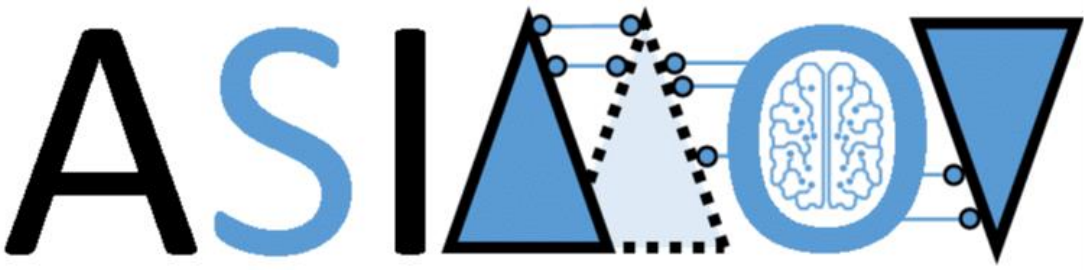
# Exploitation Plan and Report

## [WP5; T5.2; Deliverable: D5.2 version 1.2]

## Non-Confidential



## AI training using Simulated Instruments for Machine Optimization and Verification

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## Change History

| Version | Date | Reason for Change |
|---|---|---|
| 1.0 | 2022.02.10 | First version, based on the plans and reports of the Dutch and German partners, with some contributions from Finnish partners (pending the funding decision in Finland) |
| 1.1 | 2022.06.22 | M12 update to plan, results and consortium (removal of Finland) |

| | | |
|---|---|---|
| 1.2 | 2023.06.18 | M24 update to plan and achievements |

## Abstract

The ASIMOV-project develops technologies to combine Digital Twinning and Machine-Learning (e.g., Reinforcement Learning) to automate the calibration, optimization of Cyber Physical Systems. The project is centered around industry use cases to ensure that the technology developed in the project will meet actual industry needs. Exploitation of the ASIMOV-results in industry is one of the key drivers of the project.

This document provides an overview of the exploitation plans of the ASIMOV-consortium as well as reports on the actual status.

This document will be updated every 6 months. Version 1.0 reflects the status per January 2022 (month 8 in the project) and version 1.1 the status per July 2022.

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# 1 Introduction

High-tech cyber-physical systems (CPSs) play increasingly important roles in our society. They are ubiquitous, and companies, organizations and societies depend on their correct functioning. CPSs need to have high up-times, be user-friendly, and economically to use. CPS suppliers must assure that their systems reliably deliver optimal quality in customers' environments, without bothering their customers with complex system optimisation tasks that require highly skilled staff. Systems need to be optimally tuned before delivery and at installation and re-adjusted during use. Such optimization can easily require many hours/days and this total time increases rapidly due to growing project diversity and complexity. To address this major problem, it is ASIMOV's vision that CPSs must be increasingly autonomous and self-optimising, which leads to the following central question:

*How to build complex high-tech systems that select their optimal settings autonomously within minimal time and with minimal external expertise?*

To answer this question, the ASIMOV project will develop innovative technologies to create self-optimising CPSs by combining AI and Digital Twinning. The consortium, consisting of large industrial parties, SME's with strong AI-expertise, and leading universities and research institutes, will deliver the following innovations:

- creating digital twins of systems to simulate realistic system behaviour;
- training an Optimisation-AI based on the digital twin to find optimal system settings;
- verifying the validity of the digital twin for training the AI;
- using the trained AI to perform the tuning and calibration tasks on actual machine configurations.

This will lead to AI-based software that autonomously performs system optimisation tasks during manufacturing, installation, and system usage. Proof of concepts will be provided in two different industrial system domains (electron microscopes and automated driving) for which optimisation is crucial for system performance.

This document gives an overview of the plans to exploit the ASIMOV results by creating industrial and social added-value. In addition to the plan, the document also provides a report of the current exploitation status.

# 2 Consortium Overview

| **Company Name** (Project coordinator first) | **Country** | **Role *)** | **Type of organisation **)** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **I** | **S** | **U** | **R** | **O** |
| FEI Electron BV (TFS) | The Netherlands | C | x | | | | |
| Netherlands organization for applied scientific research (TNO) | The Netherlands | M | | | | x | |
| Eindhoven University of Technology (TUE) | The Netherlands | P | | | x | | |
| CQM B.V. (CQM) | The Netherlands | P | | x | | | |
| OFFIS e. V. (OFFIS)<br>**until December 31, 2021** | Germany | M | | | | x | |
| Deutsches Zentrum für Luft- und Raumfahrt (DLR)<br>**per January 1, 2022** | Germany | M | | | | x | |
| AVL Deutschland GmbH (AVL) | Germany | P | x | | | | |
| NorCom Information Technology GmbH & Co. KGaA (NORCOM) | Germany | P | | x | | | |
| LiangDao GmbH (LIANGDAO) | Germany | P | | x | | | |
| RA Consulting GmbH (RAC) | Germany | P | | x | | | |
| TrianGraphics GmbH (TG) | Germany | P | | x | | | |

*Table 1 - Consortium Overview*

*) C = Coordinator; M = country's Main participant contact; P = Participant
**) Type of organisation: I=Industry; S=SME; U=University, R=Research Institutes, O=Other

**NOTE:**
The German consortium has changed since submission of the FPP. The table above reflects the current composition of the consortium, i.e. OFFIS is converted to DLR. A CR will be submitted to ITEA to reflect the change. It is in progress for submission in September 2022.

**NOTE:**
All Finland participation is removed in version 1.1. of this document and their withdrawal from the consortium was reflected in the CR.

# 3 Exploitation Plan

## 3.1 Exploitation Prospects

This section gives a high-level overview of the exploitation prospects:
- exploitation by consortium members;
- joint exploitation opportunities for consortium members;
- exploitation opportunities beyond the consortium.

In section 3.2, an overview is given of concrete exploitation plans.

Most concrete exploitation results are expected from the industry partners in the consortium. Since academic and research partners are also encouraged to exploit the results from the project, their plans and results are included too.

### 3.1.1 Exploitation by Consortium Members

#### 3.1.1.1 AVL and NorCom

For the successful implementation of research projects, several new jobs were created at the Karlsruhe and Stuttgart locations of AVL Deutschland GmbH. There is a specific focus on the development methodology for highly automated vehicles and their implementation in efficient tools. The already very close cooperation with research institutes such as OFFIS/DLR (Institute of Systems Engineering for Future Mobility) will be significantly expanded in the field of highly automated vehicles, thus ensuring a systematic training and qualification of junior staff in this new field. At the same time, the development and testing solutions developed in the joint project will also be deployed in the European TechCenters of AVL, where they will be available for further demonstrations and customer projects. Due to the planned publications in the joint project, it is expected that the results will be well received by the relevant industrial and academic users already in the third year of the project, thus making a significant contribution to the state of the art. The planned AI-based optimisation method using digital twins will enable AVL and NorCom to significantly extend the current product and service portfolio in the areas of advanced simulation, smart testing and big-data analysis. An overall annual growth of 15% is expected in this portfolio when exploiting the results of this project.

#### 3.1.1.2 CQM

By participating in the project, CQM will extend their knowledge and experience in the area of Digital Twinning and Artificial Intelligence. This will strengthen their offering to their current customer base and will allow CQM to extend their offering to new customers in current and new markets. Participation in the ASIMOV project gives CQM the opportunity to operate at the heart of new innovations which is needed to be a credible player in their markets. CQM sees in this area a potential growth of at least 10% to 15% of its annual revenues.

#### 3.1.1.3 LiangDao

To ensure the project success, LiangDao will acquire new software and engineering talents from all over the world, who will come to LiangDao's development centre in Munich, which is near to Stuttgart and project partners. The output of the project will improve the efficiency of LiangDao's existing solution significantly: post processing of perception data over-night will be shortened to just few hours; calibration of testing systems become much faster. LiangDao is confident about a huge license revenue growth of ML-based testing and validation tools of up to 20%, and more than 30% growth of software maintenance and data operation business.

#### 3.1.1.4 DLR / OFFIS

The results of ASIMOV are used to extend our consultancy offer on the efficient transfer of research results to industry applications. OFFIS supports the foundation of spin-off companies and has set up specific guidelines for that. In the past, several spin-off companies have been founded out of OFFIS. Also, for ASIMOV, if there is a market and the results have reached an appropriate maturity level, then

founding spin-off companies is an opportunity. OFFIS has a long history of cooperation with AVL and is working together with AVL in ASIMOV, therefore this cooperation is the preferred channel to exploit our common results. Furthermore, OFFIS is reusing the methods and tools developed within ASIMOV to assemble a tool collection for the optimisation of cyber-physical systems.

Through its status as a so-called “An-Institute” to the University Oldenburg, OFFIS has close collaborations with researchers from the interdisciplinary research centre on Safety Critical Systems. Topics addressed within ASIMOV are incorporated into Master level courses at the University of Oldenburg on Embedded Systems and Microrobotics, and support PhD and Master theses.

The OFFIS transportation department became a new institute of the German Aerospace Center (DLR e.V.) as of 2022, January, 1. This new institute focusses on systems engineering and a major part of the vision is to assure technical trustworthiness of CPS. A special challenge will be the technical trustworthiness of AI based components. Results of this project will be therefore part of the fundamental basis of the future research strategy and cross-project technology demonstrators of the new institute.

#### 3.1.1.5 RAC

For the successful implementation of the research project, 3-6 new jobs will be created in Bruchsal, Germany.

By participating in the project RAC will expand their knowledge and expertise in digital Twinning and Artificial Intelligence. This will strengthen the offering to the current customer base and allow RAC to expand their offering to new customers in existing and new markets.

The business model of RAC is based on several types of income or business models:

- License income for the individual products in the product family.
- Income from maintenance and service contracts: The software components must be maintained. It is assumed that the majority of the licenses ordered with maintenance are approximately 15% of the license costs annually.
- Product-bound services: Experience shows that accompanying consulting services as well as extension and adaptation services are to be provided for the various customer applications.

RAC estimates a medium-term revenue share of 5-15% through the exploitation of results from this project, with an annual growth rate of 5-10% for this product and service area.

An increase of components and services is mainly expected by joint exploitation opportunities of ASIMOV partners in the automotive industry.

#### 3.1.1.6 FEI Electron Optics/Thermo Fisher Scientific

There is a clear market demand for making Thermo Fisher Scientific’s sophisticated electron microscopy (EM) systems easier to operate, more productive and keep them operational, with less user expertise required. Artificial intelligence, including using digital twins, and the results from the ASIMOV project are expected to play a pivotal role to this end. The project outcomes will furthermore improve the speed of research, development, manufacturing and installation of EMs. Finally we foresee a reduction in maintenance of EM systems. This will enable larger market penetration in the customer areas mentioned in section 3.1, and enable market expansion from wider non-expert user adoption. If this were to boost the 2019-2024 market growth by an additional 8.5% to 18.5% (Figure 3-4), it would equate to around $300M in additional incremental revenue growth, of which Thermo Fisher Scientific would expect to capture 40% to 60% as EM market and innovation leader.

Thermo Fisher Scientific envisions exploiting ASIMOV project results to enable more efficient R&D, increased automation of pre-ship, post installation and operational system alignments leading to greater productivity for our customers and for Thermo Fisher Scientific . An important improvement for higher productivity is realized by creating shorter set-up and calibration procedures. For instance, in the TakeMI5 EU ECSEL subsidy project aimed at the semiconductor industry, the application of AI in a Metrios TEM (Transmission Electron Microscopy) to script-free sample navigation, feature recognition and data

acquisition, reduced the total experimental time by a factor of 5. A key result from ASIMOV will be to verify the potential improvement in productivity of identifying optimum individual system or sub-system alignment settings. Furthermore, advances from the ASIMOV project are expected to cascade across Thermo Fisher Scientific's product and service ranges.

#### 3.1.1.7 TNO

The results from the ASIMOV project will contribute to strengthening the knowledge and experience of TNO (ESI) on their strategic program lines Exploiting System Context, System Performance, System Evolvability, and System Architecting, especially in the area of applying industrial AI in complex high-tech systems. TNO (ESI) will be able to leverage this knowledge in future applied research projects for the Dutch high-tech industry. This will result in additional turn-over for TNO (ESI), but more importantly it enables TNO (ESI) to fulfil its mission to strengthen the Dutch high-tech industry by embedding leading-edge methodologies into the Dutch high-tech systems industry to cope with the ever-increasing complexity of their products.

#### 3.1.1.8 Eindhoven University of Technology

TU/e/EAISI has the ambition to reinforce its already prominent role in university-industry co-operation and strengthen its position as a leading research institute in transferring cutting-edge technology to industry. This project will provide the opportunity to develop key innovative technological tools within AI and digital twinning and transfer it to leading industrial partners. Regarding human capital: We will hire 2 PhD students [2 positions for 4 years] that will be trained in this vital area for the high-tech area. Moreover, several master students will conduct their internship and final thesis projects within context of Asimov and form important human capital for the labour market.

#### 3.1.1.9 TrianGraphics

TrianGraphics (TG) expects to create a higher market visibility with the industrial use case and reference for the simulation technology application created throughout this project together with the experienced partner companies involved. Related communication activities will help to create additional revenue in the area of software licensing, software engineering services and the creation of digital twins for simulation. TG will use the acquired know-how to improve their software products and service portfolio within 2 years after the project.

### 3.1.2 Joint Exploitation Opportunities for Consortium Members

In addition to the exploitation by individual partners in the consortium, joint exploitation opportunities are foreseen (as already indicated in some of the descriptions above). The clearest opportunities are formed by the strong consortia formed around the two industrial use cases in the project. In section 3.1 Market value chain, the relations between the partners in these use cases have already been described. These descriptions indicate opportunities for joint exploitation. In the follow paragraphs, these opportunities have been summarized.

#### 3.1.2.1 The Electron Microscopy case (CQM and Thermo Fisher Scientific – TNO and TUe)

The electron microscopy use case will be developed by a consortium of four partners: Thermo Fisher Scientific, CQM, Eindhoven University of Technology and TNO. For CQM and Thermo Fisher Scientific, the cooperation in the ASIMOV-project gives the opportunity to further enhance their cooperation. CQM will have the opportunity to deepen their understanding of electron microscopy and of the applicability of digital twinning an AI in TEMs. This will give CQM the opportunity to enhance their added-value for Thermo Fisher Scientific. Thermo Fisher Scientific will benefit from the cooperation within CQM to potentially speed-up their innovation based on advanced digital twinning and AI applications.. This way, both partners will benefit from their close cooperation in the ASIMOV-project. TNO and the Eindhoven University of Technology will contribute to these joint exploitation opportunities with the results from their research.

#### 3.1.2.2 The Unmanned Utility Vehicle case (AVL, LiangDao, Norcom, RAC and TrianGraphics – OFFIS, DLR)

Similar to the cooperation and joint exploitation opportunities for the Electron Microscopy use case, the consortium for the Unmanned Utility Vehicle has been formed to create opportunities for joint exploitation. Together with AVL, the industrial partners working on this case (LiangDao, Norcom, RAC, TrianGraphics) will create opportunities for extending their joint business based on the results from the ASIMOV-project. OFFIS and DLR, being existing research partners of AVL, will contribute to these joint exploitation opportunities with the results from their research.

#### 3.1.2.3 Cross-Use case opportunities

As described above, the ASIMOV-consortium was shaped around two industrial use cases to maximize joint exploitation opportunities for the partners. Therefore, the clearest joint exploitation opportunities follow from this multifaceted approach. We will seek joint exploitation opportunities by groups of consortium partners beyond these two cases during the execution of the project.

As described in the FPP, the ASIMOV-partners will cooperate in WP2, WP3 and WP4 to develop shared technologies and processes for digital twin creation, training AI and for the industrial embedding.. Although the partners have been selected for their contribution to one of the use cases, we evision many opportunities for cross-overs. By bringing the partners together within these three WPs, we will stimulate and enhance exchange of expertise amongst all partners and amongst both use cases

### 3.1.3 Exploitation Opportunities beyond the Consortium

The results from the ASIMOV-projects are expected to be applicable in a wide range of industries, next to those represented within the project. To enhance the exploitation of the results, consortium members will seek cooperation with interested industries from their networks. Two concrete initiatives can be mentioned in this plan at this moment:

- the German consortium will work with associate partners;
- the Dutch consortium will create reference groups of companies from other application domains that have expressed their interest in the results of the project: (i) a reference group – companies (3) that have expressed their intention to validate and exploit the outcomes of the ASIMOV project for their own risk/cost; (ii) an audience group – companies (3) that will be actively informed about the results of the project, as they have expressed a clear interest in learning about the applicability of the outcomes of the ASIMOV project for their own businesses.

## 3.2 Concrete Exploitation Opportunities

### 3.2.1 Industrial Partners

| Exploitation Description | Measurable Effect | Planned date |
|---|---|---|
| AVL | | |
| Industrial usability of developed methods and tool applications. | Alignment and positive feedback from associated partners in Germany. | M24 |
| Improve efficiency of digital twinning for use-case “Unmanned Utility”. | Cost reduction by 20%.<br>Time reduction by 30%. | M24 |
| Improve efficiency for calibration of Vehicle-in-the-Loop test system for use-case “Unmanned Utility”. | Cost reduction by 30%.<br>Time reduction by 50%. | M36 |
| CQM | | |
| Apply DT and AI to improve the product development process and production | CQM revenue in 1 or 2 projects. Customer: faster development, better design, fewer problems/faster/cheaper in productions | M36 |
| Improve supply chain design, planning, and control by applying DT and AI in customer projects; e.g., warehousing, production, inventory, transportation | CQM Revenue in 2 or 3 projects. Customer: cost reduction 10%, productivity increase 10%, increased end-user satisfaction | M36 |

| Exploitation Description | Measurable Effect | Planned date |
|---|---|---|
| Support development of new products (e.g. consumer product, or complex devices in B2B) that contain AI for their operational use as a CPS. | CQM Revenue in 1 or 2 projects. Customer: improved product, better sales and margins. | M36 |
| LIANGDAO | | |
| Upgrade of conventional environment perception by AI based perception algorithms | Faster and more reliable perception process, object perception can be applied to more specific use cases/situations. Number of potential customers willgrow, estimated revenue increase is +30%. | M36 |
| Digital Twin concept will be used for configuration and validation of sensor systems. | This will safe preparation time and costs, also estimated revenue increase is +20% | M36 |
| Setup of a new product and service portfolio in the field of unmanned utility vehicles (UUV) | The work in Asimov allows LiangDao to enter the UUV market and approach a new type of customers, | M12-M48 |
| NORCOM | | |
| Extension of data management platform with focus on automotive use cases | Positive feedback from existing and new partners. Extended support for two more data formats incl. time series data | M18 |
| Integration of results into AI platform and AI service portfolio | AI models can be stored, documented and served on our platform. New modules are available for time series analysis | M24 |
| Increased turnover for platform licenses and AI services | +15% turnover | M24 - M48 |
| RAC | | |
| Increase in sales of DiagRA-X licenses | +10% in turnover | after 2024 |
| Increase in sales of MCD-AI components | +20% in turnover | after 2024 |
| Increase in sales of new services | +15% in turnover | after 2024 |
| TFS | | |
| STEM Aberration correction and calibration software | Robust method for STEM aberation correction. Reduced need for manual calibration | M18 |
| Digital twin technology optimizing R&D processes | DT used in R&D for designing new components for electron microscopes | M24 |
| AI-driven tool for calibration and alignments, trained on DT of relevant parts of the system | Significantly reduced need for user interaction with the tool regarding calibration and alignment | M36 |
| RL+DT abberation correction methodology working on both amorhous as crystaline materials | Fully automated workflow for alignment | M36 |
| AI + DT soluttion for automated microscopy callibration during factory build up | Reduced need for TEM engineers duriing build-up and pre-calibration of TEMS | After 2024 |
| TG | | |
| Integration into product portfolio (Trian3DBuilder) | Improved product optimized for AI training and database variation.<br>+25% turnover | M36-M48 |
| Optimized workflows for database generation services (digital twins of 3D maps) | Time reduction 25%<br>Cost reduction 15% | M36 |
| | | |

*Table 2 - Exploitation Opportunities for Industrial Partners*

### 3.2.2 Academic and Research Partners

| Exploitation Description | Measurable Effect | Planned date |
|---|---|---|
| DLR | | |
| Research assets of new DLR institute | - After transition of OFFIS' transportation division to a new DLR institute (see Exploitation Results), results from ASIMOV will significantly enter the institute's research assets on scenario-based verification and validation of | M8 - M36 |

| Exploitation Description | Measurable Effect | Planned date |
|---|---|---|
| | automated/autonomous systems and DTs/system simulation<br>- Results from ASIMOV will be part of the fundamental basis of the future research strategy of the new institute | |
| Follow-up projects | Creation of/Involvement in new follow-up projects, based on achieved results in ASIMOV | M24 -M36 |
| TNO | | |
| Competence Development Programs | New course, training programs (or extension of existing ones) offered by TNO (ESI) to their partners. | M24, M36 |
| New project proposals for DT/ML/RL technologies (for system calibration and in other areas) using the learnings from ASIMOV | Project proposals (impact and business for TNO) | M36 |
| Engineering for AI support and research services | | |
| TUE | | |
| R&D developments for new technologies in the area of AI and digital twinning | Integrated in exiting courses on optimal control and reinforcement learning within TUEs curriculum | M30-36 |
| Follow-up Projects | Creation of / Involvement in new follow-up projects, based on achieved results in ASIMOV. | M24 -M36 |
| Human capital | Two highly trained PhDs for the high-tech industry, plus several MSc students | M20-… |

*Table 3 - Exploitation Opportunities for Academic and Research Partners*

### 3.2.3 Joint Exploitation Opportunities

| Partners | Exploitation Description | Measurable Effect | Planned date |
|---|---|---|---|
| TUE, TFS | Enhanced cooperation based on jointly developed technical achievements in ASIMOV. Enhancing added value of TUE's offering to TFS. | | TBD |
| Germany | Improved solutions to other calibration tasks around vehicle testing can be developed, due to synergies and joint understanding between research and industry. Additionally, the scope can be widened to other mobility solutions, such as maritime. | | TBD |
| | | | |

*Table 4 - Joint Exploitation Opportunities*

### 3.2.4 Exploitation Opportunities beyond the Consortium

| Partners | Exploitation Description | Measurable Effect | Planned date |
|---|---|---|---|
| TFS, TNO, CQM, TUE | Industry reference group: workshops with 6 (at this moment) industries outside the ASIMOV-consortium to align on potential industry value and to share ASIMOV results.<br>[Canon Production Printing, Lely, Philips, Smart Robotics, Ultimaker, Thales] | - Input from industry on requirements for added-value creation<br>- Experiments by industry with ASIMOV-results (validation and identification of exploitation opportunities)<br>- Early adoption in the broader industry | M15, M18, M24, M30, M36 |
| | | | |
| | | | |

*Table 5 - Exploitation Opportunities beyond the Consortium*

# 4 Exploitation Results

The table below gives an overview of the exploitation results.

## 4.1 Industrial Partners

| Exploitation Description | Measurable Effect |
|---|---|
| AVL | |
| New internal cross-business unit wide collaboration on topic of AI-based system optimization | Regular internal alignment meetings at AVL Germany |
| New external collaboration activities with associated partners related to use-case “Unmanned commercial vehicles” | Regular meetings and workshops with associated partners in Germany (Cluster Commercial Vehicle, eMobil Baden-Württemberg) |
| | |
| CQM | |
| | |
| | |
| | |
| LIANGDAO | |
| New Collaboration with academic partner (TU Munich) related to use case UUV | External input on developing UUV product and service portfolio |
| | |
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| NORCOM | |
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| RAC | |
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| | |
| | |
| TFS | |
| New cross-business unit wide collaboration on the use of digital twins | Action towards centralized code base, regular meetings, formation of DT ‘oversight’ team |
| New activities in the field of Reinforcement learning | Newly identified use-cases where the use of RL could make a major difference |
| | |
| TG | |
| | |
| | |
| | |

*Table 6 - Exploitation Results of Industrial Partners*

## 4.2 Academic and Research Partners

| Exploitation Description | Measurable Effect |
|---|---|
| OFFIS/DLR | |
| Founding of DLR Institute upon OFFIS' transportation division | - By 2022-01-01 (M8) the OFFIS transportation division has been successfully transformed into a newly founded institute of the German Aerospace Center (DLR e.V.)<br>- The new institute “Institute of Systems Engineering for Future Mobility” focuses on systems engineering with special focus on assuring technical trustworthiness of CPS (e.g., AI-based components), see: https://www.dlr.de/se/en/<br>- The involvement of OFFIS in projects like ASIMOV laid the foundation for this transfer and future assets of the new DLR institute (see Section 3.2.2) |

| Exploitation Description | Measurable Effect |
|---|---|
| The results of ASIMOV are used to extend our consultancy offer on the efficient transfer of research results to industry applications. | In ASIMOV, we identified results and knowledge on the application of AI-based optimization, testbeds and DT creation as such methods, that is beneficial for the industry and solve their needs. Partly the results and knowledge was used in the transfer project TASTE for establishing software development methods in the automotive sector. This is currently integrated into the offers that DLR supplies to the industry via the TASTE project. |
| DLR supports the foundation of spin-off companies and has set up specific guidelines for that. In the past, several spin-off companies have been founded out of DLR. Also, for ASIMOV, if there is a market and the results have reached an appropriate maturity level, then founding spin-off companies is an opportunity. | The methods and results have not reached a status sufficiently mature for the founding of spin-off companies. |
| DLR is reusing the methods and tools developed within ASIMOV to assemble a tool collection for the optimisation of cyber-physical systems. | DLR has developed tools and methods which haven't reached a maturity level adequate for the release to the public. However, they have been integrated into long-living product-like developments called "assets". |
| TNO | |
| Engineering for AI support and research services | Knowledge is captured in the guide supported by experiment on the ASIMOV in a nutshell experimental platform |
| | |
| | |
| TUE | |
| Human capital | 2 PhDs are hired. |
| Human capital | 1 BSc student worked on a sensitivity analysis of the ronchigrams of the digital twin. |
| | |

*Table 7 - Exploitation Results of Academic and Research Partners*

### 4.3 Joint Exploitation Results

| Partners | Exploitation Description | Measurable Effect |
|---|---|---|
| | | |
| | | |
| | | |

*Table 8 - Joint Exploitation Results*

### 4.4 Exploitation Results beyond the Consortium

| Partners | Exploitation Description | Measurable Effect |
|---|---|---|
| | | |
| | | |
| | | |

*Table 9 - Exploitation Results beyond the Consortium*

# 5 Terms, Abbreviations and Definitions

*Table 10 - Terms, Abbreviations and Definitions*

| | |
|---|---|
| AI | Artificial Intelligence |
| ASIMOV | AI training using Simulated Instruments for Machine Optimization and Verification |
| DT | Digital Twin |
| ML | Machine Learning |
| RL | Reinforcement Learning |
| WP | Work Package |
| UUV | Unmanned Utility Vehicle |
| TEM | Transmitting Electron Microscope |
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# 6 Bibliography

[1] ASIMOV-consortium, *ASIMOV - Full Project Proposal,* 2020.