide a set of methods and tools to certify the "conformance" of development activities/artefacts to standards (with special focus on safety and cybersecurity standards such as IEC 61508, ISO 26262, DO-178B or ISA/IEC 62443) or to internal company rules, without worrying about the confidence of the evidence. These methods and tools aim at reducing certification and re-certification effort and times.
- AMASS will help the creation of new systems based on the AMASS assurance/certification concepts. These systems can be tested internally with the modelling tools and quickly validated and verified to be ready for production of small-scale products for OEM's in the Basque Country, such as Irizar (Bus OEM) or Mercedes Benz (Vito EV model, developed in the Basque Country). Moreover, the technology behind the reconfigurable platforms will be very valuable to foster TECNALIA position in

³ <https://www.polarsys.org/opencert/>

the field of software platforms, e.g. the OpenCert tool platform, improving the current solutions with input coming directly from industry.

- TECNALIA already runs a significant business in both Product and Process certification, supported by the ESI@net⁴ network. TECNALIA is a world reference in Software Process Evaluation based on models such as CMMI, ISO 15504-SPICE and ITmark in all continents. The results of AMASS, in coordination with OpenCert, will help our technology transfer activities in this domain by means of improved and new services/products regarding consultancy on assurance/certification concepts for E/E products.

4.1.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

Technology transfer: AMASS results could be linked to the safety-critical community to provide a mature approach for safety/security assurance, to be applied in industrial projects for three different sectors:

- Automotive and aeronautics, mostly the companies that are providers of electronic systems.
- Energy, mainly related to power systems, such as RTUs or IDEs, and electric infrastructures.

In Spain, this will be done in particular across TECNALIA clients and some specific organizations such as sectorial national clusters.

Industry cooperation: participation in seminars/workgroups (LSIS, EADS workgroups, INCOSE, Certification Together community) will be a channel for a broad communication of AMASS results, and thus as a mean for sharing experience and data. TECNALIA will use this advantage on quick design and development of safety-critical systems, and the inclusion of security assurance as a proof for applying similar solutions in the context of the Automotive cluster located in the Basque Country.

The previous aspects refer to exploitation of the project results at an external level, that is, doing business with other companies and entities coming from different sectors. But additionally, we have the opportunity for internal exploitation, that is, applying the results related to methodologies and tools to improve the internal organisation development facilities for model-based development of embedded systems, and related validation & verification activities, which we are currently being performed in the Transport Business Unit of TECNALIA.

We also plan to reinforce our “cybersecurity and safety by design” offer, by working with Schneider Electric – Spain (AMASS partner), particularly in relation to the compliance with functional safety and cybersecurity standards applicable to power systems as well as in their safety-security co-assessment tool support.

4.1.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies and partnerships develop during and after the project?

Regarding the exploitation channels, TECNALIA will use the following ones to spread the AMASS project results at an international level:

- Publication of AMASS results in prestigious international conferences and journals (such as IEEE ones).
- Use of the following Training and Consultancy Department of TECNALIA International Commercial Networks and Exploitation Channels:
 - TECNALIA delegations: Basque Country, Madrid, Barcelona, Sevilla. At the moment, TECNALIA delegations exist in Nuevo León (Mexico), Montpellier (France), Pontedera/Pisa (Italy) and

⁴ <https://www.tecnalia.com/en/ict/international-presence/esinet-network/esinet-network.htm>



Belgrade (Serbia).

- Associated Innovation Centers: At the moment, Associated Innovation Centers exist in Cairo (Egypt), Bogota (Colombia), Sofia (Bulgaria) and Anglet (France).
- Commercial alliances: TECNALIA is engaging in commercial alliances with locally active companies, in order to get quick access to market knowledge, increase sales of own products and services in the respective country through its partners, and start connected R&D projects with local clients, sometimes including the partner as well. The ESI@net in the area of ICT exists since 2001 and is composed of 35 partners from 20 different countries.
- Participation in international networks: The valorisation methodologies TECNALIA uses to introduce its technological assets in international markets differ very little from the ones it is applying in its home market. The Cyber Security & Safety research group⁵ is active in several relevant international organizations.
- Inspiring Business Forum⁶: for the early distribution of high added-value technologies and associated business opportunities, TECNALIA has created an exclusive forum for interested companies where they get priority access to business opportunities, either detected by TECNALIA or coming from a network of international partners. The Inspiring Business Forum is in the process of being opened to companies from overseas, and TECNALIA is thinking of replicating the model with local partners in other regions of the world.
- TECNALIA Ventures⁷: TECNALIA can count on its own Technology Transfer Office (TECNALIA Ventures) that supports the business units in all technology transfer issues, from licensing out to the creation of spin-off companies.
- Out-licensing of technological assets (IP): The IP produced by TECNALIA business units is licensed-out internationally to interested companies, either directly through the business units themselves or using TECNALIA's internationally active Technology Transfer Office.

4.1.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

The main outcome of the AMASS project will enhance the current safety-critical systems R&D by safety and security assurance and certification capabilities to our offering. The return is expected to be materialised onto new co-operations and collaborations and new areas where an integrated vision on safety and cybersecurity, proposed in AMASS, is needed.

It is expected to increase our consultancy and other supporting services related to safety/security assurance and testing in 1 to 2 years. We expect to increase this number thanks to the results of AMASS up to 3 services, summing up to 100,000€. This will enable TECNALIA to recover the investment in the project in 2021, after AMASS project termination.

The events, results and dissemination strategy, proposed in the project definition, will provide an increment in the social and networking activities of TECNALIA. This will provide an excellent value over the company research lines, towards the definition of new services for new customers, enhancing the offer in model-based development of safety-critical systems, safety assurance, and certification.

4.1.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

None yet.

⁵ <https://www.cyberssbytecnalia.com>

⁶ <https://www.tecnalia.com/en/tecnalia/inspiring-business-forum-en/inspiring-business-forum.htm>

⁷ <http://www.tecnaliaventures.com/?lang=en>



4.1.6 Exploitation activity update up to m33

Up to December 2018, TECNALIA has carried out several activities related to the exploitation of the results coming from AMASS. The most relevant ones are the following:

- Contact with Leet Security company: The rating agency Leet Security is an independent entity, formed for the sole purpose of developing and managing a labelling system to qualify reliably the levels of information security offered by ICT service providers. TECNALIA and Leet Security are in contact to analyse how OpenCert can support the labelling certification process and be a helpful solution to the final clients of Leet Security.
- Contact with Global Logic company: This company contacted TECNALIA because of its interest in the OpenCert platform. The platform was presented in detail to them and an economic offer was sent that included different services such as training and digitalisation of different standards.
- Contact with PESI⁸ (Plataforma Tecnológica Española de Seguridad Industrial/Spanish Technological Platform for Industrial Safety). This Technology platform was contacted during the EFES event in Lisbon and got interested in the AMASS tools and how they can be applied in the Industry domain.
- TECNALIA has been contacted by a company working on the robotics domain and related to safety/cybersecurity issues. They are very interested on early safety validation solutions such as the one promoted by Sabotage⁹. Several meetings were carried out and possible collaborations established.
- Several contacts with companies from different vertical markets have been carried out during the INCIBE ENISE conference¹⁰. They expressed their interest on approaches, methods and solutions regarding safety-security co- assessment in terms of automotive cybersecurity. The current status of cybersecurity standards for automotive was mentioned and some results of AMASS presented as a success story during the cybersecurity automotive workshop.
- We have established the first steps for a possible cooperation between Ansys, Assystem and TECNALIA with Fraunhofer Institute FOKUS in Berlin and Hochschule für Technik und Wirtschaft Berlin. This would allow to continue the work on the VeloxCar, which was started during the AMASS project, and to establish something like an ecosystem on top of the VeloxCar / CeCar platform.
- Possible commercialisation capability of some of the achieved TECNALIA results within AMASS have been evaluated by TECNALIA Ventures.

4.1.7 Challenges to market entry

Compliance with security standards in the industrial sector is still at a very early stage of adoption. In fact, it is in the last few years that the first security standards have begun to appear in some sectors, such as IEC 621351 for power systems, or IEC 62443 for IACS (Industrial and Automation Control Systems).

TECNALIA has detected that companies that are suppliers of equipment for critical sectors – mainly energy and transport – are concerned about how to address the design and development of their products considering the security aspects from the very beginning. However, most of the industries do not still consider their products with a “security/safety by design” attitude. As the consideration of security standards for the industry sector is still in its infancy, the adoption of tools to manage compliance has a long way to go. The challenge will be to offer a tool that fulfils their specific requirements and needs, and to make it easy to use. A first approach to the critical infrastructure sector, in which the advantage of using this type of tool is observed, can facilitate its later adoption in other less advanced industries.

8 <http://www.pesi-seguridadindustrial.org/es>

9 <https://www.cyberssbytecnalia.com/node/271>

10 <https://www.incibe.es/en/enise>



4.1.8 Future plans beyond the life of the project

TECNALIA plans to use the results of AMASS, such as the OpenCert tooling developed by TECNALIA, into other research projects such as PDP4E EU project¹¹ (*Methods and tools for GDPR Compliance through Privacy and Data Protection 4 Engineering*) to check if its approach could be feasible for privacy compliance. Also, the AQUAS EU Project¹² (*Aggregated Quality Assurance for Systems*) will use some of the results provided by AMASS.

The Assurance Case editor which is part of the AMASS Platform will be used in training and consultancy services in relation with safety cases. TECNALIA also plans to provide consultancy services in relation to the standards that have been used in the project such as IEC 61508 or ISA 62443.

The future Sabotage scheme defines further development of the tool by adopting it in other research projects such as the ongoing H2020-RobMoSys eITUS Project¹³ (*Experimental Infrastructure Towards Ubiquitously Safe Robotic Systems using RobMoSys*). By doing so, the feasibility to applied fault injection concepts and tools are been analysed in other safety-critical domains such as robotics. Eventually, future research opportunities may enable us to enhance current Sabotage capabilities as follows: on the one hand, the feasibility to extend the current fault injection testing approach by applying artificial intelligence and digital twins in combination with model checking for the test verdicts, will be considered. On the other hand, the framework might be extended to address not only safety but security concerns as well. The fault model library can be populated with attack models enabling us to study and evaluate the impact of cybersecurity attacks on system safety early in the development process.

It has to be noted that Sabotage will be introduced into the TECNALIA commercial catalogue.

¹¹ <https://www.pdp4e-project.eu/>

¹² <https://aquas-project.eu/>

¹³ <https://robmosys.eu/e-itus/>



4.2 Honeywell (HON)

4.2.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

Honeywell expectation is to lower the development costs as well as the costs of poor quality by deploying AMASS results in its projects, and via a formal verification integrated tool chain.

4.2.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

Aerospace market in general.

4.2.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

The exploitation is planned as follows:

- Pilot evaluation of AMASS methods and tools in the development process of selected Honeywell projects (Control Systems, Display and Graphics, etc.).
- Pilot deployment of AMASS methods and tools, in the development process of selected Honeywell projects (Control Systems, Display and Graphics, etc.).

4.2.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

Short term (1-2 years): model checking using DIVINE LLVM C/C++ should reach TRL 5 in 2019 and new low-maturity features will be added afterwards. The tools will be deployed in selected own pilot projects (Control Systems, Display and Graphics, etc.). Return on investment value is estimated to be about 2.02 just for one program in Control Systems.

Midterm (3-5 years): formal verification integrated tool chain and other AMASS results will be deployed in multiple Honeywell programs or projects, and the savings will then be computed more precisely. For example, in Control systems alone, projected savings is 2200 hours yearly (without counting automated test generation savings).

4.2.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

The IPR is protected by consortium agreement. Non-Disclosure Agreements will be signed in case that we need to share confidential information with AMASS partners we cooperate with closely. In case of a new technology invention, a patent would be considered.

4.2.6 Exploitation activity update up to m33

Deployed requirement semantic analysis on Multi-modal Interaction Manager project – automated detection of unfireable rules within gesture recognition system covers complete system.



Model checking of requirements written as C asserts using DIVINE LLVM model checker deployed to programs with Simulink models.

4.2.7 Challenges to market entry

Adoption of industrial requirement standard that has a single requirement form that is both human- and machine-readable, which allows automated formal verification of the requirements as well as automated test case generation, is difficult for legacy programs where changing the requirement standard in general would bring additional cost to the program. Therefore, we are focusing on the new programs.

4.2.8 Future plans beyond the life of the project

Follow up the project with Automated formal verification idea, where the tools would be deployed within continuous integration process, support also hand-written source codes and add more formal verification tools to increase scalability and remove false positives from static analysis tools.



4.3 Schneider Electric (TLV)

4.3.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

Schneider Electric expects to integrate new safety and security methodologies and tools to its Remote Terminal Units (RTU) devices, based on the standards, such as IEC 61508 and IEC 62443. The new AMASS tool would be integrated in the design and development RTU processes, including safety and security requirements in the workflow, improving the related verification and validation, and enabling the certification in these two aspects.

4.3.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

Schneider Electric's exploitation plan for the project will be part of the global Smart Grid Strategy of the Company. The project results will have a direct impact in control devices (RTU) for the Smart Grid, providing solutions with new safety and security features to customers in the energy sector (Utilities).

Schneider Electric intends to exploit the project results with an international vision. The important presence of Schneider Electric in the global market will represent an excellent opportunity for exploiting the results of the project and to promote it.

4.3.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

Firstly, Schneider Electric will use the AMASS platform in the case study (CS1) to check its functionality for the RTU design and development process. Tecnalia and AIT, as safety and security experts, will participate in this case study.

After the project, the future use of AMASS platform in the internal procedures will be considered, based on the evaluation and case study results.

4.3.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

(1-2 years): methods and tools that are evaluated in RTU non-production environment.

(3-5 years): methods and tools that could be applied to RTU production environment.

4.3.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

If needed, NDA could be signed to share confidential information.

4.3.6 Exploitation activity update up to m33

Up to m24 (March 2018) Schneider Electric was validating the second prototype of AMASS and defining new functionalities for the third prototype. According to the results obtained for these first prototypes, Schneider Electric could exploit the AMASS tools in two main levels. The first level is related to the RTU



development processes and affects the safety and security analysis respect to some standards (IEC 61508 and IEC 62443). The use of AMASS tool will provide the gap analysis respect to the standard requirements. On the other hand, the second level is related to RTU product and affects the security and safety co-analysis, detecting vulnerabilities and checking requirements in order to increase the resilience of the RTU against cyberattacks and safety issues.

4.3.7 Challenges to market entry

The trend of the energy market is going to products more secure that comply with new safety and security requirements. New regulations for the energy sector are emerging in order to increase the protection of its critical infrastructures. Standards such as IEC 61508 and IEC 62443 are being considered by the industry as a guide to include safety and security aspects in their products. In this context, end users are demanding security certifications that imply high cost and effort. The sector is looking for new methods, techniques and tools that improve the safety and security aspects of products and also, reduce certification costs. The challenge now is to adapt these tools to the specific needs of this sector, taking into account its standards, requirements, architectures and functionalities.

4.3.8 Future plans beyond the life of the project

Beyond the life of the project, Schneider Electric has the intention to use the AMASS results and tools to improve the safety and security of its product Saitel RTU. The AMASS platform could be integrated in the RTU development process, in order to obtain the GAP analysis of the new products respect to the standards and also to carry out the co-analysis. The target is to improve the safety and security of the RTUs.



4.4 ANSYS medini Technologies AG (KMT)

4.4.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

The main business idea of KMT is to strengthen its position in the market for functional safety tool support. It is planned to extend the existing tool suite *medini analyze* with new features or new components that will be based on AMASS ideas. Focus here is on new seamless collaboration approaches, re-use of safety related information/components, and architectural patterns.

The cloud based seamless collaboration approach for functional safety analysis, as it has been investigated in AMASS is already part of the *medini analyze* product roadmap. The idea is to lift the product from the today purely rich client Eclipse based realization to a web based thin client cloud solution in the future (see 4.4.8). This offers new possibilities as additional product features can be offered due to the availability of the data in a centralized repository. In particular the data analytics capabilities (as investigated in AMASS) raise great customer interest (cp. presentation of Daimler AG at medini user conference 2018: "Towards Digital Safety Manager").

Besides the main focus on the product offerings, KMT seeks partnerships and collaborations that allow to broaden its scope towards other domains. The focus of KMT has been on the Automotive domain. However, in 2017 a major step towards the opening into other domains has been made. There has been introduced a profile mechanism that allows to select a "safety domain" like ISO 26262 or ARP4761 for a project in *medini analyze*. This profile influences the tool behaviour – so that e.g. some actions are only executable in certain contexts. It is planned to provide further domain profiles in the coming time.

4.4.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

First step: Automotive OEM's, Tier suppliers and Semiconductors that deliver safety-related products.
Second step: OEM's, Tier Suppliers and Semiconductors in other domains (Industrial, Aerospace).

The exploitation will be organized along the medini analyze existing customer base.

4.4.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

Results of AMASS will be further developed to achieve the appropriate maturity level and then offered to the market. Either new tools will be added to the *medini* product line, or new components will be added to existing products. The business model for the tool will be a license model with the additional charge of yearly maintenance and service fees or a subscription model. Especially with the help of seamless integration, KMT will open its target market and will significantly extend its market share. Furthermore, the large participation of industrial partners with appropriate case studies and new target domains will strengthen KMT's potential to extend its current business.

Besides the above described tool business, the consulting branch of KMT will be strengthened by new topics especially in the area of certification. This topic is becoming more and more important in the Automotive domain and, with the expertise gained in the AMASS project, KMT will be able to further extend its current business in such domain.

In terms of concrete steps, KMT will conduct a number of activities that increases its reach on the market:

- User conferences – this has the broadest audience of existing customers of medini. Typically, 2 times



a year.

- Seminars – organized on the major regions (China, Japan, Europe, US) for introduction of new topics in relation to the tool offerings
- User days – per customer events
- Internal trainings/events (Sales kick-off, FAE days) – to spread the knowledge to the internal team of ANSYS (sales and technical teams)
- Webinars – various, at least once a month for new topics
- White papers – various
- Technical papers and publications – on conferences, in journals

4.4.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

Commercialization will happen via tool licenses or tool subscriptions (lease).

It is expected that AMASS results help to remain at a strong growth rate for new *medini analyze* license sales. This long-term growth rate shall be between 10 and 20% per year. The growth rate in 2017 has been 100%, but this is considered as short-term effect. The growth rate of the *medini* product business in the first half of 2018 has been ~65%.

4.4.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

Software patents are not considered useful in Europe. Consortium agreement should be sufficient to protect knowledge. There are internal procedures in ANSYS to protect knowledge.

4.4.6 Exploitation activity update up to m33

The project work in AMASS is tightly coupled to the product planning activities for *medini analyze*. In summer 2017, a 3 years product roadmap has been planned and discussed and agreed within the ANSYS SBU. This product roadmap is the basis for our exploitation plan, that foresees the provision of new features of *medini analyze* that are based on AMASS. In summer 2018 this product roadmap has been updated and includes a concrete realization plan for a seamless collaboration feature in *medini analyze* based on AMASS results. Other AMASS results will be part of subsequent product roadmap discussions (next in summer 2019.)

Product management of *medini analyze* has been made aware of the results of AMASS to plan the productization of the project results.

In 2017, the events as described above have been conducted to make customers aware of long-term product roadmaps: 2 user conferences, 7 seminars, various user days and webinars.

In 2018, the series of events has been continued with 2 user conferences and multiple seminars, webinars and user days.

4.4.7 Challenges to market entry

Customers expecting more and more complete solutions, it is necessary to demonstrate the usefulness of the tools in the customer environment.

Entering other domains than Automotive is a challenge, since not only the tool needs to be present, but also the domain experts that can show and demonstrate the tool application to the customer. Such



experts are difficult to find and hire. Therefore, the introduction of the product to the customers can take more time.

4.4.8 Future plans beyond the life of the project

The seamless collaboration based on cloud technologies are already part of the medini product roadmap. The realization will include 2 steps: In the first step, the rich client will still be used but connected to a synchronization server which enables real time synchronization among people working on the same project. In the second step the rich client will be subsequently replaced by a thin client.

Other AMASS results will be feed into the medini roadmap discussion, which is scheduled for summer 2019.



4.5 Mälardalen University (MDH)

4.5.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

Academic achievements are counted in publications, recruitments and development of new courses. But in the long run also new project grants and industrial collaborations are inevitable prerequisites for successful academic research, thus the achievements of a good project are within all these areas.

MDH will primarily further develop its competence in the area. It is envisaged at least one promotion to associate professor, and a set of strategic recruitments of senior researchers and PhD-students to establish the knowledge field at the university. Through all of them a set of journal and conference contributions are expected.

The consortium itself represents also a base for future research activities in the area, and the partnership is expected to lead to future collaborations. The project is foreseen to support the partaking organisations, so the growth and development of the partner organisations, based on successful project efforts, is also a part of the benefit for the university, since also the collaboration opportunities will grow.

AMASS is also probably the largest European initiative in the area of Assurance and Certification of Cyber-Physical Systems, so the MDH active participation in AMASS is also expected to promote its reputation, and the contributions from MDH will promote its authority in the area.

4.5.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

New research collaborations, for instance with automotive and other industry in different research programs, both nationally (SSF, KKS) and internationally (ECSEL, ITEA, Horizon).

Increased attraction of students via the development of new courses related to certification promoting the AMASS platform.

4.5.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

The main outcome is a result of intense academic research work. To let it take place a strong project management is needed, which includes and emphasizes the efforts of the individual project workers. Models and methods could be patentable, partnership could be strengthened, and mentorship of individuals could be an efficient tool for this.

There are support structures and experience of this kind of processes at MDH. There is also other public support available, as specific public funds and agencies for innovation (Västmanlands Forsknings och Utvecklingsråd, ALMI företagspartner, VINNOVA). Patenting, covering both Sweden and a European market or worldwide as well, might cost about 20,000 €.

The main research issue that MDH would like to exploit would **be the connection of the three dimensions (Process, Product, Assurance Case) for variability management and impact analysis, the patterns and the model-transformations for argument fragment generation for Cross-Domain and Intra-Domain Reuse, and patterns for compliance checking**, which in the end will allow collaborating with commercial



companies to benefit from the research. The methods may be patentable and might represent a base for a new spin-off company.

4.5.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

The academic value of the results would be the promotion of the individuals, and the possibility to propose new projects. More specifically it is expected that at least 2 Postdoctoral Fellows, 1 PhD student, 3 MSs students, and 2 engineers will work on AMASS-related topics and will become members of the group during the project.

The commercial value is harder for us to estimate.

4.5.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

For a commercialisation of the models, identification of ownership has to be done in the frame of the consortium agreement. Potential way of doing this is through establishing a spin-off company, consisting of the inventors. Another way of doing it is to let the existing business partners exploit the ideas.

For academic purposes, the most important way to protect IPR is to publish the new results. In that case collaboration agreements with specific business partners would be enough to secure the freedom to publish.

But patenting new methods could also be a way, and in the Swedish context the permanently employed researcher has the right to own the results privately, which makes the creation of a spin-off company easier.

4.5.6 Exploitation activity update up to m33

To prepare the exploitation of AMASS results, the following activities were conducted:

- Definition of a new course entitled: Quality assurance - Certification of safety-critical (software) systems to be offered for the first time during Spring 2019.
- New course related to AMASS results to be offered at MDH as part of the PROMPT initiative.
- Possible commercialization capability of some of the achieved MDH results within AMASS have been evaluated positively by Profengy (Västerås, Sweden). However, no additional effort has been spent yet to investigate further this possibility.

4.5.7 Challenges to market entry

From an industrial adoption perspective (transfer of MDH results to industry), possible challenges to MDH-market entry are as follows:

- The solution proposed within AMASS have the potential to be innovative, however, the theoretical background and its novelty might be hard to absorb and master. Thus, practitioners might have difficulty to see the benefits in their mid-term future and might be reluctant to its adoption.

To face this challenge, a course targeting regular students as well as employees has been conceived and it is currently under development and expected to be offered in March 2019. At the same time, in the context of DVA437-2018/2019 edition, the usage of CHESS tool has been proposed.



Another general challenge is represented by the fact that in some industries, the adoption of standards is still in its infancy. The personnel responsible for dealing with compliance-related tasks is used to manually check the compliance via interviews and to redo the work from scratch for each new project. This is also true for the provision of evidence regarding system safety.

Automating compliance checking or argumentation seems to be a futuristic goal. Desirable but still too far with respect to the daily execution of the work.

Once again training seems to be a contributing solution for reducing the gap.

4.5.8 Future plans beyond the life of the project

To continue maintaining and enhancing the functionalities via other projects.



4.6 Eclipse Foundation Europe (ECL)

4.6.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

By supporting the AMASS partners to publish their results in open source, Eclipse Foundation Europe GmbH plans to achieve the following important goals:

- Improving its Open Source technology portfolio
- Growing the ecosystem, around open source tools for Embedded Systems.

The benefit for the Eclipse Foundation is to recruit new members, and to provide more value to existing members thanks to a larger community.

4.6.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

Generally speaking, we target companies that design and develop embedded systems.

More specifically, we envision that large organizations will adopt the AMASS open platform, and leverage it in order to integrate assurance and certification features in their tool chains.

We also target small enterprises that are assigned more and more importance in the value chain and are now asked by their customers to cover more and more activities in the product lifecycle, including assurance and safety activities. For those small enterprises, the existence of an open source solution that can be used as is for small projects is a game changer as they get access to similar technologies than the larger companies, even with their limited resources.

4.6.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

Recruiting new members for the Eclipse Foundation starts with building a community about useful and innovative open source technologies.

At this stage, the development of the AMASS open source platform happens in public in the context of the OpenCert and CHESS projects.

After this important stage, the Eclipse Foundation is promoting the project results through newsletter and other channels, and tries to attract more partners around the AMASS open platform that would become members of the Eclipse Foundation to collaborate in this open source platform.

4.6.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

In terms of estimated value, the project helps retaining Eclipse Foundation members like CEA, Tecnalia, Infineon, Thales, ...

It also helps attract new members from the consortium. So far, MDH joined the Eclipse Foundation thanks to the AMASS project, and we hope to have at least 2 or 3 more partners joining the Eclipse Foundation, as new members by the end of the project.



4.6.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

Assets created or published by the Eclipse Foundation are published under the Eclipse Public License v2.0, or possibly the Creative Commons by-sa 4.0 license for documentation.

4.6.6 Exploitation activity update up to m33

Our main exploitation activities are focused on the promotion of the Eclipse Foundation by demonstrating our specific approach of open innovation and exploitation of research through open source.

We have promoted AMASS to potential new Eclipse members, as well as with existing members like Bosch or Thales Global Services. We usually integrate AMASS in presentations of our research activities.

We also had a focus on AMAS during the following events:

- Research booth at EclipseCon France 2017 with the participation of Tecnalía
- ERTSS 2018
- EC France 2018 with the participation of MDH including a video interview, a pitch of the project, a short talk in plenary session, and presentation on the booth
- Models 2018
- EC Europe 2018 with the participation of FBK

Finally, we focused on improving the OpenCert website and we will continue our work in this domain in order to demonstrate how AMASS technologies improve the coverage of the V model at PolarSys.

4.6.7 Challenges to market entry

We envision three main challenges to market entry for AMASS open source technologies:

- It takes time to create a vibrant open source community that ensures that the sustainability of the AMASS open source results will contribute to the growth of the PolarSys/Eclipse ecosystem.
- Open Source is an advantage to ease adoption as it allows “permission-less” evaluation and innovation, but open source adoption also requires mature technology which is always a challenge for research projects results.
- AMASS addresses conservative industries where the owners of the quality assurance and certification process are sometimes reluctant to try new approaches.

4.6.8 Future plans beyond the life of the project

The Eclipse Foundation Europe will support the organisations that develop the AMASS open platform, even after the end of the project, as long as there will be activities on the open source projects being part of the platform. This support includes:

- Providing the collaboration infrastructure (Git, Gerrit, Wiki, mailing lists, forum, website) for OpenCert, CHESS, Papyrus, and other Eclipse components of the AMASS open platform.
- Supporting the development team through the Eclipse Development Process, and Eclipse Intellectual Property due diligence.

In addition to that, the Eclipse Foundation will help with recruiting new companies interested in the AMASS Open Platform in the context of its usual business development activities.



4.7 Infineon (IFX)

4.7.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

- Strengthen the position in Advanced Driver Assistance Systems (ADAS), towards semi and fully autonomous driving.
- Key factor is the step from fail safe to fail operational (target: level 5) systems.

4.7.2 Markets/Customers

Please list the markets or customers which you intend to exploit the results from AMASS.

- Focus on automotive

4.7.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

- Project results will become integral part of future design flow.

4.7.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

- Primary goal is to act as door opener for new applications (towards autonomous driving).

4.7.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

- AMASS results itself will probably be published
- Results integrated into our in-house design flow will only be available at company internal level
- No patents planned so far

4.7.6 Exploitation activity update up to m33

N/A

4.7.7 Challenges to market entry

Infineon is already an established player in the automotive semiconductor market. Currently, no new market is within focus. AMASS will help to keep and extend the market position.

4.7.8 Future plans beyond the life of the project

AMASS results will help Infineon by learning from other domains, e.g. aviation and enable our customers



to use automotive components in a broader range of applications.



4.8 AIT Austrian Institute of Technology GmbH (AIT)

4.8.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

AIT expects to strengthen its position in the development of safety and security related engineering methods and tools, specifically, a workflow and tool automation platform for the engineering process for safety and security assurance of critical systems. The tools and the resulting expertise will be offered to other partners outside of the project, in cooperative or contracted research. Additionally, AIT will exploit the knowledge and experience gained in AMASS in the context of ISO and IEC Standardization for functional safety and cybersecurity, thus promoting recommended use of co-engineering methodologies and tools.

4.8.2 Markets/Customers

Please list the markets or customers which you intend to exploit the results from AMASS.

OEMs and suppliers for connected and safety-critical systems, in domains like automotive, railway, avionics, space, and industrial automation and control.

4.8.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

AIT thinks that, while the publicly available AMASS platform is a good basis for further exploitation, all parts developed should be suitable as standalone applications, and able to cooperate with tools outside of AMASS, in order to restrict dependencies. To support the ongoing the development of tools after AMASS, open interfaces are considered valuable.

AIT provides mainly four methods and respective tools, which are external to AMASS but connected to the platform via standardized open interfaces. This strategy allows to keep the tool software confidential for commercial exploitation while being, at the same time, open for collaborating with the AMASS platform or any other platform supporting the same open interfaces. A particular advantage of this strategy is that the AIT tools can also be used stand-alone by customers who do not use the AMASS platform.

4.8.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

Short term (1-2 years): tools with TRL 6-7, that are evaluated in non-production environment.

Midterm (3-5 years): methods and tools that can be applied to production environment.

4.8.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

Combination of open and closed code, with clearly defined interfaces. Only the interfaces are open source, while the tool software remains proprietary. Licensing business models as well as hosting the tool for a customer including consultancy are envisaged.



4.8.6 Exploitation activity update up to m33

The AMASS results regarding the workflow engine WEFACT, the standards compliant safety and security co-analysis process and the respective tool extensions in FMVEA and MORETO, and the AMT2.0 tool for Contract-Based Multiconcern Assurance by monitoring will be used as a basis for follow-up research projects. AIT's membership in several standardization groups for safety and cybersecurity offers the chance to influence standardization by bringing in experience from the AMASS project into these working groups.

Recently, a collaboration activity with AQUAS project members was initiated, who are invited to a technology exchange meeting. Moreover, AIT is inviting AMASS partners to present their developed technologies at events like the industrial sessions of the AdaEurope conferences.

AIT's workflow management technology, which was extended for multiconcern assurance purposes for application in AMASS CS3, is now planned to be further extended for application in the drones' industry domain. The respective Comp4Drones proposal has been successful in the 2019 ECSEL call.

4.8.7 Challenges to market entry

AIT's methods and tools portfolio with regards to safety and security co-engineering is slowly finding a broader market as the awareness about cybersecurity threats is increasing in industry. However, industrial practice is still mostly maintaining separate safety and security practices and teams, and flexibility to change corporate processes towards combined engineering methods is low due to associated cost for tools and training but also due to lack of acceptance in both safety and security communities.

Another limiting factor is currently the TRL of the tools provided by AIT. Therefore, effort has to be invested to professionalize the tools and increase the TRL.

For entering markets other than those covered in AMASS (industrial and automotive domains), the requirements of respective standards must be implemented (e.g. as rules in FMVEA tool) in order to provide a turn-key solution which customers usually prefer.

4.8.8 Future plans beyond the life of the project

AIT will use experience gained in AMASS in ongoing research projects like AQUAS to influence the method development for multiconcern assurance. AIT plans to increase the degree of automation in multiconcern engineering activities through research activities in other ongoing or future projects. Furthermore, AIT plans to extend the multiconcern-enabled workflow technology for more domains than those covered in AMASS; first respective results are expected in the Comp4Drones project which is scheduled to start in July 2019.

The collaboration on automated monitoring with ANSYS started in AMASS CS2 has proven very fruitful and is planned to be continued also beyond the runtime of AMASS.

Another important exploitation channel are standardization bodies in which AIT is involved, in particular those for ISO 26262 (safety) and the upcoming SAE/ISO/IEEE 21434 (cybersecurity) for the automotive industry.



4.9 Fondazione Bruno Kessler (FBK)

4.9.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

FBK expects: 1) to strengthen the applicability of FBK's tools in the process of development and certification of embedded systems; 2) to increase the adoption of FBK's tools by industrial partners; 3) to identify industrial needs and develop novel methods to address them. FBK would benefit in terms of visibility and new partnerships based on the AMASS results.

4.9.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

FBK develops analysis tools that are domain independent, but used in domains such as space, avionics, railways, automotive, health, automation control, and smart systems.

4.9.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

The concrete exploitation plan of FBK comprises the following steps:

- enhancement of FBK tools with new functionalities related to the architecture-driven approach
- integration of FBK tools in the architecture-driven approach of AMASS
- publications about the research results obtained in AMASS
- industrial adoption of the assurance-driven approach using FBK tools
- increase the maturity level of the FBK tools

4.9.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

FBK is a non-profit research organization and currently no commercial benefit is expected from the participation in AMASS.

4.9.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

Not yet planned actions for IPR protection. Research results will be published on open access publications; contributions to the AMASS platform will be released as open source; FBK tools will be released with specific licenses.

4.9.6 Exploitation activity update up to m33

At the current time, the following activities are done:

- Enhancement of FBK tools with new functionalities related to the architecture-driven approach.
- Integration of FBK tools in the architecture-driven approach of AMASS.
- The AMASS platform and approach has been disseminated by FBK in various events such as EclipseCon and EFECs.



- Increase the maturity level of the FBK tools.

No industrial adoption of the assurance-driven approach using FBK tools were found yet.

4.9.7 Challenges to market entry

Not applicable yet.

4.9.8 Future plans beyond the life of the project

Exploit the outcome of the AMASS project in future research projects.



4.10 Intecs (INT)

4.10.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

Intecs will use the methodological results and the acquired knowledge for increasing its technical lead and competitive edge in the AMASS core domains, and for opening up domains where architecture-driven, multi-concern, and seamless assurance and certification are essential for the development of trusted and reliable CPS and systems of systems. Therefore, Intecs will expand and integrate its development capabilities and consultancy portfolio in relation with best practices and standards, as improved within AMASS.

Intecs is the main contributor to the CHESSE toolset, that was delivered as open source under the Eclipse Polarsys working group (see the CHESSE Project¹⁴) since 2013. The Polarsys group is an open source industry collaboration created at the Eclipse Foundation, to focus on tools for safety critical and embedded system development.

All the extensions developed for CHESSE in AMASS are delivered under Polarsys, as soon as they are completed, as part of the existing CHESSE Project. The open source distribution of the AMASS products, specifically addressing markets of interest to Intecs, is expected to increase the company visibility, competitiveness and returns in terms of support, training, consultancy and customization services.

Intecs is also interested to influence the evolution of the OMG SysML[®] and MARTE modelling standards, according to the AMASS results.

4.10.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

Intecs designs and develops applications, tools, software, hardware components and products for Aerospace, Defence, Transportation (Railways and Automotive) and Smart Systems markets.

Intecs intends to promote the use of AMASS for the development, assurance and certification of critical systems in all these domains.

4.10.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

Participation in AMASS will feed directly the Intecs core competency and leadership position in CPS model-based development in the Europe. We have a direct commercial interest in several areas, including development capability (i.e. projects with major customers, including Finmeccanica and RFI in Italy), consultancy (we provide consultancy to a large number of customers in Italy), and tool offerings (we contribute to the Polarsys initiative and promote industrial open-source modelling and formal analysis solutions).

Concrete exploitation plans for Intecs would be:

- a) Consolidation of the enhancement of the CHESSE toolset, with the AMASS architecture-driven, multi-concern assurance, and certification-related functions and methodology
- b) Promotion and support for the industrial adoption of CHESSE by the end users of AMASS.

¹⁴ <https://www.polarsys.org/chess/>



4.10.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

Short term (1-2 years): open source availability of the integrated toolset, with improved maturity, and visibility, no direct commercial value.

Midterm (3-5 years): methods and tools to be offered for adoption by industry, we estimate a growth related to the provision of new training and consultancy services, acquisition of new projects/customers.

4.10.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

IPR generated by AMASS is offered as open source, protected by the Eclipse Public License (EPL).

4.10.6 Exploitation activity update up to m33

The plan is confirmed.

Currently:

- a) Enhancement of the CHESS toolset are available on Eclipse, integrated with OpenCert
- b) Industrial adoption of CHESS by the end users of AMASS has started

4.10.7 Challenges to market entry

Industrial adoption of open source solutions requires some time, to ensure their maturation level is high enough. However, since commercial solutions are expensive, especially for SMEs, and their customization is poorly supported and expensive, we expect we can reach the market in the near future, supported by extensive dissemination and promotion.

4.10.8 Future plans beyond the life of the project

- a) Adoption of CHESS and AMASS results for the Intecs internal industrial projects (prototyping and development of new products), in order to further experiment the toolset and increase the company capability in systems development.
- b) Achieve at the end, the enhancement of the maturity level of CHESS toolset from currently TRL 5, that is a technology validated in industrially-relevant environment, to TRL 7-8, possibly as a complete technology as successfully experimented in operational environments.



4.11 Assystem Germany (B&M)

4.11.1 Business Idea/Product & Services

What does your organization expect to achieve from AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

Main business idea of B&M is to strengthen its position in the market for software test and functional safety design tool support. It is planned to extend the existing tool TESTONA with new features or new components that will be based on AMASS ideas. Focus here is on new seamless collaboration approaches, re-use of safety related information/components and architectural patterns.

Besides the main focus on the product offerings, B&M seeks partnerships and collaborations that allow broadening its scope towards other domains. The current focus of B&M is on the Automotive domain.

4.11.2 Markets/Customers

Please list the markets or customers which you intend to exploit the results from AMASS.

First step: Automotive OEMs, Tier suppliers and Semiconductors that deliver safety related products.

Second step: OEMs, Tier Suppliers and Semiconductors in other domains (Industrial, Aerospace).

4.11.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

Results of AMASS will be further developed to achieve the appropriate maturity level and then offered to the market. Either new tools will be added to the B&M product portfolio, or new components will be added to the existing products (TESTONA, MERAN, MODICA ...). The business model for the tools will be a license model with the additional charge of yearly maintenance and service fees or a subscription model. Especially with the help of seamless integration, B&M will open its target market and will significantly extend its market share. Furthermore, the highly participation of industrial partners with appropriate case studies and new target domains will strengthen B&M's potential to extend its current business.

Besides the above described tool business, the consulting branch of B&M will be strengthened by new topics especially in the area of certification. This topic becomes more and more important in the Automotive domain and with the expertise gained in the AMASS project, B&M will be able to extend its current business here.

4.11.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

Commercialization will happen via tool licenses or subscription models. Quantification not yet possible – need to have more detailed understanding of the product capabilities to come up with a sound price model for the licensing.

4.11.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

Software patents are not considered useful in Europe. Consortium agreement should be sufficient to protect the knowledge.

Source Code Copyright will be protected by giving source code to notary.



4.11.6 Exploitation activity update up to m33

We have realized a prototypical approach combining several research topics we previously addressed:

- Contract based system specification
- Stepwise system refinement
- Template languages to express system behaviour

As a result, the prototypical tool SAVONA has been developed which features:

- System architecture modelling using SysML IBD
- Semi-formal contract specification using SSPL (System Specification Pattern Language)

SAVONA is used in further research activities such as the case studies dc-drive and velox cars to evaluate the methods proposed in the topics named above.

4.11.7 Challenges to market entry

Convincing customers to only slightly change their existing processes or use new tools supporting these is a huge challenge. Even if there are promising improvements over existing processes and technology, customers in the automotive domain tend to stick to existing and 'known to be good' tools. As a result, entering the market with a new tool requires lot of convincing and compatibility to existing tools besides the obvious fast ROI.

4.11.8 Future plans beyond the life of the project

Adoption of AMASS results for the internal industrial projects (prototyping and development of new products), in order to further experiment the toolset and increase the company capability in systems development.

The AMASS Tool Platform could be considered for use in formal specification of on-board software. This could be very useful to obtain security certifications of space software solutions.

Other AMASS results will be feed into the product roadmap discussion, which is scheduled for summer 2019.

Participation in new research projects and proposals either (1) using results from AMASS or (2) extending them.

Continuation of the contribution to the AMASS results targeted at being released as open-source technologies.



4.12 GMV Aerospace and Defence, S.A.U. (GMV)

4.12.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

By using the AMASS methodology and tools, GMV aims at reducing the development life-cycle key parameters (i.e. time and effort) and, at the same time, improving safety and qualification processes of space operational projects.

4.12.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

Space domain (embedded critical software) / mainly for the European Space Agency (ESA).

4.12.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

Firstly, GMV will apply the AMASS methods and tools in R&D studies to check its applicability in the space domain. Subsequently, it is foreseen to use the AMASS framework in small operational projects.

4.12.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

1-2 years: GMV will assess the AMASS results in R&D studies in the space domain.

3-5 years: GMV will apply the AMASS framework in small operational projects.

4.12.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

If needed, NDA could be signed to share confidential information.

GMV does not develop any product. No patents will be generated.

4.12.6 Exploitation activity update up to m33

Investigation of how the AMASS Tool Platform can be used in operational projects: Integration of model-based techniques in the development process (requirements, design, safety) → Papyrus/CHESS.

4.12.7 Challenges to market entry

The AMASS Tool Platform should be mature enough (stable, error-free, etc.) to be able to use it in Space Operational Projects (reuse, model-based design including safety issues).



4.12.8 Future plans beyond the life of the project

Analyse the feasibility of using the AMASS Tool Platform in future ESA R&D activities as well as to design the on-board software of some operational space project.



4.13 RINA (RIN)

4.13.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

RINA Services, as Notified Body no. 0474, expects to widen its experience in assessment of safety and compliance to various European standards in the railway domain, and in other sectors. Furthermore, RINA Services main activity in the project aims at developing a model of specific functions, as defined in the System Requirements Specification of European Rail Traffic Management Systems (ERTMS/ETCS), UNISIG SUBSET-026, for use in the laboratory test activities and the certification processes.

4.13.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

Railway domain in general, especially in the field of ERTMS/ETCS laboratory tests and certification processes.

4.13.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

RINA Services aims at applying the methods and tools that are going to be created in AMASS, in particular in WP3, in the System Requirements Specification of ERTMS/ETCS, UNISIG SUBSET-026, as an example that could show the implementation in the railway ERTMS/ETCS domain of the architecture-driven approach developed in AMASS itself.

4.13.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

1-2 years: RINA will assess the AMASS results.

3-5 years: RINA will apply the AMASS results in the laboratory tests, and in the definition and reviewing of the ETCS on-board subsystem tests specifications.

4.13.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

Not yet planned actions for IPR protection.

4.13.6 Exploitation activity update up to m33

RINA is currently developing the implementation of AMASS tool in its railway certification laboratory.

4.13.7 Challenges to market entry

From a certification company acting in the railway domain, the main challenge to market entry could be to be prepared for the certification of complex systems possibly developed by means of AMASS tool. The use of formal method for the medialisation of complex safety and security critical systems and the relative



framework standards is becoming more and more common in the railway sector. Consequently, there could be the need to adapt the certification processes to this trend.

4.13.8 Future plans beyond the life of the project

Beyond the life of the project, RINA plans to consolidate the model developed in the AMASS platform. The same approach can be extended in the future to other functions and systems within the ETCS framework defined in the reference standards.

RINA plans to use the results of the AMASS project both in its railway laboratory and in the certification processes of future railways systems developed using the AMASS platform.



4.14 Thales Alenia Space (TAS)

4.14.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

The main objective is to reduce the time of certification and re-certification of code and architectures, without repeating the whole process every time.

One of the most relevant improvements will be the on-board re-validation and re-certification of configurable FPGAs.

Another expected field of improvement could be the System Analysis which may be enhanced with multi-concern aspects.

4.14.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

The main customer will be other parts of Thales, including TAS-E (España), and the advantage that this will cause in the offers TAS-E presents.

4.14.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

Plans depend on that are proved and accepted by the space industry and the space government divisions. Clear stating our requirements, constraints and our problems to the AMASS tool developers to support their development of tooling is the best approach. Directions of the space industry standards with regard to safety or security multi-concern may accelerate AMASS tool adoption.

4.14.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

With the AMASS tool developed and validated, the number of acquired contracts will likely increase, with the consequent growth of the company. The human resources will also profit due to the longer time available in favour of other activities, instead of being involved in repetitive tasks, such as re-certification and re-validation. By using AMASS tools with appropriate filters, requirements quality will probably improve, which will have a positive impact in the offer and specification phases.

4.14.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

Patent or collaboration agreement.



4.14.6 Exploitation activity update up to m33

TAS is in condition to take advantage of AMASS tools for on-board architectures to consider security/safety/performance co-engineering. In the first phases of the product, the tool can be used to improve the quality and traceability of customer requirements. On the other hand, requirements formalization in the System design stage, with the help of AMASS tool, will help in security certification processes, for both ground and space segments of the aerospace domain.

4.14.7 Challenges to market entry

The AMASS Tools Platform should be more reliable to be used in the certification for Space products. It must debug the errors (must be error-free) principally including all security issues.

4.14.8 Future plans beyond the life of the project

The AMASS Tool Platform could be considered for use in formal specification of on-board software. This could be very useful to obtain security certifications of space software solutions.



4.15 Universidad Carlos III de Madrid (UC3)

4.15.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

As an academic partner, UC3 will exploit its participation in AMASS for improving and extending its current activities on education, research and technology transfer. In more specific terms, UC3 exploitation will focus on the following aspects:

- Education of a PhD student and a Postdoctoral Fellow.
- Education of Bachelor's and Master's students through theses on AMASS-related topics.
- Presentation of AMASS ideas and results in UC3 courses.
- Use of AMASS methods and tools in the laboratory sessions of some UC3 course.
- Publication of high-quality scientific papers from AMASS results.
- Contribution to the AMASS results targeted at being released as open-source technologies (e.g. in Polarsys)
- Establishment of a community of AMASS results' potential users in UC3 industry network (Airbus, Chrysler, Daimler...)
- Participation in the activities related to AMASS Advisory Board.
- Preparation of at least 2 scientific publications with researchers that are not part of the AMASS consortium.
- Standardization of AMASS results through UC3 activity at INCOSE, OMG and OSLC.
- Acquisition of new knowledge and expertise in assurance and certification of CPS that could lead to the participation in new project proposals at European or national level.
- Possibility of providing AMASS-based products and services to local companies, via technology transfer contracts.

Dealing with this set of aspects will ultimately allow UC3 to extend its competence on assurance and certification of critical systems, to establish new links with other organizations on this topic (which can lead to further collaboration in the future) and to gain recognition as a top academic institution in the area.

4.15.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

Since UC3 is an academic institution, its main market and customers correspond to:

- Students, who can acquire AMASS-related knowledge through the presentation of project information and results to them, and through the work on thesis (PhD, MSc, and BSc) on topics related to the project.
- Research community, which can gain new knowledge and identify new research gaps to fill as a result of the publication of the AMASS results that UC3 produces. These results will be reported in scientific papers and presented at conferences and workshops. Members of the research community could further collaborate with UC3 in the future. This could result in a mutual benefit, via, e.g., the exchange of knowledge and expertise and the joint preparation of research project proposals.
- Standardisation organisations, to which AMASS results could be transferred in the form of either proposals of new international standards, or recommendations, specifications and modifications of existing ones.
- Companies, with which technology transfer contracts might be signed based on AMASS results. The companies can belong to any application domain in which CPSs are used.



4.15.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

UC3 will use different means for fulfilling its exploitation plans. The main ones will be (1) the use of AMASS information and results for students' training, (2) the publication and presentation of AMASS results at different research venues and industry-oriented ones, and (3) the participation in new project proposals that relate to AMASS and that could address AMASS-sibling areas not directly or sufficiently addressed in AMASS itself.

Once AMASS ends, UC3 will continue using the above means to exploit the project results.

4.15.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

UC3 cannot provide an accurate estimated commercial value from the exploitation of AMASS results. It is an academic non-profit organization and currently no commercial benefit is expected from the participation in AMASS.

Regarding growth, the UC3 research group involved in AMASS (Knowledge Reuse Group; Computer Science Department) expects that at least 1 Postdoctoral Fellow, 1 PhD student, 3 MSs students and 6 BSc students will work on AMASS-related topics, and become members of the group during the project.

4.15.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

No specific means are planned to be used at UC3 for IP protection. As a rule of thumb, the AMASS results that UC3 produces will be open. Open access will be provided to their publication, most AMASS deliverables to which UC3 contributes are public and the implemented software will most likely be delivered to the AMASS open-source community. Authorship and copyrights are already handled in these results, with no extra action, e.g. authorship recognition and copyright management by the publisher for the publications.

4.15.6 Exploitation activity update up to m33

No relevant updates. Only minor ones are envisioned, e.g. about the final number of students that will be trained on AMASS-related aspects.

4.15.7 Challenges to market entry

From an educational and research perspectives, possible challenges to UC3-market entry are as follows:

- The problems addressed in AMASS are complex, thus students might have difficulty to understand them and be reluctant to work of AMASS-related aspects.
- AMASS is working on certain assurance and certification needs that are not major issues at this moment for many companies but will be in the future, e.g. compliance with engineering and assurance standards of different nature. Technology transfer might thus not happen in the near future.
- AMASS targets domain-independent results so that they can be applied for different system types: road vehicles, energy systems, aircrafts, satellites.... However, possible new projects might focus on specific domains. Adaptation and extension of AMASS results in these new projects might not be



straightforward.

4.15.8 Future plans beyond the life of the project

- Participation in new research projects and proposals that either (1) use our results from AMASS or (2) extend them.
- Continuation of the contribution to the AMASS results targeted at being released as open-source technologies.
- Analysis of the possibility of providing AMASS-based products and services to local companies, via technology transfer contracts.
- Continuation of the standardization of AMASS results through UC3 activity at e.g. INCOSE, OMG, and OSLC.



4.16 Rapita Systems (RPT)

4.16.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

We plan that AMASS will provide Rapita with the following innovations:

1. RapiTest Framework features. Rapita is building a new product called “RapiTest Framework” that will provide our customers with the capability to reduce their test and certification costs. RapiTest Framework is designed to drive inefficiencies out of low-level testing in large projects, thereby reducing costs and eliminating unnecessary delays in the testing process. Several key features of RapiTest Framework are being developed during AMASS, including specific language support. This will benefit Rapita by enlarging the market size and applicability of the product. Our customers will benefit by reducing testing costs through use of RapiTest Framework.
2. Automated Qualification Data. Crucial to both RapiTest and our other products is the ability to quickly and automatically produce qualification documentation and tests that our customers can use directly. Through AMASS, Rapita is developing a new way of creating qualification data for DO-178C. This will eventually allow Rapita to reduce the cost of producing qualification data for different software versions.
3. Tool integrations: our products will benefit from tool integrations with a number of related tools, including DOORS (requirements traceability), Mx-Suite (system-level test), and possibly others.
4. On-target seamless integration. Our work in AMASS includes building new ways of integrating verification software within our customers’ systems. A new product feature will enable faster and easier integration, reducing costs of adopting tooling.

4.16.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

The target market is avionics suppliers providing DO-178C, assurance level A-C software systems, primarily Tier1 suppliers. Certification and qualification of systems and the tools used to produce them is vital in this market. RapiTest Framework is designed to reduce the manual effort for certification and test of large projects, thereby reducing costs and eliminating delays in the verification process. Within this market, both “new project” and “legacy systems” are relevant opportunities, both in Europe and exporting to the US market.

4.16.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

- Rapita will add new AMASS-supported features to RapiTest Framework, bringing them to market as fast as they are available. The RapiTest roadmap of features extends well beyond its status today, with much R&D still required.
- As a new product, a fast release cycle is required, allowing us to support our customers’ certification/testing needs. Therefore, bringing the automatic qualification kit generation into a commercial state will be an important step in achieving impact. Rapita has rolled out the first qualification data for RapiTest using the new qualification framework, which will then be evaluated and improved as necessary.
- The marketing of the product will be accelerated, including promotion of its qualification data and ease of integration.
- Support for tool integration with products like Mx-Suite and DOORS will open opportunities for



partnership and joint exploitation opportunities.

- Rapita also plans to create a new service offering, based around own tools, and providing testing services for our customers.

4.16.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

- Rapita will primarily benefit from the results of AMASS by generating more licence sales of RapiTest Framework and the qualification kit.
- The market opportunity is growing as software systems get more complex and harder to certify. Therefore, innovations to reduce our customers cost of test/certification have high value. For example, if RapiTest can reduce the cost of testing by 30% then, for a large avionics project, where the cost of test is many millions, this represents both a significant saving for the customer and significant revenue in licences and services for Rapita.
- RapiTest is expected to be licensed to large suppliers over the next few years; and along with value-add services such as integration and tool qualification, the company is expecting a return on investment within 2 years after termination of AMASS project, with revenue growth of 30%/year for the subsequent 3-5 years.

4.16.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

There are a number of different innovations in RapiTest Framework, which may need different types of protection. In general, the proprietary source code will be confidential and the knowledge and skills needed to replicate the product are hard to reproduce. Patents may be investigated for specific components if necessary.

4.16.6 Exploitation activity update up to m33

Several features of RapiTest Framework have been developed by AMASS (including C++ support) – this has successfully been used on a large subcontracted verification project.

The automated qualification framework has been used for several versions of RapiTest Framework qualification data, saving significant effort and a faster time to market for it. Feedback from customers has been excellent.

Integration with Mx-Suite has developed and trialled with a few customers.

4.16.7 Challenges to market entry

Cautious market. Market entry of RapiTest Framework has been positive; however, the conservative aerospace industry takes time to fully adopt technology – stepwise evaluation of the technology precedes wide rollout.

Legacy support. Legacy test support for long-lifecycle programmes means that additional work is required to support old and legacy tests and code.

Uncertainty about model-based design. Model-based design is still in infancy, but it is changing the shape of the verification processes. Until a clear path with testing model-based engineering methods is defined, there is reluctance to make decisions about other areas of verification.



4.16.8 Future plans beyond the life of the project

Further development and productization of RapiTest and more research projects to fund the prototyping new features.



4.17 The REUSE company (TRC)

4.17.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

The REUSE Company expects to exploit AMASS results in different aspects:

- R&D Acceleration: Improve its tools and open/interconnect them with existing tools, and methodologies within the Cyber-Physical Systems (CPS) Engineering ecosystem.
- Standardization: Participate in the standardization (definition of the standards) around Knowledge Engineering activities, which are the core of TRC business.
- Synergies: generate synergies, both technical and commercial, with other tool implementers within the AMASS consortium.
- Stronger market position: raise awareness of TRC as a tool vendor in companies working with Systems Engineering (SE) methodologies about what TRC offers to improve their processes and products. This mutual knowledge can be turned into partnerships or, perhaps, a new customer for TRC. Thus, improving TRC position in the market.

4.17.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

- Automatic quality assessment market for CPS engineering work products such as:
 - Requirements
 - Models
 - Etc.
- Verification and Validation market for CPS engineering work products such as:
 - Requirements
 - Models
 - Etc.
- All of this applicable in the following industrial domains within the AMASS project or outside it:
 - Aerospace
 - Automotive
 - Railway
 - Healthcare

4.17.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

With the envisioned improvements, TRC plans to consolidate its current customer base in the aerospace industry and make progress in others, such as automotive and railway. This has been done by offering them new capabilities to manage and create new evidences for certification processes.

These ideas have been included and implemented in our commercial products and they represent the basis of the latest TRC tools public versions.

Finally, we have got technical synergies with the other partners in the consortium. However, commercial synergies have not been achieved.



4.17.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

The estimated growth for:

- Period 1-2 years: no new revenues from AMASS-derived products.
- Period 3-5 years: starting with 5% in the 3rd year and ending in 10% at the end of the 5th year.

4.17.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

The IPR is protected by consortium agreement.

Non-Disclosure Agreements will be signed in case that we need to share confidential information with AMASS partners that we cooperate with closely.

We plan to protect our new features IPR by means of patent application.

4.17.6 Exploitation activity update up to m33

Focused on the interaction with partners inside the consortium interested in using our technology to their use case.

Several iterations have been executed to improve the amount and quality of the information retrieved of the work products produced by the industry in their development process. This improvement has made possible to find more defects in the conception phase, thus reducing the global cost of the system development and certification. On the other hand, the industry has got a better understanding of our tool features and methodology, this have permitted them to think of new ways of improving the quality of their work products.

The goal of the seamless integration of TRC tools in the AMASS platform has been achieved by the definition and implementation of the OSLC Knowledge Management standard (OSLC KM for short).

4.17.7 Challenges to market entry

Not applicable.

4.17.8 Future plans beyond the life of the project

The plan of TRC for the future is to continue pushing the adoption of the OSLC KM standard by other main Systems Engineering tool vendors. And also, to develop a second version of the standard that enhances its capabilities and reduces the problems detected in this initial version.



4.18 OHB Sweden AB (OHB)

4.18.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

The development of critical on-board software applications such as Attitude and Orbit Control Systems (AOCS) is continuously becoming more complex as space missions become more autonomous. At the same time, it is expected that the pressure on budget and schedule will continue to increase such that the demand for efficient software development, still ensuring dependability and safety, will increase.

Within the AMASS projects, OHB expects to improve the engineering process of developing safety-critical systems for Space. This means making the engineering process more cost-effective without affecting quality. This will be crucial for future development of AOCS software in the telecom satellite programmes.

4.18.2 Markets/Customers

Please list the markets or customers which you intend to exploit the results from AMASS.

- ESA ARTES 33 Program (Electra primary)
- Space market in general

4.18.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

Exploitation Plan:

- Evaluation of tools and methods provided by the AMASS framework, with the aim to create seamless integrated tool-chain to semi-automated evidence management and quality assurance activities. Additionally, identification of methods to support identification of reusable components and generation of reuse-files.
- Dry run of the selected tools and methods within the Electra project.
- Compare result of using AMASS framework to results from original project to measure the effect on cost and quality.

4.18.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

Short term 1-2 years: Seamless integrated tool chain and methods for identification of reusable components is considered successful and the software engineering process is updated to describe these improvements. The engineering process is applied in selected OHB Sweden projects.

Long term 3-5 years: OHB Sweden has the objective of reducing the cost of developing safety critical systems, but without affecting its quality, and therefore establishing itself in a stronger position on the Space market.



4.18.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

The IPR is protected by consortium agreement. Non-Disclosure Agreements will be signed in case that we need to share confidential information with AMASS partners that we cooperate with closely. In case of a new technology invention, the patent would be filled.

4.18.6 Exploitation activity update up to m33

Evaluation of Compliance via Automatic Generation of Process-based Arguments (using EPF Composer and OpenCert).

4.18.7 Challenges to market entry

Software development within ESA projects.

4.18.8 Future plans beyond the life of the project

The AMASS platform could be used for future development of software to describe process tailoring and argument compliance. Also, to perform impact analysis of product variances.



4.19 Masaryk University (UOM)

4.19.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

Partnership with Honeywell International, co-operation on integration of tool for system verification and requirements engineering into industrial tool chain. Industrial relevant benchmarks. Extended integration into AMASS-based tool chain, hence, partnerships with other AMASS partners.

4.19.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

Academic and Research.

4.19.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

Joint effort on tool integration, maintenance and tool support will persist once AMASS project terminates, and so the cooperation.

4.19.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

Although it is hard to value such financial things, the open source tool supports the university, its research and reputation. Moreover, it is expected that at least 2 PhD students and 3 MSs students will work on AMASS-related topics, which will allow the students to get valuable experience.

4.19.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

Our tools are open source and no particular protection of the tools is required. As an academic partner, it is important for us to disseminate the developed tools and ideas in computer science related journals and conferences.

4.19.6 Exploitation activity update up to m33

Partnership with Honeywell International, Participation of students in AMASS activities (improved knowledge of software engineering processes, topics for PhD students), Tool-provider (integration of our model checking and requirements semantics analysis tools in the AMASS platform), dissemination of our tools and ideas in computer science related journals and/or conferences.

4.19.7 Challenges to market entry

As a university we do not aim at free economical market, we aim at academic and research community, the challenge lies in generalisation of AMASS procedures and extraction of ideas that could be sold to



research community in an appropriate form (publications).

4.19.8 Future plans beyond the life of the project

Participation in new research projects that follow-up the AMASS project. Further development of our V&V tools (mainly model checking and requirements semantics analysis related tools) with the goal to increase scalability and usability. Maintain the partnership and cooperation with (at least some) partners from the AMASS project.



4.20 Kompetenzzentrum – Das virtuelle Fahrzeug Forschungsgesellschaft mbH (VIF)

4.20.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

ViF expects to strengthen its Position in the Development of safety- and security-related Engineering Methods for model-based System, Safety and Security Engineering, and for Safety and Security Co-Analysis based on Failure Mode Effects Analysis.

4.20.2 Markets/Customers

Please list the markets or customers which you intend to exploit the results from AMASS.

OEMs and suppliers of safety- and security-critical systems in the automotive domain.

4.20.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

- Publishing and presenting results in both research and industry-oriented venues.
- Be active in preparing new project proposals, where AMASS results are used.
- Integrate results and knowledge, as generated by the project, in follow-up research projects and costumer projects.
- Cooperation and interchange of results with other research projects.

4.20.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

Short term (1-2 years): Use of the AMASS results in R&D studies and projects in the automotive domain.

Midterm (3-5 years): Use of the AMASS results in costumer projects in the automotive domain.

4.20.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

Collaboration Agreements.

4.20.6 Exploitation activity update up to m33

The AMASS results regarding safety/security co-engineering process will be used as a basis for follow-up research projects.

4.20.7 Challenges to market entry

ViF is part of the international ISO standardization group for Cybersecurity for Road Vehicle and it will take some years to have a first version of the standard available – in the meantime, it is challenging to handle cybersecurity and the interaction of Cybersecurity and Functional Safety in the automotive domain in a



harmonized way.

4.20.8 Future plans beyond the life of the project

Exploit the outcome of the AMASS project in future research projects.



4.21 Alliance pour les technologies de l'Informatique (A4T)

4.21.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

A4T intends to strengthen its co-engineering methodology and tool solution in Safety and Security, and to combine other concerns such as availability or performance. Moreover, A4T intends to develop possible partnerships with AMASS partners in relation with best practices and standards as proposed within AMASS project.

4.21.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

A4T is planning to target Safety and Security co-engineering tool market, by acquiring new costumers and augmenting market share in different domains (Automotive, Aerospace, Defence and Transportation).

4.21.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

The concrete exploitation plan for A4T during the AMASS project would be the enhancement of Safety Architect tool with safety and security co-analysis solution and the integration of the Safety Architect tool with AMASS platform tools, such as CHES and OpenCert. Thanks to the seamless integration proposed by AMASS project, A4T plan to extend its market. Consequently, the implemented solution will be further developed after the project in order to support future needs of commercial users. The business model for the tool and the bridge with other tools is a license model with the additional charge of maintenance and service fees.

4.21.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

In short term (1-2 years): Enhancement of Safety Architect tool with co-engineering solutions and develop possible collaboration with AMASS partners.

In long term (3-5 years): increase Safety Architect licence sales and get new customers in multi-concern assessment with co-engineering tool.

4.21.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

The IPR generated by AMASS is protected by the consortium agreement and may be licensed to other partners.

4.21.6 Exploitation activity update up to m33

The exploitation plan of AMASS project is to enhance the Safety Architect tool for Safety and Security co-analysis, and to interface Safety Architect with the AMASS platform. This plan is complied with the tool



roadmap and the development of new features has started.

4.21.7 Challenges to market entry

The introduction of tool-based solutions, such as Safety and Security co-analysis, to customers can take some time. The challenge is to demonstrate the applicability of the tools in the customer environment with domain experts. A4T addresses this challenge by offering extensive tool supports and demonstrations.

4.21.8 Future plans beyond the life of the project

Exploit some results of the AMASS project in the roadmap of Safety Architect tool and future projects.



4.22 Commissariat à L'énergie Atomique et aux Energies Alternatives (CEA)

4.22.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

CEA LIST is a public research institute focused on the development of software and hardware technologies for complex systems in various domains (transport, energy, robotics, etc.).

In AMASS, CEA LIST focuses on two, out of its areas of expertise:

1. "Safety and Security by Design", covering system modelling, architecture design and analysis, including issues on safety, security and risk assessment, with regards to performance criteria.
2. "Safety and Security Verification", covering code analysis and code properties checking, in order to identify vulnerabilities in critical code via the production of correction evidences.

For CEA, the AMASS project represents an opportunity to increase the level of maturity and confidence in its offer on safety- and security-oriented design and verification tools, which are respectively Papyrus/Sophia and Frama-C. The expertise of CEA, already established in the field of critical industrial systems, will thus result strengthened. CEA aims at allowing non-experts of these issues to appropriate norms, standards, and reference practices.

The gained expertise in the project will help enforcing CEA involvement in standardization actions within the Object Management Group (OMG) organization, and extending its role in the Eclipse and Polarsys communities with its open-source strategy, by increasing the distribution of its tooling.

CEA has an important industrial transfer activity, and expects to strengthen its existing collaboration with ClearSy and increase the number of collaborations with industry actors and SME's, thanks to the AMASS project results.

Finally, CEA expects to improve its educational offer, on safety and security by design, for master and PhD students, as well as to propose new training services for companies.

4.22.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

- Transfer activity in favour of industries from various domains (railway, automotive, avionics, internet-of-things, manufacturing, etc.), by developing safety- and security-critical systems.
- Education activity, by proposing new courses and trainings on safety and security co-engineering for Universities, Engineering Schools, and Companies.

4.22.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

By working on the railway use case, CEA expects to develop a tight collaboration with ClearSy, by achieving a suitable tooling platform and methodology for the railway domain, from model to code together with Papyrus and Frama-C tools.

CEA has interest in developing collaboration with Tecnia for developing a seamless integration between Papyrus and OpenCert platforms.

CEA will further take advantage from the fact that Papyrus is a building block of the AMASS Core platform



to develop interfaces to cooperate with external tools, as proposed in the AMASS platform, and with other tools connected via OSLC/transformation mechanisms.

In order to increase the visibility of AMASS platform tooling and methodological results, CEA LIST will conduct dissemination activities in national and international conferences, exhibitions and symposiums. Demonstrations at CEA internal and external industrial events will be a vehicle for advertising and building new industrial collaborations.

4.22.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

In 1-2 years, AMASS project will increase the maturity of CEA safety and security platform both on the design phase (Papyrus/Sophia) and verification phase (Frama-C).

In 3-5 years, through its industrial transfer activity and thanks to AMASS results, CEA expects to develop new direct collaborations with industrial partners in the railway domain and to increase its number of collaborations in automotive and avionics domains.

Moreover, CEA expects to develop a partnership with Tecnia partner on Safety and Security by design, by providing complementary and joint research, development, and consultancy services.

4.22.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

The IPR generated by AMASS is protected by consortium agreement. Non-Disclosure Agreements will be signed in case that we need to share confidential information with AMASS.

Papyrus modelling tool and Frama-C are released as open source. Specific add-ons to these tooling (e.g., for tackling safety, security aspects) will be released with specific licenses to interested partners.

4.22.6 Exploitation activity update up to m33

The integration of Papyrus tool and OpenCert tool is intended to be adapted for exploitation in different industrial projects in the upcoming years.

The AMASS results regarding safety/security co-engineering process will be used as a basis for follow-up research projects.

4.22.7 Challenges to market entry

Compliance with security standards is not yet a major issue for industrial sector while they are showing interested to comply with.

To use the AMASS results, the challenge will be to first teach the industrial how to include safety and security aspects in their products.

The technology and tools developed in AMASS are numerous and can be very complex. The second challenge will be to adapt the framework to the specific needs of the industrial and make it easy to use.



4.22.8 Future plans beyond the life of the project

We expect that AMASS platform will be maintained through the Polarsys project effort, and so it can reach more and more users.



4.23 Clearsy SAS (CLS)

4.23.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

The results from AMASS are expected to reduce the development effort and time-to-market for safety critical systems development. ClearSy develops for the railways (signalling systems). They will naturally improve our competitiveness on this market and we forecast a growth of our activity as a direct outcome of the project.

4.23.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

The results from AMASS are expected to contribute to the market of safety critical systems for the Railways (signalling systems). Potential customers are train manufacturers (Alstom, Bombardier, Siemens) and metro/main lines operating organisations (RATP, SNCF, Metro, etc.)

4.23.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

The results from AMASS are expected to improve our existing development cycle, by strengthening it locally (improved level of confidence of several technical/assurance aspects).

Experiments will be conducted a posteriori on past developments. Based on feedback collected, AMASS technologies are intended to be applied on on-going projects. Some technologies adjustments are expected to ease their integration into existing development flow.

4.23.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

The results from AMASS are expected to:

- provide a growth of 500k€ per year during their deployment (1-2 years)
- provide a growth of 1M€ per year during their exploitation (3-5 years)

4.23.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

As a SME, ClearSy rarely protects its assets with patents (some of our products are copied and we need to run faster than our competitors). The results of AMASS will be seamlessly integrated to our existing assets.

No specific collaboration is planned yet.

4.23.6 Exploitation activity update up to m33

We are still conducting the ClearSy Case-study (ClearSy safety platform (CSSP), our future platform for all safety applications) which will be considered as a proof of concept for the integration of the AMASS project results in our new projects. AMASS outputs are expected to be integrated into the final CSSP



certification kit.

4.23.7 Challenges to market entry

The main challenge is to ensure a high acceptance level for the users as well as for customers and (third party) safety assessors.

4.23.8 Future plans beyond the life of the project

After the end of the project, the models and proof artefacts developed during the project will be maintained by ClearSy. The technical readiness level maturity will be evaluated together with certification body, and if it is positive, a pilot project will use the platform to test its added value as well as to demonstrate its broader acceptance by teams.



4.24 Alten Sverige Aktiebolag (ALT)

4.24.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

The expectation from ALTEN on the AMASS project is to provide methods and tools for safety product development. Today this is a very complex work, proving heavy load on all stakeholders. The assurance procedure is also from a software perspective outdated with negative impact on the software product quality. Certification process is costly, and the standards requires adaption to meet next generation CPS. Modern ways of working for software development are also difficult to map to the development of functional safe products.

The expectation is to see improvements affecting both methods and tools that manage “reuse” of components in a safety scenario.

Alten expects to update the software production line “Flord” with methods and tools that can handle the impact/dependability analysis, the relation of a specific change in the software and the consequently side effect.

The future Alten tool developed in the AMASS project is LBFarkle. This tool will analyse the software, and then, generate a model based on different automated test generations, such as machine learning. Different approaches are possible as combinations of static analysis and dynamic analysis. Then test cases will be generated that will run as regressions tests, this will publish a signature that is possible to compare from a reuse perspective.

The business goal is to remove extra work due to new feature and to reduce the traditional actual design work load when developing safety software, this is to be in line with the AMASS project goals. As a side effect, Alten also understands that the improved quality that the developed tool will provide is valuable for development of any complex embedded software system.

4.24.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

Alten is a global provider of technology and services for all markets. The major domains are Aerospace and Automotive. The result of AMASS is expected to be used when developing future customer products in the embedded market with functional safety requirements. The customer expectations of Alten are strongly focused on the skills and competence of Alten individual engineers. Alten success depends on its employees’ ability to deliver customer satisfaction.

Examples of Alten customers are Airbus, Volvo, Renault, Volkswagen, BMW, Ericsson, ALSTOM, Safran and Finmeccanica. The results from AMASS will make it possible to ensure that Alten is able to protect and possibly expand its market share on product development on market related to safety-assurance.

4.24.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

To understand the future market demand and potential of the competition is the rule of business success. The AMASS project will provide a strong package of methods and tools. The idea of AMASS is very specific



actions with good understanding of the goals in relation to the State of Art.

The estimated market expectation on reliable and safe CPS is major. In near future, embedded products will have a major impact, including human interaction. To develop safe CPS with shorter TTM and with a lower cost for development, it will be mandatory important to those who want to compete. The Alten scenario is in the context to be defined from a baseline of the requirements of relevant daily work. The idea is to fill the gap with new open source tools and adapt the methods. Furthermore, own tools will be improved with new technology from the project. Alten perspective in the AMASS project context is that Alten is a technology integrator. It is needed a high level of collaboration with the academic partners to insure valuable state of art knowledge of technology. It is also needed a high level of collaboration to understand the OEM roadmap, what is needed and how to reach the estimated goals. The project will also provide partnership of strategic nature.

Alten is focusing on Automotive to address the exploitation plan.

The post-project plans are to use the results from the project in relation to the above explained show case.

4.24.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

The estimated growth of Alten business due the AMASS project is based on new customers and already existing customers. The estimated increased growth due AMASS will major. The figures are always hard to define, but as Alten major business (the estimation is about 800 MEUR for 2016) is related on best performance in this market. Not all this turnover will be affected on a short term; the estimation is that about 1MEUR will be affected and the growth there will be +10%. The conclusion is that AMASS will have a significant long-term impact on the turnover. The estimation on the growth for the long term is that it will have an increase worth 10MEUR. The project has had direct impact on the growth.

4.24.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

There are no plans to protect Alten IPR in the project. The real value is the enriched understanding during the project, the collaboration and the work progress on development of methods and tools. The LBFarkle tool to be developed will be protected as knowledge IPR and not as a commercial product. Furthermore, the virtual IPR of gained goodwill both during the project and by using the results post the project, is not to be neglected. Market reputation and image is important aspect to enable for growth.

In case the AMASS project decides to define a project common IPR (via open source or standard), Alten will support it.

Alten members has discussed the role of patent but not decided any further activity at this moment.

4.24.6 Exploitation activity update up to m33

Alten provides dissemination activities to spread AMASS results and progress:

- Alten Innovation: The purpose of Alten Innovation is "To inspire and spread knowledge of innovative technological developments inside and outside ALTEN". The goal with this event is an easy to access, through many shorter events rather few larger ones.
- Alten TechDays: six times a year, half-day workshop on ongoing research activities. A larger one is run



in December 2018 inviting the all in the Stockholm office to participate. The theme is to let all workers that have provided value for the AMASS Project with a poster present work and progress.

- Training for employees on AMASS M&T (three sessions)
- Public information: Electronic Tidningen (A Swedish domain magazine with 40,000 signed readers). Title: "Cost efficient M&T for functional safety"
- Internal workshop AMASS: Case Study 3: DC-Drive
- Development of the "AltenCar" and "Alten Cockpit", two show case studies.

4.24.7 Challenges to market entry

The future market is requiring advanced system still not seen. This requires new technology to be developed. The AMASS project has provided methods and tool that will support future development. Important value for Alten customers, is that it is expected that service provider is required to be a game changer. Customers need external support to be competitive in the future. Employers are important, but it will not be able to shift in technology fast enough without help from external help. To be the potential supplier of services of new technology requires that the provider is able to deliver skilled and competent resources.

4.24.8 Future plans beyond the life of the project

The work with the AMASS project shows that Alten idea on dynamic and static analysis with hardware-in-the-loop (HIL) is a required step. The early work on HIL is promising. AMASS focused on methods and tools on the important earlier stage of formal analysis.



4.25 Lange Aviation (LAN)

4.25.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

LAN expects to optimize the development life cycle of CPS and to reduce effort by using AMASS tools and methods. This will strengthen its position in order to achieve certification for own aviation products (costs, time to market).

4.25.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

Aviation / Avionics.

4.25.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

LAN will analyse how the AMASS tool platform can help reducing effort in its own R&D department. If successful, the design and development process will be adapted to be supported by AMASS tools.

4.25.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

1-2 years: usage of first AMASS methodology and tools with sufficient maturity in our development process for avionic products.

3-5 years: usage of AMASS framework as an integrated tool platform in R&D.

4.25.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

Usage of additional Non-Disclosure Agreements (NDA) if we need to cooperate with any partner more closely. LAN does not expect to invent patent-related results during the AMASS project.

4.25.6 Exploitation activity update up to m33

LAN intends to use automotive components, such as Infineon microcontrollers, inside the aircrafts we develop. We analysed how Commercial of the Shelf automotive components can be used in a cross-domain scenario for aviation, what artefacts may be reused for certification purpose and how AMASS Tools can support.

4.25.7 Challenges to market entry

AMASS tools must be easy to use in order to achieve high user acceptance.



4.25.8 Future plans beyond the life of the project

If it turns out that the AMASS tools are suitable for our processes and they are maintained permanently, we plan to use them in future. Therefore, not only the functionality is important, but also a constantly supported tool on which we can rely in the future.



4.26 Thales Italia SpA (THI)

4.26.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

Hardware and Software of all radio-navigation systems produced by THI are intrinsically safety-critical due to their key role in positioning techniques and in air traffic management (ATM) procedures. Methods and tools provided by AMASS will therefore increasingly improve, for the new THI products belonging to ATM family, all the involved processes: specification, design, implementation, validation, etc. This will boost the efficiency of the quality processes, will reduce costs and efforts, and will increase THI capabilities to face the challenges associated to the next-generation applications of radio-navigation beacons.

4.26.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

- The ATM market, in the sector of landing, navigation and surveillance systems
- The Air Forces market (landing and navigation systems)
- The Far East ATM market
- The Italian avionics market
- The Air Navigation Service Providers (ANSPs).

4.26.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

For THI the first step will consist in using the AMASS tools to complete a case study within AMASS, comparing the achievements with the results obtained, for similar developments, by using the previous-generation approach.

As a function of such achievements, the integration of AMASS tools and methods, into Thales development processes, will be considered.

4.26.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

THI invests about 5% of its turnover in R&D: AMASS will concur to keep stable the level of such investments, despite an ATM-market decline of 10-15% in the last 3 years.

For the next 5 years a market increase of about 5% per year is envisaged: the achievements, in terms of efficiency and technical competence, originated by AMASS, are expected to increase THI capabilities to face the challenges associated to such growth.

4.26.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

No disclosure of IP is planned and, in any case, IPR are protected by the Consortium Agreement.

Additional NDA will be signed in case confidential information needs to be shared with AMASS partners.

No patents, associated to THI activities in AMASS, are expected.



4.26.6 Exploitation activity update up to m33

Within our CS we exploited the tools provided by the AMASS platform to finalize or to address three main objectives:

- modelization of the software standard (for CNS/ATM systems) ED-109 objectives (to get evidences of the fulfilment of such objectives)
- verification and validation of the software modules (of the nav aids beacon sub-component under development) interactions, to verify that the architecture is consistent (activity started in January 2018, through P1 tools)
- production of a Safety Analysis (FTA) of the sub-component under development (the activity will be addressed through the use of P1 or P2 tools)

The first objective covers *Compliance* and *Evidence Management*.

The second objective covers *System Component Specification* and *System Architecture Modelling for Assurance*.

The third objective covers *V&V-based Assurance Impact Assessment* and/or *Contract-Based Assurance Composition*.

4.26.7 Challenges to market entry

The approach to the market presents two main issues, each posing two conflicting aspects. The importance of safety requirements for ATM systems is increasing but the cost and the effort for a complete certification is becoming quite significant.

Consequently, the industry is equipping itself with methods, techniques and tools (to support the safety processes) which also imply high costs, and plenty of time to implement and stabilize such processes.

New tools and methods, even if advanced and provided with additional functionalities, require, therefore, some time and some pressure to replace settled tools and methods.

One of the challenges of our participation to AMASS is the possibility to compare the results achievable through its tools and the capabilities offered by tools already adopted by other company departments.

4.26.8 Future plans beyond the life of the project

Some of the AMASS practices and some tool similar to AMASS ones were already in use in our development department.

The most relevant result in using the AMASS Tool Platform was the gaining of knowledge about formal methods for requirements definition (through contracts) and the relevant functional analysis and verification.

This way of proceeding is new in our development team and we will evaluate a possible reuse in next developments.



4.27 RISE Research Institutes of Sweden (SPS)

4.27.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

RISE is a research institute with the mission to generate value and sustainable development for business and society, by offering knowledge and help throughout the innovation chain. We do this by participating in publicly funded as well as contracted research with industry partners. We also perform product testing in our extensive testing facilities and certification in many areas, including safety for the automotive and industrial automation domains.

In AMASS, RISE expects to strengthen its expertise in assurance and certification, especially regarding co-engineering and co-assessment of multiple concerns and management of cybersecurity issues in safety-critical products. The expertise will be disseminated to industrial partners outside the AMASS project, in future collaborative research projects or other venues and partnerships, consistent with our role as innovation partner. The gained knowledge is also expected to represent useful input to the safety and cybersecurity standardization activities that we participate in, and as a base for improving and expanding our services in testing, certification and training. Finally, we expect the participation in AMASS to lead to future collaborations with other consortium partners.

4.27.2 Markets/Customers

Please list the markets or customers where you intend to exploit the results from AMASS.

Our principal partners are OEMs, suppliers and system integrators of safety-critical control systems, mainly within the automotive and industrial automation domains.

4.27.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

RISE will use different means to exploit the results, both during and after the project.

- Publishing and presenting results in both research and industry-oriented venues.
- Be active in preparing new project proposals, where AMASS results are used.
- Continuously integrate knowledge generated from the project in our testing, certification and training services.
- Interchange of results with other research projects RISE is concurrently involved in, such as national projects HoliSec (cybersecurity in the automotive domain) and ESPLANADE (safety for autonomous vehicles).

4.27.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

The commercial value for RISE is difficult to quantify as we are a research institute and not a for-profit business. The main expected result is to improve our dependable systems expertise and our services, enabling us to become a stronger innovation partner and fulfil the goal of generating value to business and society. Short-term, these goals include providing the results to partners outside AMASS and bring results to new research projects. Long term, this also includes growth of the dependable systems research group and of our testing, training and certification offerings.



4.27.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

We currently do not foresee that any IPR requiring protection will be generated because, as a general rule, research results will be published publicly. The consortium and grant agreement regulate many of the IPR issues among partners. If a need for IPR protection should arise, collaboration agreements with specific partners may be needed.

4.27.6 Exploitation activity update up to m33

RISE is currently looking for research projects related to the interplay between safety and security since unsolved questions remain in this area and AMASS results will be very useful in this further work. For instance, we plan to use some of the knowledge and results from AMASS in the ongoing project ECSEL SECREDAS (Cyber Security for Cross Domain Reliable Dependable Automated Systems) that started in April 2018.

4.27.7 Challenges to market entry

There is still no consensus on how to handle cybersecurity for many types of CPS, i.e. for the automotive domain a suitable cybersecurity standard is still not in place, even though work is ongoing to fill this gap.

4.27.8 Future plans beyond the life of the project

Work on safety/security interplay and on continuous assurance for agile organizations are already ongoing in other projects and is predicted to continue beyond AMASS and benefit from the AMASS results.



4.28 Comentor AB (COM)

4.28.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

COM delivers expert services within safety-critical embedded systems. We combine long experience from the automotive industry with a strong cross competence between software and systems engineering.

COM expects to strengthen its expertise, especially in co-engineering and co-assessment of multiple concerns as well as management of cybersecurity issues in safety-critical products. This expertise will be disseminated to our customers.

4.28.2 Markets/Customers

Please list the markets or customers which you intend to exploit the results from AMASS.

COM's principal customers are OEM's, suppliers and system integrators of safety-critical embedded systems, mainly within the automotive and industrial automation domains.

4.28.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

COM will use different means to exploit the results, both during and after the project:

- Publishing and presenting results in both research and industry-oriented venues.
- Continuously integrating results and knowledge, as generated by the project, in our expertise services.
- Participation in regional and international safety and security networks.

4.28.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

COM expects a growth in services related to safety and security, and as a first step, to expand the business from mainly safety expert services to also include more security and multiple concern services.

4.28.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

Comentor mainly anticipates that product results will be publicly available. COM has not yet identified a need to protect specific IPR.

4.28.6 Exploitation activity update up to m33

Comentor makes use of the findings and knowledge found in our participation in the AMASS project when working with Automotive OEMs and Automotive suppliers. In our plan we have also included:

Participation in Swedish ISO standardization working group.

Interplay with other related research projects (via customers).



4.28.7 Challenges to market entry

The challenges now are mainly to create a thorough understanding for cyber security problems and what can and shall be done to them. Many speak about cyber security, but few people have a deeper understanding of the implications in the Automotive domain.

4.28.8 Future plans beyond the life of the project

Consulting assignments on safety/security in for example agile organizations (already started at OEM).
Participating in ISO standardization (already started in the Swedish working group).



4.29 Alstom Transport SA (ALS)

4.29.1 Business Idea/Product & Services

What does your organization expect to achieve with AMASS? How will this benefit your organization? Examples might include: new products, new services, joint/partnerships, strengthening position in market.

The results from the AMASS project are expected to have a beneficial impact on Alstom activities regarding two main aspects.

First, the Alstom Case Study will help improve the existing development and validation process of the Automatic Train Control (ATC) system of the Urbalis 400 Communication-Based Train Control solution. Indeed, by introducing the use of formal methods in this process, which are exhaustive and unfalsifiable mathematically-based techniques, the level of confidence in the safety demonstration can be increased. When developing a new baseline (product evolution), the impact analysis will be made easier with the use of formal development and it will ensure the early validation of safety related requirements of the system.

Secondly, the AMASS tools and platform are expected to help create an assurance project guidance that will facilitate the safety demonstration of the ATC.

These two aspects combined will improve Alstom's competitiveness on the market as the company will be able to provide safer systems with shorter delays.

4.29.2 Markets/Customers

Please list the markets or customers which you intend to exploit the results from AMASS.

The results from AMASS are expected to be directly exploitable in the Urbalis 400 ATC product. Therefore, all potential customers for the Urbalis 400 CBTC solution are targeted. This solution is already in service on 39 metro lines and has been ordered for a total of 76 lines throughout the world today, but this number is still expected to grow in the following months. The results from AMASS could then be expended to other product lines in order to broaden the spectrum of potential customers.

4.29.3 Participant Exploitation Plan

How can you turn your ideas into reality? What steps do you need to take? How will the technologies, partnerships develop during and after the project?

After implementing the full workflow of the Alstom Case Study, the results will be analysed in order to provide an estimation of the costs reduction regarding the development and validation of new ATC baselines. Should these results be positive, the goal will be to integrate the AMASS tools and methods in all ATC development activities and systematize their use.

4.29.4 Commercial value

Please give estimated commercial values or estimated growth in 1-2 years and 3-5 years.

The main commercial value of the AMASS project for Alstom will stem from the early validation and verification of the safety requirements of the system. The use of formal development implies that safety properties are proven to be satisfied at each step (refinement) of the design process. It is therefore highly unlikely that safety related issues should be detected after the product development is finished. In case of a product evolution (that is to say a new baseline of the product), the use of formal methods ensures that the impact analysis does not have any gaps. This ensures a reduction of the costs related to the correction



of the product after the end of the development that is estimated at about 30% of the global costs today.

4.29.5 The means by which IPR will be protected

How would you intend to protect IPR generated by AMASS? I.e., patent, collaboration agreement or else.

In order to protect IPR generated by the AMASS project, Alstom will sign Non-disclosure Agreements when sharing confidential information is required.

4.29.6 Exploitation activity update up to m33

We are still conducting the Alstom Case Study which will be considered as a proof of concept for the integration of the AMASS project results in new projects.

4.29.7 Challenges to market entry

In order to be able to use the AMASS project results, the main challenge will be to ensure a high acceptance among users of the new validation process.

4.29.8 Future plans beyond the life of the project

After the end of the project, the new development and validation process of the ATC which was set up in the Alstom Case Study shall be maintained within the company. However, the widespread use of the AMASS tools and methods in Alstom activities shall be industrialized since the introduction of a new tool in the Alstom signalling process is submitted to company authorization. The technical readiness level maturity will be evaluated, and if it is positive, a pilot project will use the platform to test its added value as well as to demonstrate its broader acceptance by teams.



5. Conclusions

Market trends identified in D8.2 [2] are all growing in a positive trend, which represents a *level of concern* to the consortium, i.e. they might impact on the cost or influence on product or service direction. “New development practices” and “Automation of labour-intensive activities and intelligent control” are on top of the list of these trends.

Although there are many concerns, AMASS partners are able to minimise the impact or utilise their expertise, by using or developing model-based techniques, formal methods, continuous integration, controlled flexibility and “Agile” methodology. Many examples of how each partner deals with the *concerns* are in the individual exploitation plan and update. These plans and updates have shown that the AMASS partners are able to maximise the impact of the research funding, i.e. to create more products or services and teaching courses.



Abbreviations and Definitions

AMASS	Architecture-driven, Multi-concern and Seamless Assurance and Certification of Cyber-Physical Systems
API	Application Programming Interface
ADAS	Advanced Driver Assistance Systems
AOCS	Attitude and Orbit Control Systems
ARP	Aerospace Recommended Practice
ARTEMIS	ARTEMIS Industry Association is the association for actors in Embedded Intelligent Systems within Europe
ATC	Automatic Train Control
ATM	Air Traffic Management
AUTOSAR	AUTomotive Open System ARchitecture
BVR	Base Variability Resolution
CA	Consortium Agreement
CMMI	Capability Maturity Model Integration
COTS	Commercial Off-The-Shelf
CPS	Cyber-Physical Systems
CS	Case Study
E/E	Electrical/Electronic
EC	European Commission
ECSEL	Electronic Components and Systems for European Leadership
EPF	Eclipse Process Framework
EPL	Eclipse Public License
ERTMS/ETCS	European Rail Traffic Management Systems / XXXX
ESA	European Space Agency
FAA	Federal Aviation Administration
FMVEA	Failure Modes, Vulnerabilities and Effect Analysis
FPGA	Field Programmable Gate Array
FTA	Fault Tree Analysis
GDP	Gross domestic product
HW	Hardware
IACS	Industrial and Automation Control Systems
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMA	Integrated Modular Avionics
INCOSE	International Council on Systems Engineering
IoT	Internet of Things
IP	Intellectual Property
IPR	Intellectual Property Rights
ISO	International Organization for Standardization
JU	Joint Undertaking
LSIS	Laboratoire des Sciences de l'Information et des Systèmes
MARTE	Modelling and Analysis of Real Time and Embedded systems
NDA	Non-Disclosure Agreement



OEM	Original Equipment Manufacturer
OMG	Object Management Group
OO	Object Oriented
OSLC	Open Services for Lifecycle Collaboration
PLC	Programmable Logic Controller
QA	Quality Assurance
QVT	Query/View/Transformation
R&D	Research & Development
ROI	Return of Investment
RTU	Remote Terminal Unit
SLOC	Source lines of code
SME	Small and Medium-sized Enterprise
SWOT	Strengths, Weaknesses, Opportunities and Threats
SysML	Systems Modelling Language
TRL	Technology Readiness Level
TTM	Time to Market
UML	Unified Modelling Language
V&V	Verification and Validation
V2I	Vehicle to Infrastructure
V2V	Vehicle-to-Vehicle
WP	Work Package



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Appendix A: Domain specific market trend analysis survey

The template of the market trend analysis survey is shown in the following pages.



30/03/2018

[AMASS]D8.3 Domain specific market trend analysis

[AMASS]D8.3 Domain specific market trend analysis

*Required

1. Email address *

Basic information

2. Which industry your company is working in? If multiple industries, please submit a separate form for each.

Mark only one oval.

- ☐ Automotive
- ☐ Railway
- ☐ Space
- ☐ Aerospace
- ☐ Other:

Time to market & competitiveness

In an increasingly competitive market, with an ever-increasing speed of innovation, partners must pursue easier, faster, and more efficient ways to build and assure safety and security of critical systems to remain competitive. A key part of this relies on fast and reusable certification.

3. How applicable is this trend to your organisation? *

Mark only one oval.

	1	2	3	4	5	
Not applicable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Highly applicable

4. Do you see a positive or negative direction for this trend? Or no change? *

Mark only one oval.

	1	2	3	
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive

5. Please give an example and a brief description on how your company is adapting/preventing impact to this trend. *

https://docs.google.com/forms/d/1YfqL9hPA8BiPOU98P_UmzvMtEkqH7STeNihywoVNRs/edit

1/8



30/03/2018

[AMASS]D8.3 Domain specific market trend analysis

6. Any other comments on this trend?

Reuse challenges

The trend and need is to increase reuse-gear development and certification process as a major means to reduce costs. As noted above, the challenge with reuse is not necessarily with the reuse itself but with reuse of certification and safety artefacts, especially where artefacts are cross-domain. A safety artefact for aerospace might not be able to be applied directly "as is" in the railway or automotive domains for example.

7. How applicable is this trend to your organisation? **Mark only one oval.*

	1	2	3	4	5	
Not applicable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Highly applicable

8. Do you see a positive or negative direction for this trend? Or no change? **Mark only one oval.*

	1	2	3	
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive

9. Please give an example and a brief description on how your company is adapting/preventing impact to this trend. *

10. Any other comments on this trend?

Open solutions

There is a trend to move from closed, proprietary systems to more open CPS. Open here includes: open source, open interfaces/API, and collaborative solutions from multiple partners integrated together.



30/03/2018

[AMASS]D8.3 Domain specific market trend analysis

11. How applicable is this trend to your organisation? **Mark only one oval.*

	1	2	3	4	5	
Not applicable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Highly applicable

12. Do you see a positive or negative direction for this trend? Or no change? **Mark only one oval.*

	1	2	3	
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive

13. Please give an example and a brief description on how your company is adapting/preventing impact to this trend. *

14. Any other comments on this trend?

Security

Combined safety and security engineering methods are needed and being developed. One challenge is when safety and security are in conflict. Safety is often achieved by simplicity, whereas security is often achieved by layers of complexity.

15. How applicable is this trend to your organisation? **Mark only one oval.*

	1	2	3	4	5	
Not applicable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Highly applicable

16. Do you see a positive or negative direction for this trend? Or no change? **Mark only one oval.*

	1	2	3	
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive



30/03/2018

[AMASS]D8.3 Domain specific market trend analysis

17. **Please give an example and a brief description on how your company is adapting/preventing impact to this trend. ***

18. **Any other comments on this trend?**

Rising complexity

There is an increased recognition of risks due to the increasing complexity: larger code bases, more cooperating systems, and distributed/multi-core systems are simply harder to get right, and to justify their safety too.

19. **How applicable is this trend to your organisation? ***

Mark only one oval.

	1	2	3	4	5	
Not applicable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Highly applicable

20. **Do you see a positive or negative direction for this trend? Or no change? ***

Mark only one oval.

	1	2	3	
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive

21. **Please give an example and a brief description on how your company is adapting/preventing impact to this trend. ***



30/03/2018

[AMASS]D8.3 Domain specific market trend analysis

22. Any other comments on this trend?

New development practices

The software development process and practices are developing. New methodologies like Agile (common in many industries) are gradually making their own way into safety-critical software development. Model-based development techniques, formal methods, object-orientation, and new simulation techniques are also increasing and are having an impact on the way we deal with reliable software in safety-critical systems.

23. How applicable is this trend to your organisation? **Mark only one oval.*

	1	2	3	4	5	
Not applicable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Highly applicable

24. Do you see a positive or negative direction for this trend? Or no change? **Mark only one oval.*

	1	2	3	
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive

25. Please give an example and a brief description on how your company is adapting/preventing impact to this trend. *

26. Any other comments on this trend?

Automation of labour intensive activities and intelligent control

The software development process and practices are developing. New methodologies like Agile (common in many industries) are gradually making their own way into safety-critical software development. Model-based development techniques, formal methods, object-orientation, and new simulation techniques are also increasing and are having an impact on the way we deal with reliable software in safety-critical systems.



30/03/2018

[AMASS]D8.3 Domain specific market trend analysis

27. How applicable is this trend to your organisation? **Mark only one oval.*

	1	2	3	4	5	
Not applicable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Highly applicable

28. Do you see a positive or negative direction for this trend? Or no change? **Mark only one oval.*

	1	2	3	
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive

29. Please give an example and a brief description on how your company is adapting/preventing impact to this trend. *

30. Any other comments on this trend?

Increasing product lifespans

Given the rate at which technology is developing, tools, methods and documentation that are used for the original product need to be available throughout the product lifespan. This is so that incremental development and bug-fixes, for example, can be performed cost effectively.

31. How applicable is this trend to your organisation? **Mark only one oval.*

	1	2	3	4	5	
Not applicable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Highly applicable

32. Do you see a positive or negative direction for this trend? Or no change? **Mark only one oval.*

	1	2	3	
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive



30/03/2018

[AMASS]D8.3 Domain specific market trend analysis

33. **Please give an example and a brief description on how your company is adapting/preventing impact to this trend. ***

34. **Any other comments on this trend?**

Cross-domain and cross-country standardization

To handle increased product complexity, with no extra effort, there are moves by, for example, the aerospace certification authorities, including the FAA, under "overarching properties" to further streamline the certification, and ideally to better harmonise practices between different airworthiness authorities - especially as there's now more commercial aviation development in Russia, China, and Japan. Similar harmonization and strategic moves may be taking place in other domains.

35. **How applicable is this trend to your organisation? ***

Mark only one oval.

	1	2	3	4	5	
Not applicable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Highly applicable

36. **Do you see a positive or negative direction for this trend? Or no change? ***

Mark only one oval.

	1	2	3	
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive

37. **Please give an example and a brief description on how your company is adapting/preventing impact to this trend. ***



30/03/2018

[AMASS]D8.3 Domain specific market trend analysis

38. Any other comments on this trend?

Changes in certification and safety

There is an increased focus on system-level safety risk management, allowing for reduction in regulatory oversight when data exist showing that risks are low. Meanwhile, civil standards are increasingly being applied to military systems too.

39. How applicable is this trend to your organisation? *

Mark only one oval.

	1	2	3	4	5	
Not applicable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Highly applicable

40. Do you see a positive or negative direction for this trend? Or no change? *

Mark only one oval.

	1	2	3	
Negative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Positive

41. Please give an example and a brief description on how your company is adapting/preventing impact to this trend. *

42. Any other comments on this trend?

☐ Send me a copy of my responses.

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8/8



Appendix B: AMASS SWOT analysis survey

The template of the SWOT analysis survey is shown in the following pages.



AMASS SWOT ANALYSIS

To make a summary analysis of external and internal factors on AMASS core technology in different domains

Please respond by 9th November 2018.

Which technology does this analyse (e.g. AMASS core concepts, or specific parts of it)?

Please provide a name and a short description of the technology that you would like to do a SWOT analysis on.

Which domains (e.g. aero, automotive, rail, medical) does this analysis cover?

Please provide which domain or domains that your analysis would cover.



INTERNAL FACTORS	
STRENGTHS (+)	WEAKNESSES (-)
<p><i>What advantages does AMASS core technology have?</i> <i>What does it do better than others?</i> <i>What unique feature it has or gap it addresses?</i> <i>What do people in market see it as strengths?</i> <i>What factors mean that it "gets the sale"?</i> <i>What is the unique selling proposition?</i></p> <p><i>Your analysis shall be stated here and the questions above are only here to guide your thinking.</i></p>	<p><i>What could it improve?</i> <i>What should it avoid?</i> <i>What are people in the market likely to see it as weaknesses?</i> <i>What factors lose its sales?</i></p>

EXTERNAL FACTORS	
OPPORTUNITIES (+)	THREATS (-)
<p>What good opportunities can you spot? What interesting trends are you aware of? Useful opportunities can come from such things as:</p> <ul style="list-style-type: none">• Changes in technology and markets on both a broad and narrow scale.• Changes in government policy related to your field.• Changes in social patterns, population profiles, lifestyle changes, and so on.• Local events.	<p><i>What obstacles does AMASS core technology face?</i> <i>What are competitors doing?</i> <i>Is changing technology threatening its position?</i> <i>Could any of your weaknesses seriously threaten the adoption of the technology?</i></p>



Appendix C: Overall Strategy for Exploitation

The AMASS project is industrially focused so we place emphasis on the ability to take the new technologies, developed through this project, and bring them to use by the project industrial partners, supplying their respective supply chains.

The AMASS initial exploitation strategy is split into three areas:

Industrial exploitation:

- Mainly driven by industry partners, who have both short-term and long-term technology exploitation needs, the AMASS project will use its results, as soon as possible, in product development projects within industry partners, in order to improve existing and new products in their capability of better and more efficiently developing and certifying secure/safe large and complex composed CPS.
- Interaction between partners needs to be encouraged and facilitated, in order to exchange experience and knowledge in different business environments through complementary case studies conducted using the AMASS integrated framework.
- In the longer-term, some companies may form partnerships, and influence their customers and/or suppliers to use the AMASS Safety/Security Assurance Methodology.

Exploitation via **Community** (driven by partners active in the Eclipse Community):

- The project shall establish cooperation with other (non-project) organizations in the community, to further develop AMASS technology.
- The project shall build new technology and tools inside the community-driven framework and provide added-value and services around that core.

Academic exploitation (mainly driven by academic partners):

- Preparation of high-quality journal and conference papers, to support own reputation and to be further used by themselves and other parties.
- Preparation of course materials, based on the project experiences and prepared textbooks (primarily the universities).
- Introduce some of the methods and tools, available for public usage, in lectures at universities, in a form of practical usage.
- Provision of consulting services (by universities) to increase their societal and economic value.



Appendix D: Exploitation Opportunities and Results

Table 2. Exploitation Opportunities and Results

Item	Title	WP/T	Owner	Description	Benefits to partner or community	Activity type (1)	Status/Note
1	Using RapiTest Framework on a service contract	WP5, T5.3	RPT	Activity engaging with customers on needs for v&v service contract	Reduce testing cost.	Individual	Completed
2	Investigating how Rapita tool chain would be benefit for OHB	WP1, T1.2	RPT	Evaluation for Rapita tools with OHB current process.	Integration with Matlab and reducing cost on testing for OHB; Future licence revenue for RPT.	Cluster	Completed with a case study published.
3	Investigating how Sophia tool for safety and security analyses would be benefit for Cleary use case	WP1, T1.2	CEA	Evaluation of CEA tools on railway engineering process	Increase the TRL of CEA tools.	Cluster	Initial evaluation
4	Investigating how to perform co-analyses (safety and security) based on Papyrus tool and its plugin Sophia	WP4	CEA	Definition of safety and security co-analyses tools/methods and methodologies based on Papyrus	Ensure the relevance and adequacy of CEA functional safety and cybersecurity tools to industry needs.	Cluster	Introduction
5	Seamless integration of formal verification tools in the development process	WP5	HON	Integration of data-symbolic C/C++ model checking using DIVINE from Masaryk University, integration of requirement analysis tools, integration of V&V tools from FBK	Reduced development cost, reduced number of development cycles, improved quality of both requirements and the system.	Cluster	Data-symbolic DIVINE from UOM integrated by HON. Tool maturation is ongoing.
6	Integration of formal	WP1	CLS	Use of Frama-C (CEA) on code	Ensure the relevance and	Individual	Proof of



	verification tools in the development process			generated for railway applications	adequacy of CEA formal verification tools to industry needs; improved quality; diversification of certification assets.		concept
7	Investigating CHES support with respect to UCs needs. (e.g. UC4 space domain)	WP1	INT	Evaluate how the CHES toolset can provide support design and safety assessment to then support assurance needs.	Ensure the maturity (TRL), relevance and adequacy of CHES to industry needs.	Cluster	Evaluation on-going
8	Additional example models based on case studies	WP1	KMT	For the automotive case studies there will be medini analyze example models	Demonstrate benefit of AMASS results to tool user community.	Individual	Available
9	Technology demonstrators for collaborative engineering	WP5	KMT	The demonstrators will showcase the potential of web-based collaboration patterns in safety analysis	This will be used for in-house exploitation and later on influence general tool development strategy	Individual	Demonstrator available
10	Investigating how Papyrus/CHES tool can be used in GMV	WP1	GMV	Evaluating the convenience of using Papyrus/CHES as SysML/UML tool instead other commercial tools	Reduce costs in software licenses	Individual	Evaluation and results documented in D1.6
11	Integration of AMASS tool in the RTU development process	WP1	TLV	Evaluate how AMASS tool can provide safety and security assessment in the RTU development process	Reduce effort and cost in safety/security certification process.	Individual	Evaluation ongoing using prototypes
12	Process/Product/Assurance Case Variability management via integration of BVR tool	WP6	MDH	Design and implementation of a unified approach for systematic reuse and variability management tool support for Anti-Sisyphus. Initial application of the approach to OHB case study and LAN/IFX cross-domain. In addition, explorative evaluation planned in the context of ICCF (IACS Cybersecurity	Cost and time reduction	Mainly Individual (INT partly contributed to the implementation for the management of system	Further evaluation ongoing



				Certification Framework Protection Profile) in collaboration with EWIC/Sec and EWICS/Med Chairs.		variability)	
13	Automated and formal compliance checking	WP6	MDH	Design and initial prototype implementation of logic-based reasoning for compliance checking. Initial application of the approach for checking processes against automotive standards.	In a long term, cost and time reduction related to compliance checking	Mainly Individual (partly CSIRO/Australia offered support for the integration with Regorous compliance checker)	Further evaluation ongoing
14	Systematising Reuse of Multi-Context Safety Elements Using Component Contracts	WP6	MDH	In initial application of the approach to the automotive domain	Cost and time reduction	Individual	Further evaluation ongoing
15	Automatic generation of argument fragments	WP6	MDH	Design and implementation of model transformations, enabling process as well as product-based arguments generation (including fallacy-detection ad guidelines for removal). Explorative evaluation of their benefits in the context of avionics, space, rail, and automotive domains.	Cost and time reduction	Individual	Further evaluation ongoing
16	Co-analysis via ConcertoFLA	WP4	MDH	Design and implementation of an extension of ConcertoFLA to support co-analysis. Explorative application to OHB case study.	Risk analysis enhancement	Individual	Further evaluation ongoing
17	Investigating how TRC tools can be used in the	WP1	TRC	Evaluating the introduction of TRC Tools in the engineering tool	Cost and time reduction	Cluster	Evaluation on-going



	use cases from B&M and Alstom			ecosystem of the Use Cases by Alstom and B&M			
18	Integration of AMASS-targeted features by TRC in TRC tools	WP1, WP3, WP5, WP6	TRC	Transfer of results from AMASS to the current TRC commercial products	Tool enhancement	Individual	Partial transfer already performed
19	Integration of AMASS-Platform (CHESS tool) with ALL4TEC's tools (Safety Architect and Cyber Architect)	WP5 and WP4	A4T	Tool integration for Safety and Security co-analysis	Partners can import their system models from CHESS to Safety Architect, activate Safety&Security viewpoint in safety architect, reuse security analysis artifacts from Cyber Architect to Safety Architect for safety and security co-analysis.	Cluster	Demonstrator available
20	UC3 results transfer to industry	WP1-WP6	UC3	Definition of collaboration agreements or contracts with companies for UC3 results transfer	New incomer and collaboration projects	Individual	Contacts with some companies have started (e.g. NoMagic and Boeing)
21	Safety Analysis for Automated Driving	WP3	TEC-INT-FBK-B&M-KMT-AIT	Joint exploitation of CHESS, OCRA, SAVONA, Medini Analyze, AMT 2.0 and Sabotage for the Design of Automated Driving E/E systems	Tool enhancement. Integration of contract-based, fault injection and monitors for safety analysis. Cost and time reduction by applying an early safety V&V.	Cluster	Demonstrator ongoing
22	Server-side analysis of data	WP5	KMT	Technology for the analysis and query of data at the server side on safety project content (elasticsearch, Kibana)	Multiple purpose technology - application for example to find information back in many safety projects or to increase consistency among different safety projects.	Cluster	Demonstrator available



23	Tool integration - system models	WP5	KMT	Tool integration for the usage of system (SysML) models for safety analysis. Focus on seamless integration. Application of QVT technology.	Customers could use their system models for safety analysis more user friendly by seamless import (including graphical information) and round-trip support	Individual	Demonstrator available
24	Tool prototype - system verification	WP3	B&M	The prototypical tool SAVONA allows an easy way to create static architecture models of systems. Additionally, these models can be specified via template languages which enable an automatic verification of the specification against the model.	Cost and time reduction; no need to verify system model and specification manually.	Individual	Demonstrator available
25	e-Drive demonstrator	WP1/ WP5	KMT	Complete example showcasing seamless integrated tools for system design (SysML), system safety analysis, software modelling and auto code generation + fault injection with the demonstrator. System update (introduction of safety mechanisms + their implementation) is also shown. Tools used: SCADE Architect, medini analyze, SCADE Suite.	Customers could use their system models for safety analysis more user friendly by seamless import (including graphical information) and round-trip support	Individual	Demonstrator available
26	Grow the OpenCert, CHES and Papyrus ecosystem	WP7	ECL	The AMASS open source platform provides a comprehensive platform supporting Assurance and Certification Process for CPS. The goal is to promote both the technology and the Eclipse open source ecosystem by growing the open source community and	Cost reduction and improvement of the platform by involving more users and contributors worldwide.	Cluster	On-going effort



				fostering business use of the technology.			
27	Evaluation of Process variability and Process argumentation with EPF Composer/BVR tool/OpenCert	WP1	OHB	Evaluation of method for process variability and process argumentation provided by MDH.	Ensure the relevance of the selected process activities and improvement of efficiency.	Individual	Evaluation ongoing

Notes:

(1) Activity type: Individual -> only one partner; Cluster -> collaboration with 2 or more partners, but not yet project wide; Global -> project wide collaboration.



Appendix E: Intellectual Property Register

Table 3. Intellectual Property Register

Item No.	Project IP Originator	IP Owner	IP Type	IP Description	Date IP created	Patent, Trademark or Design No.
1	RPT	RPT	Background IP	RapiTestFramework V1.0	30th Sep 2016	Copyright/Know-how
2	KMT	KMT	Background IP	medini analyze functional safety tool	since 2008	Copyright
3	KMT	KMT	Foreground IP	medini analyze model of automotive case studies		Copyright/Know-How
4	KMT	KMT	Foreground IP	Technology Experiments (source code) for collaborative engineering		Copyright/Know-how
5	KMT	KMT	Foreground IP	Requirements and Business cases for collaborative engineering		Know-how
6	KMT	KMT	Foreground IP	medini analyze connection to OpenCert		Copyright/Know-how
7	KMT	KMT	Foreground IP	Approach for cross-domain and intra-domain re-use based on SysML libraries		Copyright/Know-how
6	CEA	CEA	Background IP	Sophia	2011	Copyright/Know-how
7	CEA	CEA	Background IP	Papyrus	2009	Copyright/Know-how
8	CEA	CEA	Background IP	Frama-C	2007	Copyright/Know-how
9	FBK	FBK	Background IP	NuSMV - Symbolic Model Checker	2001-2017	Copyright/Know-How
10	FBK	FBK	Background IP	nuXmv - Symbolic Model Checker	2001-2017	Copyright/Know-How
11	FBK	FBK	Background IP	OCRA - Verification Tool	2001-2017	Copyright/Know-How
12	FBK	FBK	Background IP	SDE - Syntax-Directed Editor	2001-2017	Copyright/Know-How
13	FBK	FBK	Background IP	mathsat - SMT Solver	2001-2017	Copyright/Know-How
14	FBK	FBK	Background IP	xSAP - Safety Assessment Tool	2001-2017	Copyright/Know-How
15	FBK	FBK	Background IP	HyCOMP - Model Checker	2001-2017	Copyright/Know-How
16	FBK	FBK	Foreground IP	Eclipse Plugins for Architecture-driven Assurance		Copyright/Know-How
17	HON	HON	Background IP	HiLiTE - internal V&V tool	2008	Copyright/Know-



						How
18	HON	HON	Background IP	HAM - internal library	2009	Copyright/Know-How
19	HON	HON	Background IP	ForReq tool - internal V&V tool	2011	Copyright/Know-How
20	INT, MDH, and others	INT, MDH, and others	Background IP	CHESS	since 2009	Copyright/Know-How
21	INT	INT	Foreground IP	CHESS extensions for integration with OpenCert		Copyright/Know-How
22	MDH	MDH	Background IP	Anti-Sisyphus -conceptual approach for systematizing reuse regarding process, product, assurance case as well as for enabling impact analysis	2015	Copyright/Know-How
23	MDH	MDH	Background IP	Automatic generation of argument fragments	since 2014	Copyright/Know-How
24	MDH	MDH	Background IP	Approach for Systematising Reuse of Multi-Context Safety Elements Using Component Contracts	since 2014	Copyright/Know-How
25	MDH	MDH	Foreground IP	Automated and formal compliance checking	since 2016	Copyright/Know-how
26	TRC	TRC	Background IP	Requirements Quality Suite, (RQS) including: - Requirements Quality Analyzer (RQA) - Requirements Authoring Tool (RAT) - Knowledge MANAGER (KM)	since 2008	Copyright/Know-how
27	TRC	TRC	Background IP	The semantic indexing and retrieval engine (CAKE/RSHP) and its corresponding APIs	Since 2000	Copyright/Know-how
28	TRC	TRC	Background IP	The System Knowledge Repository (SKR) and System Knowledge Base (SKB) metamodels (including the System Asset Store and the System Conceptual Model)	Since 2000	Copyright/Know-how
29	TRC	TRC	Background IP	SQA as the System Quality Analyzer for System Engineering Assets	Since 2015	Copyright/Know-how



30	TRC	TRC	Background IP	System Interoperativity Manager - T+ plugin	Since 2015	Copyright/Know-how
31	TRC	TRC	Foreground IP	Creation of Papyrus connector for TRC tools	Since 2016	Copyright/Know-how
32	TRC	TRC	Foreground IP	Creation of Rhapsody connector for TRC tools	Since 2016	Copyright/Know-how
33	TRC	TRC	Foreground IP	Creation of structured-information file connector for TRC tools	Since 2016	Copyright/Know-how
34	UC3	UC3	Background IP	OSLC KM 1.0 specification	2015	Know-how
35	UC3	UC3	Foreground IP	OSLC KM 2.0 specification	Since 2016	Know-how
36	UC3	TRC, UC3	Foreground IP	OSLC connectors of the AMASS Platform	Since 2017	Know-how
37	UC3	UC3, TRC	Foreground IP	Semantics-based models of assurance standards	Since 2017	Know-how
38	UC3	UC3, TRC	Foreground IP	Artefact Quality Analysis features	Since 2017	Copyright/Know-how
39	UC3	UC3, TRC	Foreground IP	System artefact search engine	Since 2017	Copyright/Know-how
40	UOM	UOM	Background IP	DIVINE - Model Checker		Copyright/Know-How
41	TEC	TEC	Background IP	Sabotage - Simulation-based Fault Injection Tool	Since 2016	Copyright/Know-How
42	TEC	TEC	Background IP	OpenCert - Assurance & Certification Toolset	Since 2015	Copyright/Know-How
43	TRC	TRC	Foreground IP	System Interoperativity Manager - AMASS plugin	Since 2018	Copyright/Know-How
44	TRC	TRC	Foreground IP	Creation of SQL Query connector for TRC tools	Since 2017	Copyright/Know-how
45	ALT	ALT	Background IP	Farkle	Since 2016	Copyright/Know-How
46	ALT	ALT	Background IP	EMC2	Since 2017	Know How
47	ALT	ALT	Foreground IP	Alten Car	Since 2017	Copyright/Know-How
48	ALT	ALT	Foreground IP	Farkle AMASS	Since 2017	Copyright/know-How
49	A4T	A4T	Background IP	Safety Architect tool	Since 2011	Copyright
50	A4T	A4T	Background IP	Cyber Architect tool	Since 2017	Copyright
51	A4T	A4T	Foreground IP	Interface between Safety Architect and Cyber Architect	Since 2018	Copyright/Know-How
52	MDH	MDH	Foreground IP	Anti-Sisyphus -further development: implementation via	2017	Copyright/Know-How



				integration with BVR Tool and addition of impact analysis capabilities		
53	B&M	B&M	Foreground IP	TESTONA - Test Design Tool using the Classification Tree Method	Since 2006	Copyright/Know-How
54	B&M	B&M	Background IP	SSPL - System Specification Pattern Language	Since 2018	Know-How
55	B&M	B&M	Foreground IP	SAVONA - System Modelling & Specification Tool	Since 2018	Copyright/Know-How
56	UOM	UOM	Background IP	Remus2 - Requirements Semantics Analysis Tool	Since 2017	Copyright/Know-How