PHC-19-2014: Advancing active and healthy ageing with ICT: service robotics within assisted living environments

Project Title:

Robotic Assistant for MCI Patients at home

RAMCIP

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Research and Innovation Action (RIA)

Deliverable

D9.5. Report on exploitation activities – v1

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List of definitions & abbreviations

Abbreviation	Definition
DoF	Degrees of Freedom
EC	European Commission
HRI	Human Robot Interaction
H/W	Hardware
IPR	Intellectual Property Rights
pHRI	Physical Human Robot Interaction
R&D	Research and Development
SME	Small-Medium size Enterprise
S/W	Software

Executive Summary

This deliverable presents the initial results from the Task T9.3 (Exploitation), focusing on exploitation activities, which has been carried out in the context of the European Union (EU) HORIZON 2020 Programme (H2020) Research and Innovation Action RAMCIP. This is the first version of the "Report on exploitation activities" deliverables series, presenting as such the roadmap of the RAMCIP Consortium for defining the initial version of the exploitation plan for the project outcomes.

The key aim of T9.3 is to define a concrete exploitation strategy so as to prepare the grounds for the future exploitation of project outcomes, both at individual partners' and at Consortium level. To this end, the present deliverable identifies the main exploitable assets of the RAMCIP project, along with their exploitation possibilities and defines a preliminary exploitation framework which will be further elaborated towards the second version of the deliverable, as the project results further evolve during the third project year.

The exploitation activities of the RAMCIP project, as described in the present deliverable, focus on the following dimensions:

a. Definition of the project's overall exploitation strategy and roadmap
b. Analysis of the RAMCIP exploitation framework including IPR management, focusing both on the identification of the project's individual exploitable assets, as well as on the exploitation analysis of the overall RAMCIP robot; the latter provides the basis towards the business modelling approach for the RAMCIP robot, as described in the deliverable D9.4.
c. Definition of the individual exploitation plans of the Consortium partners

The current deliverable focuses on the formulation of the project's exploitation strategy and on the establishment of a preliminary analysis on the steps (b) and (c) described above.

More specifically, first of all, the main individual project outcomes of the RAMCIP project, which could have exploitation potential after the end of the project as individual components have been identified, along with their IPRs and possible exploitation opportunities. In this scope, special emphasis has been put on establishing preliminary detailed exploitation analyses for the key RAMCIP robot H/W parts, i.e. the platform, arm and hand. As concerns IPRs, the owners of the individual outcomes have been identified, while an overall IPR management framework has been also established. In addition, the individual exploitation plans of the RAMCIP Consortium partners have been elaborated.

In the context of the preliminary RAMCIP exploitation framework definition, the Consortium has emphasized on developing a preliminary exploitation analysis for the overall RAMCIP robot, already at this project stage, as a first basic step towards the project's business modelling activities reported in the deliverable D9.4. This comprised the following:

- A feature/value analysis focusing on key robot features whose inclusion or not in a possible future commercial RAMCIP robot version may have significant impact on the robot physical design and cost.
- Identification of the exploitation potential of the integrated RAMCIP robot in terms of its possible exploitation routes, focusing both on the primary application case, directly related to the project objectives and use cases, as well as further application scenarios that could add extended exploitation routes to a future product.

Both the exploitation analysis of individual project outcomes, as well as the analysis of the exploitation potential of the RAMCIP robot, will be further augmented in the third project year, on the basis of further, more concrete insights that will be obtained from the project's pilot trials. In this scope, the

present deliverable can be considered as a living document, whose final version will be provided by the end of the project (due for M36), as the RAMCIP deliverable D9.11 (Report on exploitation activities – v2).

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1. Introduction

1.1 Purpose and scope of the Deliverable

This report describes the work carried out in WP9 – "Dissemination and Exploitation" and specifically in the task related to the project's exploitation activities during the first year of the project (T9.3), focusing on the analysis of the exploitable outcomes of the RAMCIP project.

As such, its purpose is two-fold. On the one hand, the present deliverable describes the individual exploitable components developed within the RAMCIP project and on the other hand, analyses the exploitation potential of the main project outcome, namely the integrated RAMCIP robot.

As concerns the individual exploitable products, a detailed analysis of each main expected outcome is provided, along with the definition of product ownership and IPR issues analysis.

As concerns the integrated robot, a preliminary analysis has been performed, so as to define the future main product of the project. The RAMCIP robot, as is currently being developed from the project, is targeted to meet a series of user requirements, as have been defined in the deliverable D2.1. As such, the RAMCIP robot is targeted within the project to encompass a large amount of features and capabilities, so as to allow it to meet the requirements of a large amount of target use cases. Given that not all features being implemented in the RAMCIP project have equal value for the potential end users, a systematic analysis has been performed so as to identify already at this project stage some major robot capabilities that should be included in a corresponding potential future product. More specifically, the Consortium has started to perform a systematic features/value analysis, while it has also identified different exploitation alternatives that could be followed in the future.

The current document is the first of the "Report on exploitation activities" deliverables of the RAMCIP project, focusing on drafting a preliminary analysis of the individual and integrated exploitable project products. On top of this, the deliverable D9.4 (RAMCIP market analysis and business plan – v1) has been developed, which reports the outcomes of project efforts put so far on the analysis of the potential market for the RAMCIP robot and on top of this, describes the preliminary business model that has been defined for the future commercialization of the integrated RAMCIP robot.

During the third project year, when the final integrated RAMCIP robot is anticipated to be built and be applied in the project's pilot trials, the exploitation analysis of the project will be further elaborated so as to provide a more concrete view, based on an updated, more accurate understanding of the robot, its capabilities and trial outcomes, especially as concerns the end user's point of view on the RAMCIP robot.

1.2 Relation to other Deliverables

The current deliverable is mainly related to Task 9.3 (Exploitation). It is the first of the "Report on exploitation activities" deliverable series (D9.5, M24; D9.11, M36). The present deliverable has a strong relation to the deliverable D9.4 (Market Analysis and Business Plan – v1). More specifically, D9.5 describes the overall exploitation framework of the RAMCIP project, focusing first on the analysis of the main project individual exploitable assets and IPR issues, while as concerns the integrated project outcome, it attempts a preliminary feature/values analysis of the RAMCIP robot. The latter feeds into the deliverable D9.4, which is more dedicated to the exploitation of the integrated RAMCIP robot, by setting the grounds for establishing the corresponding preliminary market analysis and

business plan. Both the present deliverable, as well as the deliverable D9.4, will be further elaborated during the third project year, so as for their final versions to be developed by the end of the project.

1.3 Deliverable structure

The present deliverable begins (Section 2) with the description of the RAMCIP exploitation strategy and roadmap.

Section 3 describes the RAMCIP exploitation framework, focusing first on the description of the main individual assets that have been identified at the current project stage, and then, on a preliminary analysis of the exploitation potential the integrated RAMCIP robot.

Section 4 describes the IPR management framework that has been defined for the outputs of the RAMCIP project.

Section 5 summarizes the individual exploitation plans of the RAMCIP Consortium partners and Section 6 draws the conclusions of the present deliverable.

2. Exploitation Strategy and Roadmap

The overall RAMCIP exploitation analysis activities focus on the following key areas:

1. **Identification of Exploitable Assets**. This identifies the set of Exploitable Assets, governed by the IPR structure, which the RAMCIP consortium believes to have significant value for exploitation.

2. **IPR Management**. This defines the rules for controlling the use and exploitation of the project results and knowledge. In this respect, it provides the required contractual, and thus legal, structure to support the project's exploitation activities.

3. **Individual Exploitation Plans**. This describes the exploitation activities, pursued individually by each partner, having as a guide the IPR Management framework, the market studies and the individual plans of each partner.

4. **Exploitation analysis of the RAMCIP robot.** This is a core part of the exploitation activities, focusing on the analysis of both the integrated RAMCIP robot, as the main exploitable asset of the RAMCIP project.

In addition to the above areas, which mainly focus on the identification of the individual exploitable assets and the analysis of the exploitation potential of the RAMCIP robot, one further key area is also included in the RAMCIP exploitation strategy, which focuses specifically to the market and business model analysis for the integrated RAMCIP robot:

5. **Market Analysis and Business Plan for the RAMCIP robot**. This aims to provide a good understanding of the relevant market conditions and opportunities, as well as the business challenges involved, leading to the definition of the preliminary business plan towards the commercial exploitation of the RAMCIP robot.

The latter area is addressed in the project deliverable series entitled "RAMCIP Market Analysis and Business Plan" (D9.4 – v1; D9.10 – v2), which build upon the identification of the RAMCIP robot as exploitable product described in the present deliverable series (D9.5, D9.11).

RAMCIP is adopting an exploitation strategy based on individual and common exploitations, aligned with the formal innovation lifecycle, as shown in Figure 1 below. The procedure is compliant with the EC Recommendations COM-799[1].

[1] COM (2007) 799 Final, Communication from the Commission, Pre-commercial Procurement: Driving Innovation to ensure sustainable high quality public services in Europe dated 14 December 2007.

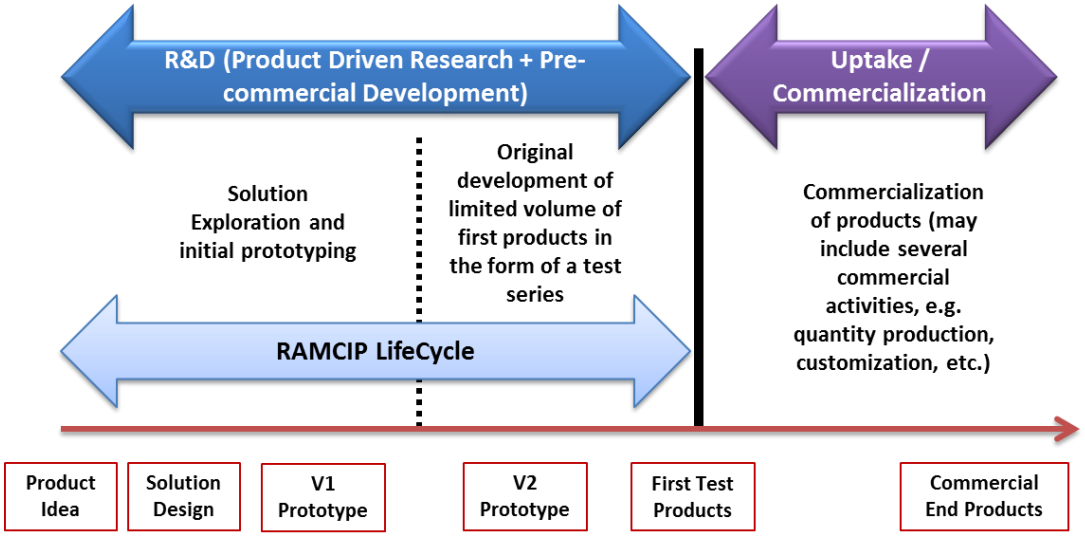


Figure 1: Overview of the RAMCIP Exploitation strategy

The RAMCIP vision

In January 2015, the RAMCIP Consortium started with the idea of developing a novel service robot, to support older adults with MCI and at early AD stages at home. As further explained in the project's target use cases defined in the deliverable D2.1, and also, in the preliminary features/value analysis of Section 3.2.3 of the present deliverable, the integrated robot of the RAMCIP project will include a series of features, enabling it to support the target end users in a series of important aspects of their daily life, ranging from food preparation, nutrition and hydration activities, through to medication intake activities.

At present, the implementation of the RAMCIP robot is still underway towards a fully functional, prototype system. In fact, before the end of the RAMCIP project lifecycle, a service robot which will have been tested in a series of important use cases for our target population, in real home environments, will become available.

Exploitation analysis roadmap

Besides the development and prototyping phase, RAMCIP has adopted a strategy and an exploitation roadmap, in order to be ready for the uptake and the potential commercialization of its results.

RAMCIP aims to organise different activities, as detailed in what follows, in order to facilitate the future exploitation of its results.

As a key preparatory activity, special attention has been given on creating a ***strong corporate image for RAMCIP***, so as to establish the project as a reliable and renowned player in the personal service robotics sector. In this scope, the RAMCIP Consortium partners have produced a series of marketing facilitators, such as the project website, its logo, newsletter, social media presence etc., aiming to diverse key target groups, including both industry leaders and stakeholders, as well as researchers and the general public. In addition, strong **targeted dissemination** activities have been pursued by the project in order to increase its visibility. A large number of dissemination means have been used, including innovative channels, such as social networks, posters and presentations in conferences and European initiatives (such activities are described in Deliverables D9.1 and D9.6; Periodic dissemination report – v1 and v2 respectively).

As concerns the core exploitation analysis activities of the project, those have a strong focus on the **identification of the RAMCIP exploitable foreground**, both at the level of individual components, as well as at the level of the envisaged

integrated service robotic system. Alongside, IPR management issues are investigated.

On the other hand, the RAMCIP consortium, via market monitoring and analysis, has identified the state and trends of the market, and the potential RAMCIP exploitable outcomes as well as the **potential market opportunities**, where they can be exploited.

Finally, the RAMCIP consortium will work towards the creation of ***links with appropriate stakeholders*** that would broaden the Consortium's reach to the targeted market.

The following list summarises the key activities involved in the RAMCIP exploitation analysis roadmap, specifically those implemented during the 2nd project year and those that are planned to follow during the 3rd year of the RAMCIP project implementation:

Year 2:

- Identification of individual project exploitable assets and identification of IPRs related to the foreground
- Analysis on IPR management issues
- Preliminary analysis of the exploitation potential of individual core RAMCIP robot H/W parts, relevant to the individual business plans of the SME project partners.
- Investigation of the exploitation potential of the RAMCIP robot and analysis of the robot features value from the users' point of view and from caregivers and clinical psychologists

Year 3:

- Elaborated exploitation analysis on individual project exploitable assets and IPRs.
- Elaborated analysis of the exploitation potential of individual core RAMCIP robot H/W parts, relevant to the individual business plans of the SME project partners.
- Elaborated analysis of the RAMCIP robot as exploitable product; further elaboration of the robot features/value analysis from the user's point of view and from caregivers and clinical psychologists, following the feedback from the pilot trials.

3. Exploitation Framework

This section describes the main identified RAMCIP assets that can be exploited by the Consortium as whole, as well as from individual Consortium partners, in respect to their IPRs.

For the first part of this analysis, related to the individual exploitable assets (Section 3.1), a decomposition of the whole RAMCIP robot system in individual components has been performed, in order to identify the specific parts of the overall RAMCIP robot that can be considered as the main individual exploitable assets at the present project stage.

Then, the exploitation potential of the overall, integrated RAMCIP robot system is analyzed (Section 3.2), by taking into account robot features and added value that they bring to an integrated RAMCIP robot system, in respect to the user's view on the target RAMCIP robot capabilities.

It should be noted that, since we are in the middle of the project implementation phase, the following descriptions could be subject to updates during the third and last year of the project's lifetime, before the end of the project where their implementation will be ready.

3.1 RAMCIP main individual exploitable assets

3.1.1 Hardware-oriented exploitable assets

3.1.1.1 Mobile platform

Asset name
Mobile platform (WP7)
Asset Owner
ACCREA
Asset Description
A robotic mobile platform. Controlled by joystick or autonomously. Indoor or outdoor version
Value Proposition
A series of mobile robotic platforms differing in number of wheels (and controllers) suitable for human environments: equipped with torque controlled wheels and a safety system limiting the interaction forces between the platform and the environment. Depending on onboard equipment, the platform may have basic equipment allowing to control the platform with the joystick or by pushing it. Such a version contains only the basic set of motors, electronics and computer. A more sophisticated version would allow to have the same control modes and also the autonomous one, but would also contain a set of versatile sensors: laser scanners, stairs detectors, etc. and additional component, e.g. a manipulator or a gripper according to the customers' needs.
Potential applications
Personal service robots (domestic), professional service robots (e.g. warehouses, terrain monitoring)
Potential end users
Labs or hospitals, universities for research reasons, logistics companies, private

use.
Route to exploit
Manufacture/sell Roll out a new, standalone series of products.

3.1.1.2 Manipulator arm

Asset name
Manipulator arm (WP7)
Asset Owner
ACCREA
Asset Description
5 DoF, 6DoF or 7DoF manipulator arm. May have a gripper attached.
Value Proposition
As a standalone product, a manipulator can be used as a testing platform for research reasons, a helper holding and keeping in place the object e.g. camera or tool while a task is fulfilled by a human. Moreover, the manipulator can be a part of the bigger construction and a gripper can collect the items. The other option is to attach the manipulator to industrial machines to perform tasks. More specifically, there will be a version of the arm scaled for assistive technology applications, like e.g. attached to a wheelchair or a universal holder arm for medical interventions.
Potential applications
A manipulator itself or as a part attached to e.g. a platform
Potential end users
Labs or hospitals, universities for research reasons, patients with motor problems in the upper extremities.
Route to exploit
Manufacture/sell

3.1.1.3 F/T sensor

Asset name
Force / Torque sensor (WP7)
Asset Owner
ACCREA
Asset Description
Elaborate technology allowing to manufacture reliable F/T sensors in different shapes and sizes
Value Proposition

Sensitive sensor to be used in versatile solutions
Potential applications
New robot hardware Sensor used in manipulators, platforms to detect and recognise contact, truck weights, rail monitoring
Potential end users
Robot producers, different applications where force sensor can be used, university experiments
Route to exploit
Manufacture/ place into other ACCREA products or sell as an individual product

3.1.1.4 Controller for robotic drives

Asset name
Joints Controller (WP7)
Asset Owner
ACCREA
Asset Description
Component able to provide low-level control
Value Proposition
Modular safe robot joint control
Potential applications
Creating robot hardware, adjusting the control of the hardware to its own needs
Potential end users
Clients buying ACCREA products
Route to exploit
Manufacture/sell

3.1.1.5 Modular robotic joints

Asset name
Modular robotic joints (WP7)
Asset Owner
ACCREA
Asset Description
A series of backlash – free robotic joints integrating a gearbox, a motor, sensors and control electronics.
Value Proposition
Modular robotic joints in different sizes with universal attachments, able to

constitute various types of kinematic chains. Available as single-motor and dual motor versions. Various control modes available – current, velocity and position modes.
Potential applications
Creating robot hardware of various types and sizes.
Potential end users
Robot integrators, researchers, machine industry.
Route to exploit
Manufacture/sell

3.1.1.6 Lightweight grasping system

Asset name
Lightweight grasping system (WP7)
Asset Owner
SHADOW
Asset Description
Multi-fingered adaptive gripper with intelligence and compliance
Value Proposition
Intelligent grasping allows one tool to handle a wide range of interactions without needing complex programming
Potential applications
Mobile service robots, flexible automation, logistics
Potential end users
Production managers, logistics systems suppliers, mobile robot developers
Route to exploit
Roll out as new product - "Smart Grasping System". Current status: Soft launch at Innovate 16, funding secured beyond RAMCIP project for additional development (NMBP project COROMA, I-UK project iSee, possible Eurostars project e-Bin, internal R&D funds, customer development collaborations) now engaged with initial test customers to explore application

3.1.1.7 Augmented Reality Head

Asset name
Augmented Reality Display (WP4)
Asset Owner
SSSA
Asset Description
Augmented reality standalone head
Value Proposition
Interactive system that can be used for both robotic applications and home-

centered interaction
Potential applications
Entertainment, home assistance, interaction interface in general, advanced robot interaction
Potential end users
Companies or researchers in the area of robot or interaction design
Route to exploit
Future research projects

3.1.2 Software-oriented exploitable assets

3.1.2.1 Human detection and identification toolkit

Asset name
Human detection and identification toolkit (WP3)
Asset Owner
CERTH
Asset Description
Software toolkit comprising methods for human detection, 3D silhouette extraction and position tracking in the known, mapped robot's operational environment, as well as methods for user identification, based on both face recognition and body features analysis
Value Proposition
Seamless integration between laser and RGBD; detection of still human
Potential applications
Collaborative robots - Personal service robots (domestic), professional service robots (e.g. warehouses)
Potential end users
Developers of both personal and professional service robots and their algorithms and methods, both at academic and industrial level
Route to exploit
Future research projects

3.1.2.2 Human pose tracking software

Asset name
Human pose tracking software (WP3)
Asset Owner
CERTH
Asset Description

Software product for the tracking of user's pose based on depth measurements derived from the robot's RGBD sensors
Value Proposition
Robust human pose tracking for realistic domestic environments, upon diverse user views and occlusions
Potential applications
Personal service robots (domestic), professional service robots (e.g. warehouses)
Potential end users
Developers of both personal and professional service robots and their algorithms and methods, both at academic and industrial level
Route to exploit
Product development, Future research projects

3.1.2.3 Environment mapping and monitoring toolkit

Asset name
Environment mapping and modelling toolkit (WP3)
Asset Owner
CERTH
Asset Description
Software toolkit comprising algorithms and methods for the 3D reconstruction of the robot's operational environment and the development of the overall hierarchical semantic map in accordance to the corresponding RAMCIP framework. By the end of the project, a UI will accompany the toolkit's algorithms and methods, so as to ease the development of the hierarchical semantic map through the developed toolkit. The hierarchical semantic map allows the robot to understand the home environment in a human-compatible manner. It can be used to enable service robots operating in a known, correspondingly mapped environment, to utilize information encoding objects, spaces and their relations, coupled with their metric 3D representations.
Value Proposition (Significant benefit of our approach – innovative aspects)
Enables the development of a hierarchical semantic representation of the robot's operational environment, coupled with the environment's metric3D map.
Potential applications
The toolkit can be applied to service robots designated for both personal and professional use (e.g. from service robots for eldercare at home through ones operating in warehouses etc.)
Potential end users
Developers of both personal and professional service robots and their algorithms and methods, both at academic and industrial level
Route to Exploit
Product development, Future research projects

3.1.2.4 Robot localization toolkit

Asset name
Robot localization toolkit (WP3)
Asset Owner
CERTH
Asset Description
Software toolkit comprising methods for robot localization in a known, mapped operational environment, including the RAMCIP approach for localization refinement based on the recognition of large environment objects
Value Proposition (Significant benefit of our approach – innovative aspects)
Refinement of robot localization estimate based on known positions of large environment objects in space
Potential applications
Personal service robots (domestic), professional service robots (e.g. warehouses)
Potential end users
Developers of both personal and professional service robots and their algorithms and methods, both at academic and industrial level
Route to exploit
Future research projects

3.1.2.5 Articulated objects state tracking toolkit

Asset name
Articulated objects state tracking toolkit (WP3)
Asset Owner
CERTH
Asset Description
Software toolkit comprising methods for the recognition and state tracking of large articulated household objects
Value Proposition (Significant benefit of our approach – innovative aspects)
Computer vision -based state detection of large articulated objects during the robot's operation, suppressing the need for corresponding smarthome sensors
Potential applications
Personal service robots (domestic), professional service robots (e.g. warehouses) - perception of environment state
Potential end users
Developers of both personal and professional service robots and their algorithms and methods, both at academic and industrial level

Route to exploit
Future research projects

3.1.2.6 Object 3D reconstruction and recognition toolkit

Asset name
Object 3D reconstruction and recognition toolkit (WP3)
Asset Owner
CERTH
Asset Description
Software toolkit comprising methods for 3D reconstruction, recognition and pose estimation of small household objects
Value Proposition (Significant benefit of our approach – innovative aspects)
Robust object recognition towards robot perception and grasping tasks in realistic environments with occlusions
Potential applications
Baseline technology for object recognition, 6-DoF pose estimation and tracking, applicable to diverse service robots, for personal and professional use
Potential end users
Developers of both personal and professional service robots and their algorithms and methods, both at academic and industrial level
Route to Exploit
Product development, Future research projects

3.1.2.7 Human activity recognition and behaviour monitoring toolkit

Asset name
Human activity recognition and behaviour monitoring toolkit (WP3)
Asset Owner
CERTH
Asset Description
Software toolkit comprising methods for both the recognition of user low-level actions in relation to the home environment, as well as the recognition and assessment of higher-level, complex activities, towards the user's behaviour monitoring and the identification of abnormalities
Value Proposition
Robust low-level action recognition in realistic domestic activity monitoring cases and personalized assessment of high-level activities
Potential applications
Personal service robots (domestic) - perception of the human activity and behaviour

Potential end users
Developers of personal service robots and their perception algorithms and methods, both at academic and industrial level Developers of screening and monitoring procedures for activities of daily living in patients with behavioural disorders due to neurological or psychiatric diseases, in a real home environment (ecological approach).
Route to exploit
Product development, Future research projects

3.1.2.8 Close-distance human limbs tracking software

Asset name
Close-distance human limbs tracking software (WP3)
Asset Owner
CERTH
Asset Description
Software product enabling the fine-grained tracking of the user's body parts (e.g. lower limbs) through depth measurements taken from an RGB-D sensor, upon very close distance between the user and the robot
Value Proposition
Human limbs tracking under close distance, partial user views
Potential applications
Collaborative robots with pHRI capabilities - Sports performance analysis
Potential end users
Developers of personal service robots with pHRI capabilities, as well as researchers focusing on body movement analysis
Route to exploit
Product development, Future research projects

3.1.2.9 Human skills modelling toolkit

Asset name
Human skills modelling toolkit (WP3)
Asset Owner
SSSA
Asset Description
Software framework for the modelling of skills, based on probabilistic models
Value Proposition
Analysis of high level user capabilities
Potential applications

Ambient Assisted Living, Human Robot Interaction
Potential end users
Researchers in the field
Route to exploit
Future projects

3.1.2.10 Robot cognitive functions toolkit

Asset name
Robot cognitive functions toolkit (WP3)
Asset Owner
CERTH
Asset Description
Software toolkit comprising the RAMCIP ADM and the behavioural part of the user's VUM, which establishes the cognitive functions of the robot, driving robot decisions on when and how to assist the user.
Value Proposition
Personalized, real-time inference on when and how the robot should provide assistance to the end user
Potential applications
Personal service robots, robotic companions
Potential end users
Developers of personal service robots and robotic companions, both at academic and industrial level
Route to exploit
Future research projects

3.1.2.11 Human-aware navigation software

Asset name
Human-aware navigation software (WP5)
Asset Owner
CERTH
Asset Description
Software product enabling robot path planning that takes into account the human's position and movement in the robot's operational space. It enhances the robot's capacity to perform its navigation tasks while not interfering with the user's personal space and current activities
Value Proposition
Real-time robust human-aware global path planning in the robot's known operational environment

Potential applications
Personal service robots (domestic), professional service robots (e.g. operating at warehouses)
Potential end users
Developers of both personal and professional service robots and their algorithms and methods, both at academic and industrial level
Route to exploit
Product development, Future research projects

3.1.2.12 Emotion recognition and affective robot policy toolkit

Asset name
Emotion recognition and affective robot policy toolkit (WP4)
Asset Owner
CERTH
Asset Description
Toolkit comprising emotion recognition methods and an affect-oriented policy for robot actions, aiming to support the user in maintaining positive outlooks
Value Proposition
Multimodal fusion -based user emotion recognition and follow-up through affect-oriented robot actions
Potential applications
Personal service robots, robotic companions
Potential end users
Developers of personal service robots and robotic companions, both at academic and industrial level Developers of screening and monitoring procedures for detection of behavioural symptoms of affect changes in patients at home real environment (ecological approach).
Route to exploit
Product development, Future research projects

3.1.2.13 Multimodal human-robot communication toolkit

Asset name
Multimodal human-robot communication toolkit (WP4)
Asset Owner
FORTH
Asset Description
Toolkit comprising a human robot communication framework enabling easy development of robot-oriented interactive applications using common interaction

modalities and a rule engine that can be used for user interface adaptations
Value Proposition
Generic framework for developing elderly-friendly applications for robotic platforms and supporting interaction modalities
Potential applications
Robot user interface application development
Potential end users
Robot user interface developers
Route to exploit
Product development, Future research projects

3.1.2.14 Control solutions for grasping

Asset name
Control solutions for grasping (WP5)
Asset Owner
CERTH
Asset Description
Software toolkit which enables successful grasping utilizing environmental contacts (e.g. flat objects from supported surfaces) and grasp stability through slippage detection from 3D tip force sensing and appropriate reaction.
Value Proposition
The developed toolkit goes beyond the state-of-art grasp planners achieving human-like grasping effectiveness.
Potential applications
Robot grasping
Potential end users
Robot & Prosthetic Hand Manufacturers and Users
Route to exploit
Future research projects, SME spinoffs

3.1.2.15 Control solutions for robotic manipulations

Asset name
Control solutions for robotic manipulations
Asset Owner
TUM
Asset Description
Software product for controlling the robot manipulator that ensures adherence to safety requirements

Value Proposition
Implementation of beyond state-of-art algorithm with stability proof.
Potential applications
Robotics in general
Potential end users
Developers of personal service robots and robotic companions, both at academic and industrial level
Route to exploit
Future research projects

3.1.2.16 Control solutions for pHRI

Asset name
Control solutions for pHRI
Asset Owner
TUM
Asset Description
Control algorithms adaptable to presence/absence of humans in the proximity and probability to which the robot violates the user safety.
Value Proposition
The beyond-state-of-art algorithm is sensitive to humans in proximity, making it safe and suitable for personal care robots
Potential applications
Personal service robots, robotic companions
Potential end users
Developers of personal service robots and robotic companions, both at academic and industrial level
Route to exploit
Future research projects

3.1.2.17 Architecture Generation Tool

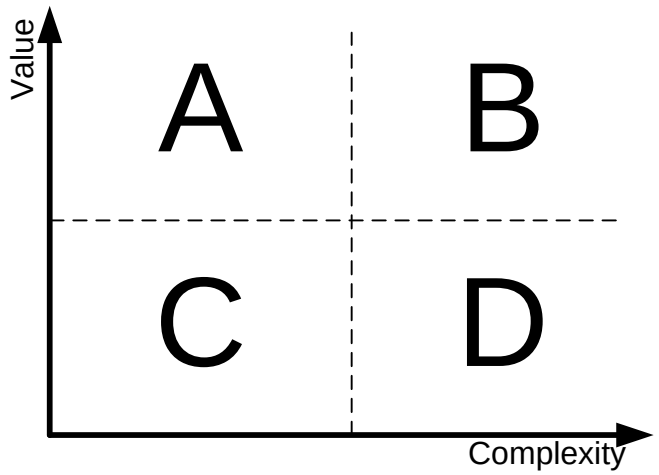
Asset name
Archgen Tool
Asset Owner
SSSA
Asset Description
Software for the description of robotic architectures with interface to ROS
Value Proposition
Simplification of design of complex architecture

Potential applications
Robotic projects, mainly in research
Potential end users
Researchers in the field
Route to exploit
Publishing on public repository

3.2 Exploitation potential of the RAMCIP robot

3.2.1 RAMCIP robot features/value analysis

In order to initiate a systematic feature / value analysis, a rather simple method has been chosen, i.e., each feature (be it hardware, functional, software, etc.) shall be allocated into one of the four quadrant of the Value / Complexity chart as shown below:



Correspondingly, the category A=high value & low complexity; B – high value & high complexity, C – low value & low complexity; D – low value & high complexity.

The preliminary analysis of aspects closely related to the robot's hardware parts, performed by ACCREA, is shown below.

Feature/functionality	Complexity/Value
Manipulation	
Reaching objects at height of 190cm	D
Reaching objects at height of 170cm	B
Reaching objects at height of 150cm	A
Reaching objects from the floor	B
Reaching to the back of the robot	D
Dedicated manipulator is used for manipulation (i.e. platform is not used for manipulation)	B
Platform is a part of the manipulation functionality	A
Locomotion	
Robot can move to the front / back / rotate	A
Robot can move to the front / back / rotate and sideways	B
Interaction	
Two screens: interaction touchscreen on the body and face screen	D
One multifunctional screen (like care-o-bot 4)	A

Ona touchscreen (on the body) and facial expressions like Pepper	B
Interaction with the robot using voice	A
Interaction with the robot using gestures	B
Interaction with the robot by physical interaction with the arm	C
Interaction with the robot by physical interaction with the body	C
Interaction with the robot by physical interaction with the platform	C

A further elaborated analysis will be performed in the third project year for the functionalities and software of the RAMCIP robot, as a result of the project pilot trials and interviews with the potential users of RAMCIP.

3.2.2 Insights on the potential RAMCIP robot exploitation case

Following the analysis of the main RAMCIP robot features described above, the present section investigates the exploitation potential of the integrated RAMCIP robot in the context of a series of case studies. Specifically, the RAMCIP robot's exploitation potential is first analysed in the scope of the direct and main case, that of providing assistance to MCI and early AD patients at home. In addition, possible future extensions of the robot's exploitation routes beyond the end of the project are taken into account, which concern potential robot applications in the premises of day-care centres dealing with the support of MCI and early AD patients, as well as in the premises of memory clinics.

3.2.2.1 RAMCIP in the home of MCI and early AD patients

The core concept of the RAMCIP project is exactly to develop a novel service robot that will be capable to provide support to MCI and early AD patients at home. Given the ever increasing ageing trend of the European, as well as the worldwide, population, it is expected that in the future, the need to augment the caregiving process with novel ICT solutions, including service robots that will be able to substitute for some periods of time in their caregiving tasks, will become more and more demanding.

The RAMCIP robot can be considered as a significant possible answer to the above need, especially when considering also the increasing rates of older people who suffer from cognitive impairments. Through a series of features that are considered significant for people with MCI and at early AD stages (as further explained above, in Section 3.2.1), the RAMCIP robot is expected to be capable to provide support to the target end users inside their home environment, in a series of use cases related to important daily activities and needs.

Through the above, the RAMCIP robot is anticipated to be a service robot that can both: (a) support the target end user (i.e. MCI and early AD patient) in a series of domestic daily activities and (b) relieve some of the caregiving burden of the target end user's human caregiver (either informal or formal), by being capable to substitute her/him in some of her/his duties for some periods of time.

Therefore, it becomes clear that as the majority of the envisaged RAMCIP robot features lead to a robot that can play a significant role in both the target end user's life and that of the person's caregivers, the RAMCIP robot is perfectly in line to the aim of being a robot of significant exploitation potential exactly at its target application case, that of providing support to MCI and early AD patients at home.

4. IPR Management

The aim of this chapter is to identify and manage legal and IPR issues, including pre-existing IPR (within the consortium partners) and IPR management of the outcomes of the project. A number of software and hardware components derive as outcomes of the RAMCIP project. Thus, the provision of effective intellectual property protection for knowledge capable of industrial or commercial application is considered essential. The general management of the project knowledge and of IPRs is specified in the project's Consortium Agreement.

4.1 Pre-existing know-how

It is unanimously agreed, that all partners are prepared to provide their pre-existing know-how in order to contribute to the success of the RAMCIP project. The Partners will respect each other's intellectual property rights on all pre-existing items that are owned by one of the Partners and that are used in the context of the project.

Considering the fact that a Partner is the holder of patents, copyright protected material or other intellectual property items that are needed for the execution of the RAMCIP project, will provide those items to other Partners at fair licensing conditions.

Partners will only use the products, information, source code or other protected items owned by another partner in the context of the RAMCIP project, when the licensing conditions for exploitation of these items in the context of the project have been clearly communicated by the Partner who is the right holder of these items.

4.2 IPR of the outcomes of the RAMCIP project

In order to manage the intellectual property rights on the RAMCIP project results, the partners have agreed on the principle that for every result in the form of know-how, report, hardware, computer program or any other form eligible for intellectual property protection, the right holder or right holders will be accurately identified.

The Partners also have agreed on the principle that they will respect each other's rights on the exploitation of the RAMCIP project results. The wish and responsibility to publish research results and carry out Technology Transfer will be carefully weighed against the necessity to keep specific foreground within the consortium and not to endanger future exploitation.

All partners provide information about planned publications to the consortium and to the Management Team. So, a publication can be delayed until patents applications have been filled. This rule is valid up to 1 year after the end of the project.

Following the completion of the final & integrated RAMCIP prototype (in WP7) and related tools (of WPs 3, 4, 5 and 6), a number of hardware and software components will be derived for developing the RAMCIP robot.

The general management of the project knowledge and of the IPRs is specified in the Consortium Agreement that is signed by the Partners. The consortium was set up during the GA preparation phase and was finalized at the latest at the same time as the contract. It addresses technical, commercial, organizational, financial and legal provisions of the partners. The IPRs of existing solutions from RAMCIP partners are covered by the consortium agreement. Its content reflects and in some cases complements the terms and conditions defined in the Commission Contractual Rules.

There will be certain intellectual property rights acquired automatically, without any need to apply for them. The most important of these rights is copyright: any document (including a computer program) or hardware developed by a Partner will "belong" (under copyright law) to that Partner. Since intellectual property is automatic, a Partner will not have to take any positive steps to obtain it. However, having copyrighted it will not necessarily excuse a Partner from acquiring other rights; (e.g. a computer program is protected by copyright, but it may, in some cases, also be patentable). Each Partner will be required to use the knowledge owned by her/him as a result of the project, in accordance with its own interests. This could include enabling other parties to use the knowledge.

4.3 Patents Request and Handling

The RAMCIP project involves novel research in the domains that it addresses, thus it is expected that partners may generate Intellectual Property that has to be protected through patents (e.g. hardware and software algorithms, etc.), yet made available for other partners for their own work in the project, and exploited outside of the project by appropriate licensing.

The main aspects that are likely to arise are outlined in the following paragraphs:

a) Ownership and transfer of ownership of *knowledge.* *Knowledge* shall be the property of the *contractor* carrying out the work leading to that *knowledg*e. Where several *contractors* have jointly carried out work generating the *knowledge* and where their respective share of the work cannot be ascertained, they shall have joint ownership of such *knowledg*e.

b) Protection of *knowledge.* Where *knowledge* is capable of industrial or commercial application, its owner shall provide for its adequate and effective protection, in conformity with relevant legal provisions, including the Contract and any *Consortium Agreemen*t, and having due regard to the *legitimate interests* of the *contractors* concerned. Details of any such protection sought or obtained will be included in the *Consortium Agreement.*

c) Access rights to *knowledge.* The general principles relating to *access rights* are the following:

a. *Access rights* shall be granted to any of the other *contractors* upon written request. The granting of *access rights* may be made conditional on the conclusion of specific agreements aimed at ensuring that they are used only for the intended purpose, and of appropriate undertakings as to confidentiality. *Contractors* may also conclude agreements with the purpose of granting additional or more favourable *access right*s, including *access rights* to third parties, in particular to enterprises associated with the *contractor(s),* or specifying the requirements applicable to *access right*s, but not restricting the latter;

b. Access rights to *pre-existing know-how* shall be granted provided that the *contractor* concerned is free to grant them;

c. Access rights for execution of the project are the following:

   I. *Contractors* shall enjoy *access rights* to the *knowledge* and to the *pre-existing knowhow*, if that *knowledge* or *pre-existing know-how* is needed to carry out their own work under that *projec*t. *Access rights* to *knowledge* shall be granted on a royalty free basis. *Access rights* to *pre-existing know-how* shall be granted on a royalty-free basis, unless otherwise agreed before signature of the *contract;*

   II. Subject to its *legitimate interest*s, the termination of the participation of a *contractor* shall in no way affect its obligation to grant *access rights* to the other *contractors* pursuant to the previous paragraph until the end of the *project.*

d. Access rights for use of *knowledge* are the following:

I. Contractors shall enjoy access rights to knowledge and to the pre-existing knowhow, if that knowledge or pre-existing know-how is needed to use their own knowledge. Access rights to knowledge shall be granted on a royalty-free basis, unless otherwise agreed before signature of the contract. Access rights to pre existing know-how shall be granted under fair and non-discriminatory conditions to be agreed.

Finally, in order to clarify the issue of exclusive licensing, this is expressly accepted (both for foreground and background) but is conditional on all participants waiving their access rights to the specific resource and confirming this in writing. The consortium is aware of the services of the Commission's IPR Helpdesk. Once any patent has been applied for, the Project Coordinator will inform the other partners as to who will need to be contacted for licenses (subject to a patent being approved) when considering future commercial exploitation. The Project Coordinator will also contact the Commission-funded IPR support organization to ensure that they are made aware of the new pending patent.

5. Individual Exploitation Plans

In the present section, the individual exploitation plans of the partners of the RAMCIP Consortium are summarized. The core preliminary joint exploitation plan of the project, developed at the present project stage, which relates to the main project outcome, i.e. the integrated RAMCIP robot, is reported in the deliverable D9.4 "Market analysis and business plan".

5.1 Commercial and end user partners

5.1.1 ACCREA

ACCREA will develop the drive modules, the arm (or a series of), the FT sensor and the platform into the standalone products. They will include the mechanics, the electronics and the control systems integrated into functional modules. The prototypes of these products will be featured on the robotic exhibitions and trade fairs (Innorobo, RoboCup) in order to collect the preorders and feedback from the robotic community.

ACCREA is in the course of specifying a portable universal lightweight arm with the potential of being integrated with e.g. a wheelchair.

5.1.2 SHADOW

Since the RAMCIP project can no longer fund the development of the Smart Grasping System, Shadow have secured additional external funding to continue development, support the project partners in their work and take the technology to market. This consists of multiple resource streams:

- Follow-on research funding (H2020 NMBP project COROMA, I-UK project iSee, possible Eurostars project e-Bin, other national funding bids in process) which will support the continued systems development and application engineering
- Shadow's own internal R&D funds which Shadow is using to fund continued direct work in RAMCIP beyond the resources available.
- End-user funding in the form of early adopter commitments and development engagements to perform user-specific application development and hardware engineering.

The use of these resource streams will allow us to transition the core grasping component into a market-ready product and develop the supporting systems and tools needed to transition from a research tool into a real-world deployable system. During 2017, Shadow will roll out test hardware to early adopters, enhance the capabilities of the core Grasping System and engage with further potential end users and customers to create a real product.

5.1.3 LUM

The project allows introducing information about new directions in the development of medical robotics into a training program for medical students and young physicians. As well it is the opportunity for investigating the usefulness, acceptability and effectiveness of the robotic solutions in health care from different points of view (health care professionals, non-formal and formal caregivers, end-users of RAMCIP robot). Some research aspects of the project will be the basis for doctoral dissertations. In addition RAMCIP project can be a basis for development of preliminary guidelines: How to conduct training of patients with MCI and AD for the most effective cooperation with robots for future projects and development programs.

The participation in the RAMCIP project gave the possibility to increase the awareness of the problem of elderly persons with memory impairment among the general public. Many public events during which the RAMCIP project was presented met with wide interest of the national and local media. The physical presence of the RAMCIP robot may be an opportunity to present alternative solutions for independent living of the vast group of the elderly persons. The special training for the end-users and their caregivers combined with the possibility of real interaction may positively influence the quality of life of the aforementioned persons.

The mutual cooperation of the RAMCIP partners originating from different fields (technical universities, medical university and commercial partners) influenced LUM's position as the advisory body on the new technological solutions available on the market for persons with memory impairments.

5.1.4 ACE

Fundació ACE mission is to manage dementia in a multidisciplinary way and it has become a global reference in the treatment and management of dementia. As a stakeholder and service provider for the Spanish Public health system in Spain, Fundació ACE exploitation plan would be to provide RAMCIP devices for free to end users of FACE reference population. Then, the basic strategy would be to raise funds from our associates, anonymous donors or directly from public and private sponsors to purchase devices making low cost renting or free cession to elderly persons who requesting the devices or caregivers with low incomes.

Additionally, Fundació ACE as a diagnostic and management center for patients with neurodegenerative diseases could develop a strategy to use RAMCIP devices in control and/or real home environment for screening purposes to diagnose and to monitor patients with cognitive deficits in an ecological setting. Furthermore, the RAMCIP robot could be used in the Day Care Centres that are part of this institution.

5.2 Research Centres and Universities

5.2.1 CERTH

CERTH foresees the research and development of the RAMCIP a) high-level cognitive functions, as well as the methods that will develop in RAMCIP for home and human activity monitoring and modelling; and b) control solutions for safe reaching, grasping and transferring objects using anthropomorphic hands as well as for safe physical human-robot interaction activities, as capable to lead into research products of significant exploitation potential.

In this context, CERTH will focus on applying the acquired knowledge and expertise in the field of computer vision, user modelling and MCI-AD user behaviour analysis in further national and EU research projects, whereas it will also investigate the creation of SME companies as spin-offs oriented in commercializing products derived from the above research and the participation in new spin-off commercial companies capable of exploiting its research when new market needs and solutions are identified. Furthermore, CERTH seeks to develop Master and Doctoral dissertations in the areas of cognition, human activity monitoring and modelling, pHRI, safety-control, grasping with anthropomorphic hands and other related topics.

Clearly, the majority of the CERTH exploitable outcomes mentioned above are strongly related to the service robot applications. As such, as also described in Section 3.1.2 of the deliverable, the potential end users of the majority of the CERTH foreground concerns developers of service robot solutions, which can either be targeting personal or professional applications. Alongside, a series of outcomes, related for e.g. to user behaviour analysis, affect recognition and

cognitive training games, can also find further extended use, in a wider range of healthcare domains, as standalone solutions. Indicatively, the MCI patient behaviour analysis module could find application in further domains than the service robotics one, as it depends on human monitoring which can be realized through diverse infrastructures, e.g. sensors installed in a smarthome. Similarly, the affect recognition methods can also be applied in further applications, as they rely on sensors which may as well be utilized without a full service robot. Lastly, the cognitive training games that will be provided from the RAMCIP robot could as well be provided through some single tablet device.

Following the above, it becomes clear that a series of CERTH research outcomes not only have a strong exploitation potential as significant features for service robots targeting assistive living applications, but they also hold exploitation potential as standalone applications that could be applied in further, diverse healthcare domains. The above will be thoroughly taken into account when further exploring the exploitation potential of the CERTH RAMCIP foreground in the third project year and after the end of the project.

5.2.2 TUM

TUM focuses on exploitation at educational and academic levels. TUM considers high-quality cutting-edge education is the key for Europe's global competitiveness in the field of home care service robot. Through the lectures and coursework closely approximating the progress of RAMCIP from system control perspective, we offer a prime opportunity for students to learn the state of the art technology of a robotic assistant for real-life applications and improve their chance for a job in industry or in research. Furthermore, we will offer topics for research theses at Bachelor/Master/PhD levels to advance further on the success of RAMCIP. Furthermore, we will make the software and datasets generated within the project open source, so that the results of our developments (i.e. control scheme for robotic systems) are widely exploitable for future research.

5.2.3 SSSA

SSSA will primarily exploit the results of the project in the educational and academic settings thanks to the various courses that are active in the Master in Embedded Computing Systems, and the PhD program in Emerging Digital Technology, where robotics and Virtual Environments courses are established. In addition, SSSA has a tradition of technology exploitation with spin-offs, supported by the Joint Technology Transfer JOTTO. Most software will be made available on public repositories, and the acquired datasets will be made available for further research.

5.2.4 FORTH

FORTH expects to take advantage of the outcomes of RAMCIP, in the context of its Ambient Intelligence Programme, in order to enhance and expand research and development on natural interaction with robots in Ambient Assisted Living applications and services and smart home environments, with the ambition to move towards prototype components and tools supporting the systematic, effective and efficient development of multimodal adaptive human robot interfaces targeted to older users in assistive environments, and reducing development time and effort.

6. Conclusions

This deliverable presented the initial results of the RAMCIP exploitation activities, defining the initial version of the exploitation plan for the project outcomes. As the first version of the "Report on exploitation activities" deliverables series, the present deliverable focused on reporting the preliminary exploitation plans of the RAMCIP Consortium partners.

In this scope, an exploitation strategy has been defined, along with a project roadmap, decomposing the whole exploitation methodology into concrete actions implemented either by the individual partners or by the RAMCIP consortium as a whole.

Alongside, the overall RAMCIP exploitation framework has been specified, through a preliminary analysis of the exploitation potential of the RAMCIP robot, as well as its individual components. In this scope, individual project assets as well as the envisaged integrated RAMCIP robot, have been described in terms of their main functionalities and benefits to be exploited from the stakeholders group as innovative and competitive products. More specifically, the individual expected project products, both concerning H/W and S/W have been identified, along with their IPRs. Special emphasis was put on analysing the exploitation potential of the key robot H/W parts (platform, arm, hand), as well as of the overall RAMCIP robot. Notably, the exploitation analysis of the RAMCIP robot presented herein, included a preliminary features/value analysis and insights on the exploitation potential of the robot in the core application scenario, as well as in further ones that could as well be targeted in the future.

Although implemented for serving the functionalities of the RAMCIP concept, the individual components, as well as even the RAMCIP robot, are anticipated to be solutions with strong exploitation potential, able to be utilized in several other applicable sectors delivering added value to their prospective customers. These conclusions, and taking into consideration that we are in the middle of the project final implementation, allow individual partners, groups and the whole consortium as well to exploit the different by-products in different time-frames and in different markets.

Then, the IPR management strategy was presented defining the rules for controlling the use and the exploitation path of the aforementioned outcomes and knowledge. The direct outcome of this effort was to suggest the required contractual and legal framework to be handled by the whole consortium members as the reference, in order to support the project initiatives in their exploitation efforts.

Finally, the present deliverable concluded with an elaborated analysis of the individual exploitation plans of the RAMCIP Consortium partners.

It should be noted at this point that the present deliverable (D9.5) is the one of the two deliverables that have been prepared at the current project stage in the scope of the RAMCIP task T9.3 (Exploitation); the second deliverable concerns the first version of the "RAMCIP Market Analysis and Business Plan" (D9.4). As such, the present deliverable focuses mainly on the definition of the overall RAMCIP exploitation strategy and the identification of the project's individual exploitable products along with IPR management issues. Alongside, the present deliverable prepares the grounds for the RAMCIP business modelling efforts (reported in D9.4), by performing also a preliminary exploitation analysis of the integrated RAMCIP robot.

In accordance to the RAMCIP exploitation strategy and roadmap, during the third project year, the preliminary RAMCIP exploitation analysis reported in the present deliverable will be further elaborated, on the basis of the more concrete view that will have been obtained on the final project individual exploitable products and

integrated robot, which will include also the feedback from the project pilot trials. As such, the present deliverable can be considered as a living document, whose final version will be reported by the end of the project, in the context of the deliverable D9.11 (Report on exploitation activities – v2).

References

[1] RAMCIP Grant Agreement Annex I – "Description of Action" (DoA)

[2] Blank, S., Dorf, B. (2012) *The Startup Owner's Manual. Vol. 1: The step-by-step guide for building a great company*. United States: K & S Ranch Consulting

[3] YCB Object and Model Set, http://www.ycbbenchmarks.org/