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FitOptiVis

From the cloud to the edge - smart IntegraTion and OPtimisation Technologies for highly efficient Image and VIdeo processing Systems

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Executive summary

This report corresponds to deliverable D8.6 which is one of the outcomes of Task 8.3 “Training, education and workshops”. This report complements D8.4, including the feedback collected during the second end user workshop focused on the progress done for MS4, MS5 and MS6.
The feedback was generally positive and confirms the exploitation possibilities of FitOptiVis proposed solutions in all the use cases. QRML is considered as a very good tool and its use is encouraged even outside FitOptiVis scope. The end user board also saw many possibilities of collaboration between the use cases, specially between UC6 (Multi source streaming composition) and UC8 (robot calibration) and between UC1 (water supply) and UC9 (Surveillance of smart-grid critical infrastructure).
The feedback and questionnaires are shared with the project management board and use case leaders. The feedback will be used to improve the exploitation potential of FitOptiVis solutions leading to partial demonstrators aligned with real market needs, due after year two of the project.

1 Introduction

The purpose of the second end-user workshop deliverable is to complement the feedback already provided during the first workshop with the feedback gathered for the second one. This document is a living document that will be ultimately updated with the feedback from the third workshop to produce the next deliverable (D8.7).

The purpose of the First End-User Workshop deliverable is to provide an overview of the feedback given by the End User Board (EUB) members during the workshop organised in Eindhoven on 10 September 2019. The focus of the Second End-User Workshop was to get feedback from the partial demonstrators with the aim to improve their market opportunities and synergy possibilities which took place virtually on 20 October 2020 due to pandemic emergency situation.

The initial milestone for the related task (T8.3) was to build up the EUB consisting of international experts on the FitOptiVis' use cases appointed as such by the use case leaders and chaired by the EUB manager (Víctor Sánchez). More information about the EUB members can be found in Section 1.1.

The EUB workshops have been strategically planned to cover different aspects that are key for each project phase as summarised in Section 1.2. Following that planning, this first EUB related deliverable was focused on collecting feedback on the requirements presented in D1.1 (Initial requirements and use cases) and D1.2 (Validation and evaluation strategy) with the aim of redefining the requirements where needed to better cover real needs in accordance with the EUB members' knowledge. The feedback collected during the second workshop mainly contributes to D1.5 (Final requirements and use cases), D7.3 (Business Models and Final Innovation, Standardization and Exploitation plan and report) and D8.8 (Final Dissemination and Communication plan and report).

During the first workshop, discussions took place among the EUB members and FitOptiVis' participants. The discussions were guided in accordance with the points included in a questionnaire that was created by the FitOptiVis management board and the use case leaders and that was distributed to the EUB members beforehand.

For the second workshop and given its the virtual character, we decided to create an online questionnaire that contains most of the information presented during the virtual meeting, in the form of including recording videos from the partial demonstrators. This way of proceeding ensures that in case of technical difficulties during the workshop, the end user board members were able to provide feedback.

2 End User Board

2.1 Members

Each use case leader was consulted and responsible for appointing a member that was an expert in that particular use case or application scenario able to provide feedback on the technologies that are being developed within the project.

The selection criteria were:

- Not being involved in the FitOptiVis project in order to avoid that the feedback provided is affected by solutions developed currently.
- Have a very good use case knowledge, with the aim to provide relevant feedback based on experience with real world problems, challenges and opportunities.
- Being capable of evaluating technical requirements that helps the technical partners to focus on what it is important from the end user point of view.
- Have knowledge about the use case's market to ensure the exploitability and impact of the solutions to be developed.

The selection criteria were created in consultation with the project management board and presented during the plenary meeting held in Cagliari.

The selection process resulted in the following EUB members:

EUB member	Entity	Position/Affiliation
Ángel Álvaro	Thales	R&D manager at Thales Alenia Space España
Fabrizio Cardinali	Knowhedge	CEO at Knowhedge (which is an electronic engineering company specialised on AI).
Montserrat Gea	Lleida University	Vice-rector of internationalisation and professor at nursing and physiotherapy.
Jari Hannuksela	Visidon	R&D director
Frank Hoogenraad	Philips	Product Manager for Philips MRI systems
Jaroslav Kacer	Brno municipality	Chairperson of Smart City committee of Brno
Yvonne Kruijt-Stegeman	Philips	Member of the system architecture board at Philips
Sergio Navarro	ITI	Business responsible for industrial vision
Pedro Ruiz	Integrasys	R&D Engineer in the area of Advanced Systems

Table 1: FitOptiVis end user board members

Fabrizio Cardinali, Montserrat Gea, Tino Álvarez (replacing Jari Hannusksela), Frank Hoogenraad, Yvonne Kruijt-Stegeman and Sergio Navarro physically joined the first end user workshop, while Ángel Álvaro joined via teleconference. Jaroslav Kacer and Pedro Ruiz did not manage to attend due to personal circumstances.

For the second workshop we have seven attendees: Ángel Álvaro, Fabrizio Cardinali, Esther Rubinat (replacing Montserrat Gea), Frank Hoogenraad, Laura Calvino (replacing Yvonne Kruijt-Stegeman), Sergio Navarro and Pedro Ruiz.

2.2 Strategy for the End User Workshops

During FitOptiVis lifetime, three workshops are planned. The feedback of those workshops will be gathered in D8.4, D8.6 and D8.7. Each workshop has been planned in a way that it collects relevant information for each project phase, specifying which input the EUB members will receive and which output is expected from them:

- 1st end user workshop (Eindhoven, September 2019)
  - **Input**:
    - Initial use case requirements
    - Preliminary Virtual Platform specification
    - Preliminary components and methods released with standalone assessment
  - **Output**:
    - Preliminary technology assessment
    - Feedback for the use cases' requirement redefinition

- 2nd end user Workshop (Virtual, October 2020)
  - **Input**: Partial demonstrators
  - **Output**: Feedback to use cases' requirement redefinition from the market perspective

- Final end user Workshop (Spain/Virtual, October 2021)
  - **Input**: Final demonstrators
  - **Output**: Feedback for the exploitation plan

Figure 1 shows how the end user workshops are embedded into the project phases and their relationship with milestones.

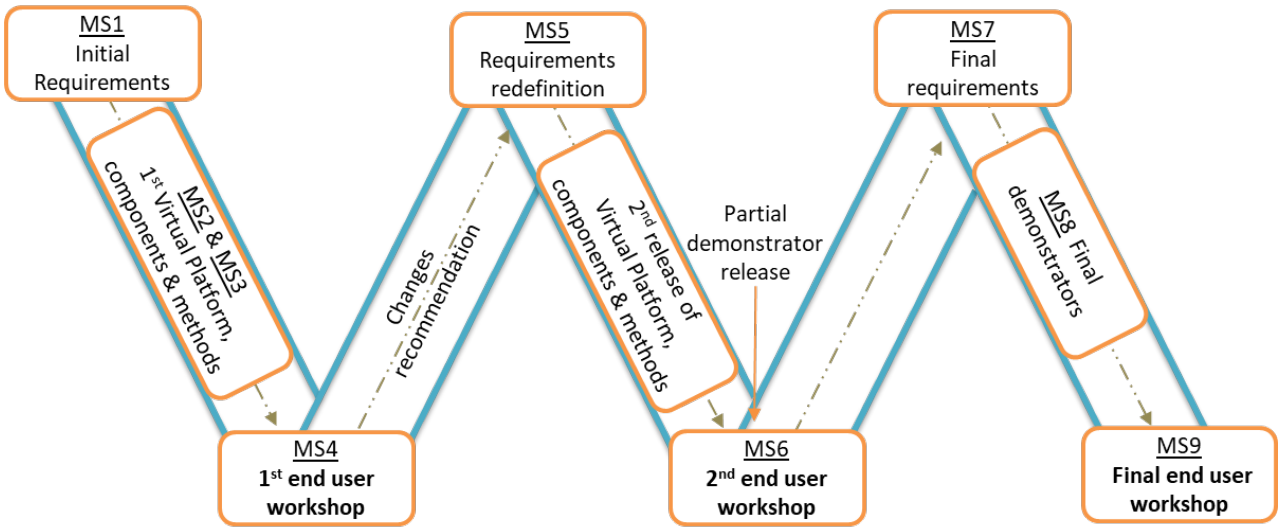

Figure 1: End user workshops, link with project phases and milestones

It is intended that before each workshop the EUB members receive the needed documentation and input requested (in the form of a questionnaire) while during the workshop the project developments are presented to provide an overview of the work carried out, encouraging discussions with the project participants.

2.3 First Workshop

The first workshop was held in Eindhoven on 10 September 2019 and co-located with a FitOptiVis plenary meeting that took place afterwards on 11 and 12 September. The agenda for the workshop can be seen in Figure 2. It consisted of an introductory part where members from the FitOptiVis management board presented the project and latest results, followed by an interactive session where discussions among the EUB members and the project members took place. As aforementioned, six EUB members attended physically and one via teleconference.

September 10, 2019		
12:00	*Lunch*	
13:00	Opening, welcome, introductions	Victor Sanchez - TUE
13:05	Project overview	Frank van der Linden - Philips
13:20	FitOptiVis objectives and technical overview	Twan Basten - TUE
13:40	Use cases and requirements	Geran Peeren - Philips, Marcos Martínez - TASE
14:05	Architecture	Marc Geilen - TUE
14:30	*Break*	
15:00	Interactive feedback end-user board on project results and use cases	Victor Sanchez - TUE
17:30	*End of the workshop*	

Figure 2: First end user workshop agenda

Figure 3: Attendees to the first FitOptiVis End User Workshop

2.4 Second Workshop

The second workshop was held virtually on 20 October 2020 through MS teams and co-located with a FitOptiVis plenary meeting that took place the day after. Our preference was to have a physical meeting but because of the measures related to COVID-19 we opted for a virtual one. There were no serious problems with the connection, but we noticed it was more difficult to have an iterative discussion than in physical meetings. The agenda for the workshop can be seen in Figure 4. We started with a project status and overview followed by all the partial demo presentations and a Q&A. At the end, we had an open session where all the workshop participants could comment and provide feedback. A total of 46 people participated in the workshop. The online questionnaire used can be found here. In addition the questionnaire and the partial demo's videos were shared during the EFECS conference that took place on 25-26 November 2020 on the FitOptiVis virtual booth.

Day 1, October 20, 2020		
13:00	End use board opening, welcome	Victor Sanchez - TUE
13:05	Project status and overview - Component-based Quality and Resource Management	Twan Basten - TUE, Frank van der Linden - Philips
13:40	Demo: QRML, SDSL and FIVIS + Q&A	
14:05	***Break***	
14:20	Demo: UC1 - Water supply + Q&A	
	Demo: UC3 - Habit tracker + Q&A	
	Demo: UC9 - Surveillance of smart-grid critical infrastructure + Q&A	
14:50	Demo: UC7 - Sustainable safe MRI + Q&A	
	Demo: UC8 - Robots Calibration + Q&A	
15:15	***Break***	
15:30	Demo: UC2 - Virtual reality + Q&A	
	Demo: UC5 - Road traffic surveillance + Q&A	
15:55	Demo: UC4 - 3D industrial inspection + Q&A	
	Demo: UC6 - Multi source streaming composition + Q&A	
	Demo: UC10 - Autonomous exploration + Q&A	
16:25	***Break***	
16:40	Interactive feedback end-user board on project results and use cases	Victor Sanchez - TUE
17:30	***End of day 1***	

Figure 4: Agenda for the second end user workshop

3 Feedback from End User Workshop

3.1 Feedback from the first end user workshop

As can be seen in Annex 1, to collect feedback a questionnaire was used. The questionnaire consists of a first part that deals with general aspects of the project, which is followed by specific questions per use case. Each use case prepared general questions that could be answered by any EUB member and more detailed questions targeting the members that are familiar with the use case. All the questionnaires collected are shared among the project management board and the use case leaders.

In general, all the EUB members agree to the importance of run-time quality and resource management and hence the relevance of the project. Most EUB members highlighted the need and the benefits of component modelling for the use case applications/markets. Some expressed doubts about the need of resource virtualisation and run-time adaptability for some of the use cases.

During the workshop, it was pointed out that besides using the component abstractions to adapt applications at run-time, they can also be used to facilitate application upgrades/updates and to support the efficient and effective development of product families. For some use cases, this capability is more relevant than run-time adaptability and run-time quality and resource management.

With respects to the need of additional key technologies to achieve FitOptiVis objectives that are insufficiently covered in FitOptiVis, most members said that the currents technologies were enough while a couple mentioned data fusion, reconfigurable Artificial Intelligence (AI) on the edge and Digital Signal Processors (DSPs) as technologies that can help to achieve the promised results.

Support for run-time re-configurability and exposing quality-resource trade-offs are seen as feasible, for those uses cases where it is relevant, and some efficiency overhead is acceptable to get virtualisation, timing predictability and composability. There was general consensus that FitOptiVis domain-specific language templates provide a useful and effective way to make FitOptiVis results available to developers and users of image and video pipelines.

Overall, all the EUB members recognised the requirements of each use case and, in most cases, they complemented them with some suggestions. The discussions that took place during the workshop and the completed questionnaires, show the relevance and need of the proposed approaches. The use case leaders will follow up on the suggestions received and will improve the requirements that will lead to the development of the partial demonstrators.

With respect to the impact and exploitability, the feedback received indicates that the EUB members truly believe that FitOptiVis proposed solutions have a market potential and that they are suitable to be adopted fast by developers. At the same time, each member sees further applications and domains that can benefit from the proposed solutions, methods and architecture even for non-video related domains and expresses his/her believe that the solutions, can be adopted if they meet their goals.

3.2 Feedback from the second end user workshop

As previously mentioned during the executive summary and the introduction, an online form was used to collect the formal feedback (the questionnaire is accessible here) which has 9 questions per partial demo.

Overall, all the EUB members see broad market possibilities to all the partial demonstrators and the technologies developed within the frame of FitOptiVis. In a nutshell, the feedback was generally positive and confirms the exploitation possibilities of FitOptiVis proposed solutions in all the use cases. QRML is considered as a very good tool and its use is encourage even outside FitOptiVis scope. The end user board also saw many possibilities of collaboration between the use cases, specially between UC6 (Multi source streaming composition) and UC8 (robot calibration) and between UC1 (water supply) and UC9 (Surveillance of smart-grid critical infrastructure.

Below a more detailed feedback per partial demonstrator:

QRML, SDSL and FIVIS
The EUB sees the possibility to use QRLM in different areas within Philips including their interaction with other companies. There are also possibilities to use QRML in alignment with DICOM hierarchical storage in medical settings. Looking into the standard was advised. In addition, one EUB member mentioned that QRML has potential to be adopted to optimise the design of space based image acquisition systems and ground based image processing solutions where the trade-off between quality and reduction of processing time is critical. It was proposed to present the tool to the European Space Agency, in order to raise awareness and get an ESA validated label which will help on the solution exploitability. However, one EUB member thinks that the tool needs to improve its usability and guidance/tutorial material.

UC 1 - Water supply
The EUB thinks that the use of security tags along with the cameras and distributed intelligence would increase the solution possibilities and market potential, however, the legal acceptance of the recorded footage needs to be study further. It has been indicated that as standalone tool, it can be sold to security camera manufacturers to be used as simple system configuration tool to be bundled to their cameras, but the current competition needs to be analysed further to focus on the factors that makes this solution unique. The EUB recommendation is to focus on adding a certification technology such as DLT based video footage certification and consider TTE (trusted execution environment) during the last project year to improve the commercialisation possibilities even further.

UC2 - Virtual reality
The EUB sees a great market potential for this tool, especially for media and broadcast players and industry 4.0 including remote training, maintenance and assistance using augmented reality tools. The EUB proposes to focus on integrating the proposed solution in other devices (i.e. VR/AR glasses) and target moving objects for the last part of the project. At the same time, it is recommended to contact already automotive (PSA) and/or aeronautics (EADS) companies that could help focusing the solution to their needs.

UC 3 - Habit tracking
The EUB believes that COVID-19 has shown the importance of this type of tools to remotely monitor fragile population. Older adults' residence may be quite interested in this solution as they are lacking enough personnel to monitor closer all the order adults, especially considering the foreseen demographic change. That being said, this solution needs to improve on (1) reducing the cameras needed per room, (2) interoperability with other existing smart devices at home and (3) multi-person identification and tracking in environments where there is more than one person. The EUB recommends contacting companies already providing eHealth services at home (like Sanitas or ASISA) to integrate this solution into the packages they already provide.

UC4 - 3D industrial inspection
The EUB sees clear market possibilities for the suggested solution. The use of other commercial tools more powerful than telegraf can give more possibilities to the solution in development, as well as, implementing techniques to reduce the bandwidth. Porting to Kafka, Ignite, prometheus and/or other Apache technologies completely open source should be considered
The EUB indicates that it would be interesting to explore the possibility to have an "open" inspection region so that larger objects can be inspected without the need to drive them through an enclosed cavity which limits it to small/medium objects.

UC5 - Road traffic surveillance
The AI algorithm is based on decision trees due to computational constraints. Using region of interest to reduce the computation needs on the camera can allow the use of more complex AI and could be investigated to increase the commercial possibilities.
However, the EUB believes that a clear benchmark with current technology and a plan to integrate the proposed solution with traffic management systems is missed at the moment. EUB recommends working on these aspects for the last part of the project.

UC6 - Multi source streaming composition
EUB believes this application has market potential if medical approval/certification is granted. A better integration with QRML could lead to a cost reduction and performance improvement. This use case can also get benefits of using some of the techniques from UC8.

UC7 - Sustainable safe MRI
The EUB sees the market potential of the proposed solution. A key aspect that needs to be improved is how to model patient comfort. The process validation of this solution requires the interaction with people (users) that unfortunately has been limited because of COVID-19. The EUB recommends looking for alternative ways to carry out the process validation.

UC8 - Robot calibration
The EUB sees clear collaboration opportunities with UC6 that were discussed during the telco UC6 can use the point tracking from UC8 to improve the collision prevention algorithms that are manually calibrated at the moment.

UC9 - Surveillance of smart-grid critical infrastructure
The EUB sees clear connection and synergy possibilities with UC1 and recommends that both use case align. The integration of UC1 and UC9 into one solution can highly improve the exploitation possibility of both. However, the EUB miss a cost-benefits analysis and a benchmark of the proposed solution with current competitors already in the market. In addition, it is not

clear how this use case benefits from the tools, language and methods developed under the framework of the FitOptiVis project, which can further improve the commercialisation opportunities of the suggested tool.

UC10 – Autonomous exploration

The EUB sees a very good market potential for the solutions provided in this use case. The application of the solution would not be directly exploitable, but it is a great starting point for several potential market-ready products targeting all kind of satellites from high-end to smallsats. The recommendation of the EUB in order to ensure the exploitability of the developments in the project is to make sure that a roadmap of next steps is defined in order to ease the adoption of the solutions in market-ready products.

Annex 1: Questionnaire for the first end user workshop

FitOptiVis

From the cloud to the edge - smart IntegraTion and OPtimisation Technologies for highly efficient Image and VIdeo processing Systems

End user board feedback after the first end user workshop
Eindhoven 10 September 2019

End user board member name and surname Affiliation

Date of submission of this feedback

Short Bio and interest in the project

Project idea and objectives

Question 1
The **main objective** of FitOptiVis is to develop **an integral approach for smart integration of image- and video-processing pipelines for cyber-physical systems**. The backbone of the approach is a reference architecture providing a component model and resource virtualization approach for run-time quality and resource management. ***Question 1.1****: Do you see run-time quality and resource management as a key requirement in your application domain? Please elaborate your answer.* [insert your answer here] ***Question 1.2****: Do you recognize component modeling and resource virtualization as crucial technological developments to support quality- and resource management? What would be the main advantage for you in having available a virtual platform in your application domain?* [insert your answer here] ***Question 1.3****: Do you see any key technologies needed to achieve the main FitOptiVis objective that are currently not addressed in the project?* [insert your answer here]

Architecture

Question 1

The reference architecture proposes the use of **domain specific component abstractions** that focus on (re-)configurability, quality metrics, and resource usage. Components should explicitly **expose** their **trade-offs between application qualities and resource budgets** in the form of configurable set points for design-time optimization and run-time reconfiguration.

Question 1.1: *Do you believe that in your application domain it is* ***meaningful*** *and* ***feasible*** *to support run-time (re-)configurability, and to expose quality-resource budget trade offs? Please elaborate. Preferably give examples, challenges, limitations.*

[insert your answer here]

The reference architecture builds on **resource virtualization** concepts and the definition of **virtual execution platforms** to gain timing predictability and composability, at design time and at run-time, thereby possibly paying a price in terms of efficiency and resource utilization.

Question 1.2: *Do you believe that* ***virtualization****, timing* ***predictability*** *and* ***composability*** *are necessary and effective means to achieve complex designs for image and video pipelines in dynamic, distributed heterogeneous systems*? *Is it acceptable to pay a price in efficiency (performance, power/energy, cost)? Please elaborate.*

[insert your answer here]

FitOpTiVis intends to make the template solutions for component modelling and virtualization available in the form of a **domain-specific language**. The general DSL is explicitly intended to be refined for specific domain and use-cases.

Question 1.3: *Do you believe that a DSL provides a useful and effective way to make the generic, template FitOptiVis solutions available to developers and users of image and video pipelines?*

[insert your answer here]

Project impact and exploitability

Question 1

FitOptiVis' ultimate goal is to define an integrated development environment to enable cost effective and rapid smart integration of energy efficient image and video processing pipelilnes for CPS. The environment include a reference architecture, development tools, runtime support and dedicated software and hardware components.

Question 1.1: *Do you believe that the FitOptiVis solutions are suitable for adoption by developers and/or users?*

[insert your answer here]

Question 1.2: *Would you consider using any of the FitOptiVis solutions yourself? Do you see any aspects, tools, etc in your daily work that you would like to have integrated in the FitOptiVis environment in order to improve its usability?*

[insert your answer here]

Question 2

The proposed solutions will be applied in 10 use cases to demonstrate the effectiveness of the envisioned solution:

1. Surveillance of Water Supply
2. Virtual Reality
3. Habit Tracking
4. 3D Industrial Inspection
5. Road traffic surveillance
6. Multi Source Streaming Composition
7. Sustainable safe MRI Use case
8. Robot Calibration
9. Surveillance Smart-Grid critical infrastructures Use case
10. Earth observation from satellite.

Question 2.1: *Do you see any other applications or domains that can benefit of FitOptiVis approach?*

[insert your answer here]

Most of the envisioned exploitation is based on the application of FitOptiVis solutions in use cases. However, some of the results will be made available in open source formats.

Question 2.2: *Do you work with open-source approaches in your own domain? Do you have any concrete suggestions for FitOptiVis technology that in your view should be made available in open source format? Do you have ideas about business models for open source projects? Or do you know companies that have been successful with an open-source approach?*

[insert your answer here]

Water supply use case

Question 1

FitOptiVis will develop a methodological approach for balancing power consumption and performance of distributed video pipelines. The pipeline for this use case is composed of smart cameras and heterogeneous sensors and actuators. The system is supposed to be able to collect and elaborate information and trigger the appropriate actuations.

The goal is to provide continuous and real-time surveillance of a critical and distributed infrastructure including an aquifer, a series of water pipelines, some inspection wells and a distribution tank. In particular, the system shall be able to verify the facility's integrity, actuate maintenance intervention and detect unauthorized accesses by means of advanced face recognition algorithms.

The identified user needs are:

- Improvement of the system reliability, security and surveillance capabilities: continuous monitoring of the distributed infrastructure to detect damage, water leak, and unauthorized accesses in sensible areas.
- Increase the automation of the monitoring system: smart system decision to autonomously pilot actuators and support operator in damages recovery.
- Reduction of the human intervention on site, in remote and dangerous areas.
- Cost reduction.
- Recovery time reduction.

Question 1.1*: Do you recognise these user needs? Do you see any other user needs?*

[insert your answer here]

Question 1.2*: Do you think FitOptiVis technologies would address these user needs? Are we missing something?*

[insert your answer here]

Question 2 – only if you are familiar with this use case

This use case will apply such methodology in an advanced monitoring and management system for a water supply critical infrastructure. Two scenarios have been identified.

The first one is the "Unauthorised access" scenario.

Question 2.1*: How relevant is the compromise between energy consumptions and performances in the unauthorised access detection? Please provide some concrete examples in which one metric is more relevant with respect to the other and vice versa.*

[insert your answer here]

Question 2.2*: Automation of some processes (or of part of them) is a project level requirement. In which aspects of the unauthorized access detection is more relevant such requirement? Which are the system*

functionalities where an approach which exploits total or partial automation can provide more improvements (in terms of time, costs, reliability, etc.) with respect to a completely human based one?

[insert your answer here]

The second scenario considered in this use case is called “Leakage/Damage Inspection”

***Question 2.**3: Which is the most relevant damage that should be detected? Which are the one with the most critical consequences?*

[insert your answer here]

***Question 2.4**: Which are the technologies currently used for this purpose?*

[insert your answer here]

***Question 2.5**: As in question 2.2, which is the level of automation of this system? Which are the functions that should be automated first?*

[insert your answer here]

Virtual reality use case

Question 1

Virtual reality systems are everyday more important in medical, gaming and military applications and cinema industry. Recent advances in digital photography and video led to the development of advanced 3D vision and display systems. Emerging technology of virtual reality applications should be supported by high-quality video capture, efficient coding and processing technologies as well as an accurate, fast positioning system.

The identified user needs are:

- Efficient 3D scene description.
- Efficient compression of point cloud of the 3D object.
- Efficient delivery/streaming of point cloud data.
- Efficient rendering of static and dynamic point clouds on power-limited mobile device.
- Improve user interaction.

Question 1.1*: Do you recognise these user needs? Do you see any other user needs?*

[insert your answer here]

Question 1.2*: Do you think FitOptiVis technologies would address these user needs? Are we missing something?*

[insert your answer here]

Question 2 – only if you are familiar with this use case

Question 2.1 *We would like to hear your guidelines how to find and identify the real disruptive innovation elements inside current VR market? Which should be relevant for the FitOptiVis VR case?*

[insert your answer here]

Question 2.2 *We would like to hear your guidelines how to find and identify the new application areas inside VR mobile use case with big buzz potentials?*

[insert your answer here]

Question 2.3 *We would like to hear your guidelines how to find and identify the new business models areas inside VR use case? Which models are relevant for the FitOptiVis VR case?*

[insert your answer here]

Habit tracking use case

Question 1
The Habit Tracking Use Case is mainly applicable to elderly population. The objective is to assess their current physical habits and identify the situations where methodological and behavioural concepts can efficiently promote physical activity and healthy lifestyle. It also aims to detect deviations from a standard behavioural pattern or emergency situations. The identified user needs are: • Robustness of tracking system with reduction of bandwidth. • Reconfiguration of deep learning vision. • Deployable in heterogeneous platforms. • SW/HW co-design to improve energy consumption and performance. ***Question 1.1****: Do you recognise these user needs? Do you see any other user needs?* [insert your answer here] ***Question 1.2****: Do you think FitOptiVis technologies would address these user needs? Are we missing something?* [insert your answer here]

Question 2 – only if you are familiar with this use case
Question 1.1*: Do you think it is useful to use these devices to keep track of vital signs? Following a treatment prescribed by a Doctor.* [insert your answer here] ***Question 1.2****: Do you think it is important to send the vital signs in real time or could it be sent at the end of each session? If you think it should be in real time, what maximum response time would you consider reasonable?* [insert your answer here] ***Question 1.3****: Do you consider it important to take the measurements of the different vital signs at the same time or could it be spaced in time?* [insert your answer here] ***Question 1.4****: Do you think it is interesting that the user receives questionnaires to know their mood or details of their treatment or food intake during the measurement of vital signs?* [insert your answer here] ***Question 1.5****: Do you think the generation of alarms is important for the user or do you think it would be more convenient for alarms to reach the doctor or caregiver members directly?* [insert your answer here] ***Question 1.6****: What do you think would be the most useful data presented to end-users (doctors/nurses)?* [insert your answer here]

3D industrial inspection use case

Question 1

The inspection system is based on capturing objects in free fall. In this fashion, there are no hidden parts and the whole body of the object can be analysed. Additionally, the system does not require specific mechanisms to handle each different type of object. Thus, it is versatile without increasing costs or complexity and can analyse mixes of objects and classify them.

Briefly, the operations can be divided into the following: image acquisition, pre-process, segmentation, building 3D model, analyse of the constructed model. To guarantee stability and an acceptable throughput rate, these operations are distributed. Specifically, image acquisition, pre-process, and segmentation are executed in low power execution platforms located next to the cameras. These execution platforms can detect problems (e.g., the object was partially out of the field of view) in this early stage of the whole process and instruct the system to capture the same object again or discard it. This saves network usages and improves the overall performance of the system.

The identified user needs are:

- Easy to integrate with existing quality inspection process
- Resources monitoring
- Useful for different shapes and type of parts
- Fault tolerant system
- Improve the user experience
- Reduce costs.

***Question 1.1**: Do you recognise these user needs? Do you see any other user needs?*

[insert your answer here]

***Question 1.2**: Do you think FitOptiVis technologies would address these user needs? Are we missing something?*

[insert your answer here]

Question 2 – only if you are familiar with this use case

***Question 2.1** Do you use an inspection system in your application domain?*

[insert your answer here]

***Question 2.2** If so, is there an automated process to inspect the objects or the inspection is done manually (by a human operator))?*

[insert your answer here]

***Question 2.3** If requiring an inspection system, what would be your minimal requirements in terms of parts per minute to be inspected?*

[insert your answer here]

Question 2.4 Is there any accuracy or tolerance requirements when measuring an object?

[insert your answer here]

Question 2.5 What kind of analysis should be performed in your Q.C. process? (GDT, surface analysis or geometrical comparison)

[insert your answer here]

Question 2.6 Could you briefly describe the current industrial inspection procedure of your organization? (if any)

[insert your answer here]

Question 2.7 What is the ratio of inspection required (0-100%)?

[insert your answer here]

The size of the object to be inspected is limited by the size of the inspection device. To best fit the requirements the solution is to design the inspection system according to the targeted objects.

Question 2.8 *Could you specify the size of the inspected objects or describe them to give an idea of their volume?*

[insert your answer here]

Analysed objects are configured for the process and these configurations could be changed to inspect several parts.

Question 2.9 *In your industrial domain, how many different objects/parts are required to be inspected?*

[insert your answer here]

Question 2.10 *Do you use different inspection lines for each type of object?*

[insert your answer here]

Objects properties are important for ZG3D due to the use of images to build a 3D object.

Question 2.11 *Which materials compound the targeted object? Is there any transparency? Does it have a reflective surface?*

[insert your answer here]

Question 2.12 *Are there holes or concavities in the part to be analyzed?*

[insert your answer here]

Question 2.13 *Can you provide a CAD file of the object? If not we can model it.*

[insert your answer here]

Road traffic surveillance use case

Question 1

This use case aims to optimise traffic conditions and make the road generally safer and environment cleaner in municipalities. The principle is based on collecting the information about traffic (speed of vehicles, travel time, …), processing such kind of information and using it for optimizing of the traffic and reducing the effects on traffic flow and air quality.

For the correct operation precise information about traffic is needed, using mainly cameras. Their outputs often have to be combined to extract desired information (average speed, travel time, …). Optimally, the cameras should be standalone devices that do as much processing as possible and can be operated even without a stable power supply. Thus, it is possible to distribute cameras over large area with high density and collect as much data as possible.

Main enabling factor is an ability of license plate (LP) detection of the embedded cameras. Image/video data and other signals (e.g. radar, induction loops) are locally acquired and pre-processed, the vehicles and their license plates are detected. The preselected results are then transferred to the server and processed in the server application (or cloud) using more demanding algorithms (such as LP recognition). This way, data traffic of the dense camera network is significantly reduced.

As the communication is through a (typically wireless but possibly wired or optical) computer network, the images are often augmented with more information, such as timestamp, signature, occurrence of object, etc. in order to ensure secure transfer.

The identified user needs are:

- Dense information about traffic flow that can be used for traffic optimization for safer road and cleaner air (e.g. rerouting traffic, speed reduction).
- Reasonable costs and complexity of the system that can be installed on the site of any city (possibly added to existing infrastructure) and then easily maintained (mostly remotely).
- Reliability of the system under all conditions – weather and 24/7 operation.

***Question 1.1**: Do you recognise these user needs? Do you see any other user needs?*

[insert your answer here]

***Question 1.2**: Do you think FitOptiVis technologies would address these user needs? Are we missing something?*

[insert your answer here]

Question 2 - only if you are familiar with this use case

Core part of road traffic surveillance system is a smart camera with embedded object detection and tracking engine trained for licence plates (LPs).

***Question 2.1**: Could the LP detection be used in your application domain?*

[insert your answer here]

***Question 2.2**: Besides LP detection, which objects are potentially interesting for you to be detected?*

[insert your answer here]

***Question 2.3**: Is the concept of smart camera with embedded processing interesting for you? If yes, what other image processing tasks fits your application domain?*

[insert your answer here]

After the detection, computationally demanding tasks (e.g. LP recognition) can be offloaded to cloud.

***Question 2.**4: Does the nodes (smart cameras) vs. cloud (server) concept make sense in your application domain?*

[insert your answer here]

***Question 2.5**: Are there any related computationally demanding tasks in your application domain that should be optimally offloaded to cloud?*

[insert your answer here]

***Question 2.6**: What kind of data could be transferred from the nodes to the cloud. Is security of such transferred data important for you?*

[insert your answer here]

Using sophisticated design, smart camera will have low power consumption preserving sufficient computational power (thanks to HW acceleration). Low heat dissipation criterion is met at the same time.

***Question 2.7**: Is power consumption of smart video devices (nodes) crucial for your application domain?*

[insert your answer here]

***Question 2.8**: Is battery or solar power operation of nodes potentially interesting for you?*

[insert your answer here]

***Question 2.9**: Is there any need for low heat dissipation (e.g. device operating in sealed waterproof box) in your application domain?*

[insert your answer here]

Multi source streaming composition use case

Question 1

When a hospital team is operating on a patient, they need visual information to be presented on a large-screen monitor. The multi-source streaming composition use case aims to optimize bandwidth requirements and image latency in an application where images from multiple sources need to be displayed on a (large) screen in varying compositions.

The data displayed comes from various devices often from different manufacturers and with varying image properties, ranging from xray- or echo- images to detailed graphics. Even though the image data comes from different devices, to the user the system acts as a single entity with a single point of entry. This is realized using a compositor and coordination device which merges the images from the devices to a large screen display but also controls those devices and manages the video-streams.

The identified user needs are:

- Good image quality for both “soft” medical images as well as “hard” graphics
- Multiple (at least 8) image sources displayed in an arbitrary composition on a large screen
- Single point of access and/or control
- Coordination between image devices
- Low image latency
- 10G optical Ethernet
- Cost and power reduction

***Question 1.1**: Do you recognise these user needs? Do you see any other user needs?*

[insert your answer here]

***Question 1.2**: Do you think FitOptiVis technologies would address these user needs? Are we missing something?*

[insert your answer here]

Question 2 - only if you are familiar with this use case

***Question 2.1:** Do you use multi source streaming composition in your application domain?*

[insert your answer here]

***Question 2.2:** In your application domain, is it important that the sources of the video streams and/or the size in which each video stream is shown can be changed run-time?*

[insert your answer here]

***Question 2.3**: Would your application domain require down scaling or upscaling of one or more video streams? If so, by which range of factors?*

[insert your answer here]

Question 2.4: *What is the resolution of the input video's and the composited video in your application domain?*

[insert your answer here]

Question 2.5: *Do you foresee changes over time?*

[insert your answer here]

Question 2.6: *How important is it in your application domain that the compositing function causes almost no delay?*

[insert your answer here]

Question 2.7: *What is the maximum delay which is allowed?*

[insert your answer here]

Sustainable safe MRI use case

Question 1

The Sustainable safe MRI use case is addressing the challenge that, while in the evolution of MRI systems more and more electric power is used to generate increasingly better-quality images, also environmental load and physiological stress on the patient such as acoustical noise and heating increase accordingly.

Each MR scan is based on a protocol that defines how the system will perform the measurement. The protocol parameters, of which there may be several hundreds, strongly affect the contrast type of the image. On the other hand, typically the quality of the produced images increases as the allowed energy disposition is increased. This optimization depends on patient characteristics. For instance, who have an increased sensitivity to acoustic noise.

The identified user needs are:

- Enabling increasing performance of MRI systems
- Control energy consumption

***Question 1.1**: Do you recognise these user needs? Do you see any other user needs?*

[insert your answer here]

***Question 1.2**: Do you think FitOptiVis technologies would address these user needs? Are we missing something?*

[insert your answer here]

Question 2 - only if you are familiar with this use case

The approach developed by FitOptiVis is expected to be useful, as it delivers quality (image quality, physiologic stress) and resource (available energy) management. Using the architecture, component abstraction and virtualization methods, a wide range of products can be supported with relatively few development effort.

***Question 2.1** Do you see that there is a demand, now or in the future, in the MRI market for this functionality?*

[insert your answer here]

***Question 2.2** Do you see that other opportunities in the MRI market for application of FitOptiVis solutions?*

[insert your answer here]

Robot calibration use case

Question 1

The proposed robot calibration system primarily aims at relatively frequent (re-)calibration of collaborative robots that can change its configuration and thus its parameters. However, it can be used also for positioning or exact localization of standard robots, machines or other objects (position calibration).
The robot calibration suite consists of 2 core parts - localization of active LED markers and mathematical optimization routine that finds best-fit robot parameters to the measured data. While the second mentioned component needs input from the first one, the first one (LED markers localization) can be used separately. Thus, it is possible to efficiently perform indoor localization and tracking tasks as well.

The identified user needs are:

- Calibration of newly placed, moved or reconfigured robots with regards to world or workpiece coordinate system.

***Question 1.1**: Do you recognise these user needs? Do you see any other user needs?*

[insert your answer here]

***Question 1.2**: Do you think FitOptiVis technologies would address these user needs? Are we missing something?*

[insert your answer here]

Question 2 - only if you are familiar with this use case

***Question 2.1**: In your application domain, do you need indoor object localization or tracking? (Or outdoor localization/tracking in limited area) Do you need to position a robot relatively to the workspace or calibrate its parameters?*

[insert your answer here]

Please fill questions 2.2 to 2.7 only if you need to localize/track objects.

***Question 2.2** How big is your workspace? I.e. in which area you need to localize the objects?*

[insert your answer here]

***Question 2.3** How accurate localization do you need? - cm, mm, sub-millimeter accuracy?*

[insert your answer here]

***Question 2.4** Do you need static localization or track your objects in time? If you need to track the objects, how frequently is required to localize them? (localization period)*

[insert your answer here]

Question 2.5 *Do you need to localize/track objects in 2D or 3D?*

[insert your answer here]

Question 2.6 *Do you need to determine only object position or also its orientation?*

[insert your answer here]

Question 2.7 *Is placement of active LED markers on your tracked object limiting? (The LED marker is a battery powered device, hemisphere with diameter of 35 mm)*

[insert your answer here]

Please fill questions 2.8 to 2.11 only if you need to calibrate robots.

Question 2.8 *How big is your workspace? I.e. in which area the robot operates.*

[insert your answer here]

Question 2.9 *How accurate calibration do you need?*

[insert your answer here]

Question 2.10 *How frequently do you perform the calibration? Is it only initial calibration upon robot installation, or repetitive calibration after robot configuration change?*

[insert your answer here]

Question 2.11 *Is the duration of the calibration process limiting? What is the acceptable duration for you?*

[insert your answer here]

Question 2.12 *What is in your case the acceptable price range for the localization/robot calibration solution?*

[insert your answer here]

Question 2.13 *Do you need a single (or several) instance(-s) of the system for your factory, or are you planning to embed/use it in your product?*

[insert your answer here]

Surveillance of smart-grid critical infrastructure use case

Question 1

As smart-grids have become more crucial for our daily life, the Society demands prevention and rapid recovery from eventual harms. This use case applies active vision mechanisms on Electrical Power Grids to prevent potential harms to the infrastructure or the operators: access control to most-critical areas, detection of abnormal situations such as fire, etc. To this aim, Time Sensitive Networking (standard deterministic Ethernet) will interconnect the Smart grid infrastructure (i.e. Remote Terminal Units, RTU) present at Electrical substations with active vision mechanisms. This arrangement will provide the following services:

a) TSN will provide deterministic latency for time-critical traffics and accurate time synchronization, enabling distributed control and monitoring. Furthermore, best effort traffics will use the same network infrastructure without compromising the stringent QoS required by time-critical traffics.
b) TSN, as a set of IEEE Ethernet standard upgrades, can operate with regular, best effort Ethernet, thus interconnecting heterogeneous devices, like the active vision and Smart grid nodes present in this use case.
c) The active vision devices present at Electrical substations will trigger alarms to the RTU through TSN time-critical traffics.
d) The TSN will provide RT-QoS connectivity of local Power Substation nodes with remote centralised control and monitoring stations.
e) The TSN will provide network synchronization to RTU's, active surveillance platforms and remote centers.
f) The RTU will support HSR on local Power substation networks.

The identified user needs are:

- Integration of smart-grid and active vision services for enhanced protection and monitoring on critical infraestructure with TSN.
- Hybrid communication between electrical substation devices and remote
- High-availability Seamless Redundancy in a RTU
- Guaranteeing smart grid communication through a Time Sensitive Networking
- Integration of smart-grid and active vision services for enhanced protection and monitoring on CI with TSN

***Question 1.1**: Do you recognise these user needs? Do you see any other user needs?*

[insert your answer here]

***Question 1.2**: Do you think FitOptiVis technologies would address these user needs? Are we missing something?*

[insert your answer here]

Question 2 - only if you are familiar with this use case

Question 2.1. *Time Sensitive Network as backbone of smart-grid infrastructures. Do you think that the potential benefits (hybrid communication, distributed control and monitoring, time synchronization) compensate the migration effort from current state-of-the art?*

[insert your answer here]

Question 2.2. *What is your opinion about the applicability of active surveillance on electrical substations. (aid to human operators in the diagnosis, prevent failures, prevent illegal accesses).*

[insert your answer here]

Question 2.3 *What is your opinion about the applicability of HSR on electrical substations (redundancy, recovery time, high availability, etc.). What do you think about the use of this technology to improve the infrastructure for the electrical substation and its active surveillance?*

[insert your answer here]

Question 2.4 *Furthermore, we would appreciate any suggestions or comments you may consider.*
[insert your answer here]

Question 2.5 *We would like to hear your feedback about the role of TSN. How it can be integrated on Power Grid control and monitoring? Can the interaction with RTU and smart vision devices be improved?*

[insert your answer here]

Question 2.6 *We would like to hear your feedback about the interaction between active vision and smart grid.*

[insert your answer here]

Question 2.6 *We would also appreciate your feedback about RTU's and HSR (smart grid) on Electrical Power Networks*
[insert your answer here]

Question 2.7 *Feedback about active vision applied on Electrical Power Network infrastructures (i.e. Substations).*

[insert your answer here]

Autonomous exploration use case

Question 1

The Autonomous Exploration use case aims to have a reconfigurable image processing chain that changes its performance according to the environmental characteristics that surround a certain spacecraft. For example, if the solar panels of the spacecraft are not charging the batteries the algorithms for object recognition should be less power hungry. If a radiation induced failure is detected on the FPGA a reconfiguration mechanism should be triggered in order to reconfigure the whole FPGA or just the affected area.

For this use case, a FPGA (Kintex UltraScale) will be in charge of processing the images produced by a CMOS sensor (CMV12000). The Kintex UltraScale will have a multi-core LEON3 embedded that will be use the FPGA for acceleration purposes through the use of OpenMP. Another innovation for the space industry that is introduced in this use case will be the use of a CMOS sensor while CCD sensors are more commonly used in the space market.

The identified user needs are:

- Autonomous Navigation
- Smart Data Compression
- Smart Object Recognition

***Question 1.1**: Do you recognise these user needs? Do you see any other user needs?*

[insert your answer here]

***Question 1.2**: Do you think FitOptiVis technologies would address these uses needs? Are we missing something?*

[insert your answer here]

Question 2 - only if you are familiar with this use case

***Question 2.1**. Further than exploration applications, which other possible fields could benefit from using object recognition features in the space industry?*

[insert your answer here]

***Question 2.2**. Frame rates in actual exploration robots are quite low (less than 1fps). Having higher temporal resolution (more fps) would slightly increase the cost of any imaging system. Do you think that the trade-off is worth it?*

[insert your answer here]

***Question 2.3**. Regarding the previous question, for you as a potential user, what could be the difference of having higher frame rate in this kind of applications? Are there any other applications which could use higher frame rate than planetary exploration?*

[insert your answer here]

Commercial Off-The-Shelf (COTS) components are being introduced little by little in space in order to get cheaper spacecrafts. Powerful "Ground" FPGAs could potentially be used in space with some additional hardware that scrubs the configuration memory. This kind of FPGAs would allow to have different configurations that change during the several stages of a mission while maintaining a high performance thanks to their reconfiguration capabilities.

***Question 2.4**. Do you think that it is of high interest having reconfiguration capabilities on an exploration platform?*

[insert your answer here]

***Question 2.5**. What potential applications could also use hardware/firmware reconfiguration in the near future?*

[insert your answer here]

***Question 2.6**. In this use case several setpoints for the hardware will be studied. They will depend on battery, sun/shade conditions and radiation induced failures. This three kind of events will trigger the reconfiguration in order to go to a certain processing setpoint. Do you think that we should consider any extra environmental condition?*

[insert your answer here]