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Robotics and Autonomous Systems 2016 & 2017 Questions & Answers

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DG CONNECT

Unit A2 – Robotics

http://ec.europa.eu/programmes/horizon2020/en/h2020-section/robotics

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1. Introduction

Horizon 2020 is the EU framework programme for research and innovation which runs from 2014 to 2020. It comprises three main pillars: Excellent Science, Industrial Leadership and Societal Challenges. The topic of Robotics and Autonomous systems (RAS) fits mainly under the ICT Workprogramme in the Industrial Leadership pillar, in the section "Leadership in Enabling and Industrial Technologies" – LEIT-ICT. This Q&A provides additional background information on the robotics topics in LEIT-ICT, labelled:

- **ICT-25-2016 & 2017**
- **ICT-26-2016**
- **ICT-27-2017**
- **ICT-28-2017**.

IMPORTANT: This Q&A is non-binding and does not supersede the official Call documentation. The contents apply to the 2016-2017 LEIT-ICT Work Programme. Please note that some documents mentioned as reference may still be draft, and readers might need to check for updates.
This document contains updated texts in the Q&As marked "new"

2. RAS work programme at a glance

The RAS Workprogramme for 2016 - 2017 addresses five complementary lines of action which span the whole research and development and innovation chain: open, generic research; targeted technology research and innovation into prioritised technological capabilities and / or system abilities; innovation actions into end-user driven applications, technology / regulatory gaps and key underlying issues (e.g. system development tools, pilot installations etc.); Pre-Commercial procurement; accompanying measures on economic, social, legal and ethical issues. The table below summarises the breakdown of these lines into specific call topics and mentions the relevant types of project instrument involved (RIA, IA, PcP and CSA[1]). It also lists some Robotics Calls in other sections of H2020.

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[1] Research and Innovation Action, Innovation Action, PreCommercial Procurement, Coordination and Support Action.

RAS Call / topic	Est. Budget	Project Type	FSTP [2]
ICT Call 3 - 20 Oct 2015 - 12 April 2016			
ICT 25 – 2016 Advanced robot capabilities research and take-up			
a) Open, generic research	15 M€	RIA	
b) Technical capabilities: Systems development, HRI, mechatronics, perception, navigation and cognition			
c) End User driven application development	15 M€	IA	
d) Filling technology / regulatory gaps			
ICT 26 – 2016: System abilities, development and pilot installations			
a) System abilities: Dependability, social interaction, cognitive ability	24 M€	RIA	
b) Multiple-actor systems			
c) Systems development technology	18 M€	IA	FSTP
d) Pilot installations for robot testing			FSTP
ICT Call 4 –08 Dec 2016 - 25 April 2017			
ICT 25 - 2017 Advanced robot capabilities research and take-up			
a) Open, generic research	15 M€	RIA	
b) Technical capabilities: Systems development, HRI, mechatronics, perception, navigation and cognition			
c) End User driven application development	19 M€	IA	
d) Filling technology / regulatory gaps			
ICT 27 – 2017: System abilities, SME & benchmarking actions, safety certification			
a) System Abilities: Perception ability, decisional autonomy, increasing dependability levels, self-verifying behaviour	28 M€	RIA	
b) SME-based research and benchmarks			FSTP
c) Shared facilities for safety certification	11 M€	IA	FSTP
d) Pre-commercial procurement: smart cities	7 M€	PcP	
ICT 28 - 2017 Robotics competition, coordination and support			
a) Non-technical barriers	3M€	CSA	
b) Standards & regulation			
c) Community support and outreach			
d) Competitions	2 M€		
Call opening 04 Oct 2016 – Deadline 14 Feb 2017			
SFS-5-2017: Robotics Advances for Precision Farming			
Robotics systems for precision farming	7 M€	RIA	
Call opening: 20 Sept 2016 – Deadline: 19 Jan 2017			
FOF-12-2017 ICT Innovation for Manufacturing SMEs (I4MS)			
New robot systems that are cost effective at lower lot sizes	8 M€	IA	FSTP
Call opening: 20 Oct 2015 – Deadline: 12 April 2016			
IoT-01-2016: Large Scale Pilots (Pilot 5 Autonomous vehicles)			
Pilot 5 - Autonomous vehicles in a connected environment	20 M€	IA	FSTP
Call opening: 10 Nov 2015 – Deadline: 03 Mar 2016			
COMPET-4-2016: SRC - Space Robotics Technologies			
On-orbit satellite servicing, planetary surface exploration etc.	18 M€	RIA	

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[2] Financial Support to Third Parties

3. General Workprogramme

Q1:   What is the main difference with previous robotics work programmes?

A: The main difference with previous robotics work programmes (WPs) is that its scope extended to explicitly cover autonomous systems (e.g. unmanned vehicles) and, whilst it is self-contained, it is based to a greater extent on the roadmap produced in the context of the SPARC Public-Private Partnership in Robotics. Also, the WP is more granular, in order to highlight new priority topics such as safety, shared facilities for testing and certification, system development tools etc. Another difference is that it no longer prioritises particular robotics market domains, and any type of robot is admissible, e.g. aerial, marine, ground, humanoid, with manipulators, miniature etc..

Q2:   Where can I find info on the results of previous robotics Calls?

A: Summaries of projects resulting from previous Calls are on the EC web sites e.g. Cordis and / or Europa, but due to restructuring these may not be easy to find. Here are links to past call results in FP7: Projects resulting from Call 1 , Projects resulting from Call 3 , Projects resulting from Call 4 , Projects resulting from Call 6 , Projects resulting from Call 7 , Projects resulting from Call 9, Projects resulting from Call 10 and in H2020 Projects resulting from H2020 Call1.

Q3:   What is the role of the SPARC PPP in robotics?

A: The Robotics Public Private Partnership (PPP) –branded "SPARC" – plays a major role in bringing together the European robotics community to develop research strategy and priority goals through the Strategic Research Agenda (SRA). SPARC is a partnership between the European Commission (the public side) and euRobotics, an association representing the robotics community (the private side). Involvement in SPARC is via membership in euRobotics, but proposers **need not** be members, nor does membership grant any advantage or preferential treatment in the evaluation and selection of proposals. In November 2015, SPARC organised a Robotics brokerage event for open Robotics and Autonomous Systems calls – see the EU Digital Agenda website at this URL

Q4:   What is the SPARC Multi-Annual Roadmap? [NEW]

A: **The multi-annual roadmap (MAR) is a "must-read"**. It is a detailed, updated companion to the Strategic Research Agenda and it provides a lot of information basic to this Workprogramme. It identifies expected progress within the community and provides an analysis of medium to long term research and innovation goals. It results from consultations within the SPARC topic groups. See the SPARC website for the latest MAR dated December 2015.

Q5:   What kind of research is encouraged – basic or applied?

A: Whilst the focus of H2020 is increasingly driven by industry and market needs, Research and Innovation Actions (RIA) can range from upstream basic research to more application-driven research. Innovation Actions (IA) should focus on more downstream projects, closer to the end user and to applications. IAs should not focus on new research but rather on the use of state-of-the-art science and technology.

Q6:   Should a proposal aim at ready-to-market products?

A: Not in the project lifetime but Innovation Actions in particular are expected to improve the market-readiness level of robotics systems.

Q7:   What kind of measures of progress do you expect in proposals?

A: Typical factors to assess progress and success in robotics systems are measured for instance in terms of their improved functionality, behaviour, performance, precision, robustness, scalability or, for more downstream projects, prospective cost-effectiveness and user acceptance. Proposals should put forward concrete, achievable targets which can be measured in such terms, as well as plans to monitor progress in the project. The overall project result should contribute to the progression from one Technology Readiness Level to another.

Q8: **What is meant by "Technology Readiness Level"?**

A: Technology Readiness Levels (TRLs) describe the progression of a technology, product or service in terms of its proven availability and suitability to a particular application or market. They were originally developed in the 1980s; TRL schemes are used by public authorities and e.g. the oil and gas industry, and now in some parts of H2020.

Q9: **Which Technology Readiness Level scheme does ICT Robotics use?**

A: The SPARC **Multi-Annual Roadmap** puts forward an indicative TRL scheme for robotics plus some illustrations. This is based on the classic TRL schemes but expands on the conventional TRL terms, making them more obviously applicable to the robotics domain.

TRL	Clarifications in robotics context (SPARC)
1	Basic principles observed
2	Technology Concept Formulated
3	Experimental Proof of Concept
4	Technology Validated in Laboratory
5	Technology validated in relevant environment
6	Technology demonstrated in relevant environment
7	System Prototype Demonstration in Operational Environment
8	System Complete and Qualified
9	Actual System Proven in Operational Environment

IMPORTANT: The LEIT-ICT-Robotics WP does not specify which TRLs should be targeted-except for the section ICT 25c (2016&2017) "End User –driven actions", where proposals are expected to address system development beyond TRL 5 (technology validated in a relevant environment). In any case, proposers should indicate the TRL they are starting from and the TRL they are aiming at, so that evaluators can gauge the level of project ambition in this respect. Proposers should also set out how they intend to measure or assess progress from a lower to a higher TRL.

Q10: **Can I propose cognitive systems-related topics?**

A: Yes, insofar as the research is directly related to robotics and autonomous systems. There are numerous specific references in the WP e.g. under ICT-25b (technology capabilities) or under ICT-26a (system abilities) – or more generally under ICT 25a (open, generic research).

Q11: **Do neuro- and life sciences fit in here?**

A: Only as a prior inspiration e.g. from previously completed work but not as a research topic *per se*. Proposals focussing on these topics should consult other parts of H2020.

Q12: **What about ethical aspects of robotics?**

A: Within each proposal, careful attention needs to be paid to the H2020 Ethical rules. Proposers should submit "ethics-ready" proposals supplying all relevant background needed for the evaluation of this aspect. Proposals contravening ethical rules may be excluded from the evaluation, selection and award procedures at any time [H2020 Rules for Participation]. There

should be no need for medical or animal experimentation unless it is germane to the core application of the project.

More broadly, the H2020 Workprogramme also calls for proposals which are dedicated to ethical issues e.g.: in "ICT 28 - 2017 Robotics competition, coordination and support" on ethical, legal and socio-economic issues (see Q29 below); in "ICT-35-2016 Enabling responsible ICT-related research and innovation" and in "Science with and for Society: SwafS-18-2016: The Ethics of technologies with high socio-economic impact and Human Rights relevance".

Q13: **What is FSTP – Financial Support to third parties? [NEW]**

A: The FSTP funding scheme, otherwise known as "cascading funding" can be used in the Workprogramme, for certain topics, where specified. It allows proposers to reserve a significant part of the project funds for organisations which are not in the original consortium ("third parties") and which can carry out research work (typically mini-projects or experiments) to help meet the WP aims. The funding levels for third parties are set out in the relevant WP section, but see also the general rules and conditions in Part K, General Annexes to the H2020 Workprogramme.

Q14: **How does FSTP work in practice? [NEW]**

A: Potential third parties can apply for funding via open calls for proposals run by the project. Projects must publish widely open calls and adhere to Horizon 2020 standards with respect to transparency, equal treatment, conflict of interest and confidentiality. All calls for third parties must be published on the Horizon 2020 Participants Portal, and on the projects' own web site. It is vital for the proposer to **clearly describe in the proposal** how the funds will be distributed and how applicants will be selected, via which criteria etc. Previous examples include the project ECHORD ++ but of course proposers are completely free to suggest different approaches. The project consortium cannot normally apply for its own call, due to potential conflict of interest, but can perform some research and innovation work if such work is outlined in the Workprogramme topic and if it is included in the proposal.

> **General tips for FSTP proposals**: follow the same basic principles as the EC main calls, including the evaluation and selection process; making all information / facilities equally available to all proposers; using an electronic submission system; publishing the call results. NB the Commission aims to provide a good practice guide on the H2020 Participant's Portal.

4. ICT-25 - Advanced robot capabilities research and take-up

Q15: **ICT 25a - what is meant by "open, generic" research?**

A: The scope is open insofar as it is not predetermined and proposals may address an s/t topic of their own choosing. By generic, we mean the research should be applicable to different domains or application areas.

Q16: **ICT 25b - what is meant by a "step-change"?**

A: Step changes represent significant advances in technical capability and are likely to impact across different market domains. Step changes are either multiplicative advances in technical capability in terms of quantifiable metric changes (for example a system being able to recognise 100 everyday objects where the state of the art is 10 objects) or a categorical step change in a technology that radically alters what can be achieved at an application level (for example moving from graphical user interfaces to more intuitive physical interaction interfaces). The SPARC multi-annual roadmap lists expected step-changes for different technical capabilities.

Q17: **ICT 25c – Why the focus on "End Users"?**

A: End Users are typically organisations that "own the problem" and will procure effective and viable solutions where robotics may be only one possible solution. They can be distinct from "Users" who will either benefit from the system or who will operate or otherwise interact with the final system. End users should participate as full project partners, e.g. setting the concrete goals and requirements for the proposed robotics development and participating in the validation, testing and exploitation of results. In practice, projects should aim to gather operational and economic data along the way, on e.g. system performance, cost-benefits, user acceptance etc. This should result in the capture of data in an economic model for developing a business case / plan for the technology exploitation in the relevant marketplace. Such models would reduce the commercial risk to potential future investors and accelerate market take-up. Proposals are expected to address areas of application where the commercial risk resulting from a lack of operational data is a significant barrier to commercial exploitation.

Q18: ICT 25d - Which type of "technology or regulatory gaps" are meant?

A: This refers to gaps between what the market needs and what the current state of the art can deliver. Proposals are expected to address a gap in either technical capability or system ability that acts as a barrier to market and can be fully addressed either through focused technical development or through technology adaptation within the context of a particular system deployment. By "regulatory gap", we mean that current regulations do not allow, or do not fully support, a viable commercial model of operation of the robot system in the stated application area. Proposals addressing regulatory gaps should identify the regulatory hurdle, the process that would be needed to overcome the hurdle and the data required to support a change to the regulations. The project should aim to provide such data. Also projects addressing regulatory gaps should include an appropriate regulatory body, at least as an advisor to the project or to provide critical overview of the project outputs. Proposals are not expected to address application areas where there are already widespread efforts underway to examine regulatory change.

5. ICT 26 - System abilities, development and pilot installations

Q19: ICT 26a - What are "System abilities"?

A: System Abilities refers to key features of robotics & autonomous systems, and are described in the SPARC SRA as: configurability, adaptability, interactivity, dependability motion ability, manipulation ability, perception ability decisional autonomy and cognitive ability. The MAR provides detailed information on these abilities.

> **ICT 26a** addresses *robot dependability*, *social interaction ability and cognitive ability.*

Q20: ICT 26b - Who or what are "multiple actor systems"?

A: Multiple Actor Systems are composed of many actors, where each actor is able to operate independently. These actors should at least include robots and / or other autonomous systems as well as people or static systems, including embedded sensor networks and cloud services, working together in the operational environment. The whole system operates through the interaction of these many actors to carry out the system function but needs to be robust against errors or inaction of any specific actor.

Q21: ICT 26c - Systems development technology – how generic should the tools be?

A: The proposed processes and tools should be applicable to diverse application domains. However it is likely that no single process model or tool chain will apply to all domains. Processes covering several related application domains could be targeted which would be tailored to the individual requirements of those domains.

Q22: ICT 26d - pilot installations – what does the EC funding cover?

A: EU funding should not be used to build a new installation from scratch, but for adding value to existing infrastructures. Regarding financial support to third parties, a minimum of 60% of the EU funds should go towards this purpose and a maximum of 40% to consortium operations and the support infrastructure – see the WP text for a description of the various tasks and functions to be addressed.

6. ICT 27 - 2017 – System abilities, SME & benchmarking, safety certification

Q23: **ICT 27a (system abilities) – different from ICT 26a (system abilities)?**

A: See Q19 above. Both topics target system abilities and have the same general aim but they are targeted towards **different subsets of specific system abilities**. The ICT 26a topics are not open in 2017.

> **ICT 27a** addresses *perception ability; decisional autonomy; increasing dependability levels to the level of graceful degradation; ability to self-verify correct behaviour in safety critical tasks*

Q24: **ICT 27b – How do I structure a proposal under "SME-based research"?**

A: ICT27b aims to support one large project which may include SMEs in the consortium and / or fund third party SMEs (see tips on cascading funds above). This action is inspired by the H2020 SME Instrument. However the Instrument differs from ICT 27b in several ways e.g. it deals directly with individual SMEs, it offers a three-phase support, it is open to all domains (including robotics) and it has different funding rates.

Q25: **ICT 27b – How should I approach benchmarking?**

A: An essential component of any research project comprises metrics, benchmarks, and performance indicators which allow the objective evaluation of key system properties. This depends of course on the particular research issues and application scenarios addressed, but particular attention should be given to these aspects by proposers. If necessary the project can develop new methods for evaluations, but should at all costs avoid "reinventing the wheel". Benchmarking activities in individual projects should aim to link into broader community efforts, including by SPARC, not just be stand-alone and project specific.

Q26: **ICT 27c – Safety certification - Are actual standards expected?**

A: Projects under this action are expected to stimulate and accelerate European input into the standards process led by national and international bodies and / or by relevant industrial communities.

Q27: **ICT 27d - How does Pre-commercial Procurement work?**

A: PcP refers to procurement of research and development services involving risk-benefit sharing under market conditions, and competitive development in phases, where there is a clear separation between the procurement of the R&D services procured from the deployment of commercial volumes of end-products. Background information is available on europa.eu on definitions and other tips. Note that a PcP project is now co-financed by the EC up to a maximum of 90% of its total eligible costs – check funding rates carefully e.g. here.

Q28: **ICT 27d - What should a PcP project do in practice, in Robotics?**
A: Bring together public procurement authorities with common needs, ideally in one large project, to develop and refine their requirements and objectives in respect to the robotic solutions they wish to acquire, organise the selection of RTD service suppliers , monitor the selection progress and procure the actual RTD work. Existing examples of PcP projects in other domains include SMART@FIRE [http://www.smartatfire.eu/] and SILVER [http://www.silverpcp.eu/].

7. ICT 28 - Robotic competition, coordination and support

Q29: **ICT 28a – Should one single action try to address all the sub-topics here?**

A: ICT 28a comprises several complementary sub-topics, e.g. promoting entrepreneurship skills, investigating ethical, legal and socio-economic (ELSE) etc., which might not necessarily be addressed in a single action. Individual proposals are invited to suggest an appropriate mix of the sub-topics listed. The overall aim of reducing non-technical barriers in a tractable and measurable way should be respected. In each case it is expected that authoritative bodies, whether from industry or public sector are closely involved.

Q30: **ICT 28b - Are new EU standards / regulations expected?**

A: Actions should provide input to standards and regulations bodies, whether European or global, so that the interests of European industry and markets are taken into account. The actual standards-making process is of course up to the relevant existing bodies.

Q31: **ICT 28c - What is the underlying aim of "Community support and outreach"?**

A: The robotics field is starting to come to public attention on a far greater scale than before. However there is a risk of fragmentation of knowledge-sharing across different countries. This action aims to foster communication, co-ordination and co-operation among relevant communities, projects and programmes, linking European, national and international activities. Its agenda may cover: organising and supporting workshops, conferences, courses, exchanges of staff and researchers, development & dissemination of training material, access to development platforms, planning and sharing research agendas, and the creation of a web-based resource to facilitate research, education, and outreach to relevant industries and general audiences. It will build on and further extend the successes achieved by previous co-ordination actions. It is important to underline that the aim is not a promotional campaign, but a service providing neutral, factual data and information to potential suppliers and users.

Q32: **ICT 28d - What do you mean by "smarter" robots in the competitions?**

A: This is a key issue. The competitions do not aim at a 'nuts-and-bolts' engineering contest but at demonstrating scientific and technical progress in intelligent systems. Proposals should ideally delineate the competition domain as concretely as possible, where meaningful reference scenarios or benchmarks can be developed and applied and where comparable results can be obtained from competing approaches and systems. No specific topic is aimed for.

Q33: **ICT 28d - What are the key features sought after in a competition proposal?**

A: Competitions primarily target researchers, but having an industrial take-up dimension would be a plus. Private sponsorship is welcome. Open participation and transparent governance are essential. Evaluation mechanisms / criteria should be clearly spelt out in the proposal, in order to demonstrate the openness and fairness of the process. Proposals should clarify on which basis the competition will select the benchmarking scenarios, e.g. in the context of any internationally recognised and / or reproducible benchmarking scenarios. Competitions should be highly visible and include marketing activities. The European added-value needs to be clearly demonstrated. The proposal should describe what impact is expected from the project (support to the community, demonstration of scientific advance, reaching out to the general public, increasing the competitiveness of European industries, etc.).

8. Practical hints for proposals

Q34: What makes for a good proposal, generally? [NEW]

A: It is essential to understand that a good proposal is **a finished project plan ready to be implemented**, not a sales brochure. Therefore, make it concrete and specific, favouring substance over style and specifics over hype. It will be evaluated by your peers, who can only be convinced by substantiated statements. Having a great idea is not enough – it has to be backed up by a well thought-out and sufficiently detailed workplan. Also, only submit a proposal which you believe is excellent all round; have it checked by an independent reader.

8.1. Proposal concept and objectives

Q35: What kind of added-value are you looking for in proposals?

A: R&I projects should aim at work that is highly innovative, which cannot be carried out at national, regional level or by the market alone and possibly can bring together different disciplines which have not worked closely together before.

Q36: What key hints can you give for writing a proposal?

A: Explain **why** the research is needed, **what** it will do, **how** it will be done, **who** will do the work and **for whom** (who is the target audience). Proposals should make the case for the soundness of the approach to achieve its goal. The proposal should clearly describe (a) what the state of the art is – not only in the consortium but in the community at large, (b) what the contribution of the project will be to going beyond the state of the art, (c) what problems will have to be solved, (d) how this will be achieved, and (e) how this will be measured. Where appropriate e.g. for scientific / academic research, please reference the relevant literature.

Q37: How should the objectives be laid out?

A: The proposal should present both its more general, overall goals and the more concrete scientific and technical objectives. It is important to address objectives which are challenging but realistic. They should be achievable in the project lifetime, specific, timed (e.g. date/milestone the objectives will be reached), and verifiable.

Q38: How important is system integration?

A: Integration is a major challenge, in particular for projects with different disciplines, different types of hardware, cooperating systems, novel combinations of components etc. Especially if your proposal addresses more downstream robotic systems prototypes, ensure that you describe concretely how you will achieve systems integration. Specify the S&T integration methodology, but also include concrete management mechanisms. The interdependencies between work-packages and tasks need to be carefully explained (including timing when results are transferred between them).

Q39: What about literature survey and system requirement definition?

A: Avoid proposing an extensive literature or technology survey as a new task within the proposed project, unless to investigate a completely new research topic. Likewise, proposals should be able to convince that they will not need open-ended or heavy investment in developing system specifications and requirements.

Q40: Do I need to include demonstrations?

A: Definitely, and more so than in previous Robotics Calls. Demonstrations are a key way to validate research work. Demonstrations should be done in settings relevant to the proposed market domain or application area, whether in actual or potential end user. Simulations are <u>not</u> encouraged, except as an early intermediate step for the preparation of real-world demos. Basic research projects will also need some form of demonstration.

Q41: **What about follow ups to previous projects or proposals?**

A: Follow-ups are allowed, but explain clearly the new added-value of the follow-up. It should not be a mere continuation of the previous project. Proposal resubmissions are treated like all other proposals. Scores can vary from one Call to the next. You are strongly advised to take into account the (new) context and aims of the Call for Proposals and <u>if still relevant and applicable</u>, the comments from the previous ESR.

> **TIP** – not explaining sufficiently HOW a project will reach its goal is the No 1 reason for proposal failure. Don't forget to describe also how you will assess the project's progress (including performance assessment and metrics).

8.2. Project implementation

Q42: **How do I demonstrate the project's "value for money"?**

A: By spelling out the costs of and need for the proposed levels of personnel effort, equipment (durable and consumables), travel, subcontracting if any, and your own resources which will be provided to the project. The contribution of personnel involved, especially principal investigators, should be spelt out.

Q43: **Should I propose a small or a large project? [NEW]**

A: The Work programme indicates a possible range of EU funding per project, however it is always important to match the budgetary size of the project to its research and innovation needs, objectives and scope. Do not artificially add partners to reach a particular budget range.

Q44: **How do I select consortium partners?**

A: The selection and number of partners must be exclusively driven by the project's needs in order to achieve its goals. Selection is dictated by the job at hand, based on partners qualifications, scientific track record (reference their most relevant publications), and their ability to complement each other's roles, skills and levels of experience. Make sure you have enough partners to do the job - but not more than needed.

> **TIP:** Lack of substantiation of the relevant mix of expertise and experience of key personnel can significantly weaken a proposal. Present the Consortium through a short description of the beneficiary's organisation, concise biographies listing relevant experience and selected publications where appropriate, plus <u>their expected level of involvement in the project.</u>

Q45: **Should an RIA always address the entire robotics value chain?**

A: Not necessarily. It depends on the nature of the project and the TRL addressed.

Q46: **Are industrial partners always required?**

A: Industry has a far greater role to play in H2020 than previous robotics programmes. Involvement from industry as manufacturers, system suppliers, integrators or users is welcome, as appropriate, depending on the needs of the project and on the technology readiness level addressed. They could e.g. carry out research, provide infrastructure/tools, provide challenging application scenarios and give access to their facilities to assess scientific progress. In all the cases, they have to show that they are stakeholders in the work and its results, in particular through demonstrating a sound commitment and strategy to exploit the project results. In cases where industrial partners might not be appropriate e.g. for basic s&t research, proposals should still identify the potential industrial impact of the project results.

Q47: **What about end users?**

A: End user participation, particularly in more market-oriented projects, is very welcome and in some instances essential e.g. in ICT 25c-2016 and ICT 26c-2017 on "End-User driven

application development" (see Q17 above). As with any other type of beneficiary, the role of end users should be clear in the proposal.

Q48: **What about geographical balance?**

A: Geographical balance is definitely NOT an evaluation criterion in this topic. Select your partners based on the needs of the project.

Q49: **Is there a "standard" management structure?**

A: Make sure that the proposed management structure fits the project needs. It is not encouraged to adopt typical structures blindly. Keep the management as lean as possible. Specify how the integration of partners is achieved. Clearly define the interactions between teams/tasks.

Q50: **Is risk assessment important?**

A: Definitely! Explain **both** the typical project management risks **and** specific risks due to the technology approach, in a realistic and concrete way. In all cases, provide a credible contingency plan. A proper contingency plan does **not** simply amount a set of assertions that the risk will not materialise.

Q51: **How should the workplan and work packages be described?**

A: The work package descriptions are a key part of the proposal, detailing the activities, the measurable objectives and the methodologies to achieve them and to assess progress and results. The work package objectives are to be consistently reflected in the individual task descriptions and deliverables. Be concrete and specific – vagueness is a definite shortcoming. Indicate where the individual tasks take input from and what they feed into. For each task, the partners contributing to it should be listed and their involvement in terms of person months should be indicated.

Q52: **How many and what kind of deliverables and milestones are needed?**

A: Keep the list compact. Specify major <u>milestones</u> and corresponding measurable objectives and the methodology to assess them, as means of verification. This could be expressed, for example, as the expected advance in functionalities, behaviours, performance, sophistication, etc. It is not sufficient to simply state, e.g., "software available" or "subsystem operational". The <u>deliverables</u> list should be well balanced. Avoid making deliverables out of intermediate, consortium internal deliverables and reports. The descriptions of the deliverables should be detailed and informative enough to allow a proper understanding of what can be expected to be delivered and (together with the milestones) give a clear picture of the project and its major steps, including the progress to be made from one phase or review period to the next.

> **TIP:** Projects with a longer-term, scientific bias are expected to have a significant percentage of public deliverables and public-domain results (including sharing of databases, software, tools, if possible via open-source). Projects with more industrial dimensions do not necessarily need to make all deliverables public. The proposal should make this clear and describe its plans to protect or exploit such results – e.g. through patents, licensing or technology transfer. This should be clearly justified (e.g.: explain the IPR policy, whether the restriction might be removed after the corresponding paper has been published…).

Q53: **What kind of legal and financial checks are made on retained beneficiaries?**

A: Refer to the Call documentation and to the Workprogrammes and Annexes on the H2020 Participant's portal. In short, all participants should check already at the proposal stage what they might need to provide if the proposal is retained. In H2020, there will be less time than before to progress through the grant agreement preparation stage. Note that the Commission will verify the financial capacity in advance <u>only for coordinators</u> when the requested funding from the Union for the action is equal or superior to EUR 500 000. The financial capacity will not be verified for legal entities whose viability is guaranteed by a Member State or an

associated country and for higher and secondary education establishments. Also for new beneficiaries, ensure you appoint a LEAR (legal entity appointed representative) early on.

> **TIP**: Look at the H2020 online manual well in advance, and if need be do some self-checks e.g. on your financial viability.

8.3. Impact

Q54: **What kind of impact are you looking for?**

A: H2020, by linking Research and Innovation, puts much greater emphasis on achieving impact than previous programmes. The Workprogramme text describes the expected impacts sought. Any individual proposal is not expected to address the whole list, so spell out what can realistically be expected from the project. It is important to think about the impact *at the proposal stage*, allocate proper resources and describe the actions to achieve it.

Q55: **What kind of dissemination do you expect?**

A: Prepare a dissemination plan with a coherent vision, not just a shopping list of conferences and journals. Target your dissemination events according to the timeline of the project. Describe the main target audiences, venues and channels for dissemination / exploitation. It is essential to describe the concrete steps planned to achieve dissemination goals. Plan properly for social media. Involve the right persons (communication experts, journalists, science communication departments, etc.). Keep in mind that you are an EU-funded project and as such you promote the visibility of the H2020 Robotics programme (including by making systematic reference to it and to the funding received in your public documents).

> TIP: Pre-commercial Procurement has specific dissemination rules. Check the PcP site.

Q56: **How important is the exploitation plan in this domain?**

A: For R&I actions and especially for Innovation Actions, a well thought-out exploitation plan which includes where relevant a credible business case and describes the involvement of people with the right expertise (for technology transfer, patents etc.) is highly encouraged. The plan should explain what the target audience is and how it will reach them. It should make explicit which markets or industries it will aim at, whether end users are targeted or intermediaries like technology transfer agents, venture capitalists etc.

Projects with a more industrial approach should concretely describe the path towards exploitation (including joint exploitation by the partners) of transferable results from the work. A strategic business case is appreciated and even necessary in Innovation Actions. Developing an actual specific business plan is however beyond the scope of this RTD funding programme.

Projects with a more scientific approach should still make clear what the eventual exploitation outcomes and impact on the scientific community will be, including re-use of scientific results in further research. Proposing concrete mechanisms to ensure such re-use would be a plus. In either case, exploitation strategy should include identifying potential exploitable results and target users, as well as a mechanism for attracting them.

> TIP: Be concrete about what the project results would actually achieve in the areas described in the Workprogramme section "Expected Impact", and which concrete actions will be carried out during the project to achieve such impact.

9. **Other robotics funding in H2020**

Q57: **What is the link with the Precision Farming topic?**

A: This is a joint action between LEIT-ICT and Societal Challenge 2[3]. Systems will include autonomous or semi-autonomous farm vehicles or sophisticated sensors and intervention mechanisms. See the Societal Challenges 2 section for details.

Q58:   Is robotics still in the Factories of the Future topic?

A: Yes. Robotics appears within the new H2020 Workprogramme section called "Cross-cutting activities (Focus Areas)", under "Industry 2020 in the Circular Economy, ICT for the factories of the future". Research aims at new robot systems that are cost-effective at lower lot sizes.

Q59:   Where do I find the large-scale pilot on autonomous vehicles?

A: In the H2020 Workprogramme section entitled "Cross-cutting activities (Focus Areas)", in the focus area "Internet of Things – IoT-01-2016 Large-Scale Pilots". The Pilot 5: Autonomous vehicles in a connected environment will test scenarios of deployment of safe and highly and fully autonomous vehicles in use case scenarios, exploiting local and distributed information and intelligence.

Q60:   How is space robotics linked in?

A: The Space Robotics Technologies cluster aims at very specific technologies e.g. on-orbit satellite servicing, planetary surface exploration.

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[3] Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy

10. Workprogramme extract: Robotics and Autonomous Systems.

The importance of robotics and autonomous systems (RAS) lies in its strong economic contribution as an industrial and commercial activity in its own right and in its broad and disruptive socio-economic impact across diverse market sectors world-wide. Advanced robotics and autonomous (or near-autonomous) vehicles will have a potential annual economic impact by 2025 on a par with e.g. mobile Internet, advanced materials or energy markets[4].

Already now, industrial robotics has become a cornerstone in several of Europe's high value manufacturing industries, such as automotive, keeping these industries in Europe. This trend must be maintained, strengthened and enlarged to all main industries in Europe. Robotics technology also has an impact on a broad range of end user markets and applications. The robotics professional and consumer service sectors are expected to achieve double-digit growth during the next decade and SMEs will play a key role e.g. in opening new markets. In addition to manufacturing, important future application domains for robots, with high impact on everyday life, will include healthcare, agriculture, civil, commercial or consumer sectors, logistics and transport.

The EU's strategic vision aims at strengthening Europe's global position in the robotics market to one third of industrial robotics, two-thirds of professional services and one-fifth of the domestic services market by 2020. Overall, an expected robotics-related increase of the EU GDP by EUR 80 billion is targeted.

This Work Programme directly supports this strategic vision. The main approach is to generate new RAS technical capabilities and system abilities and to move research results out of the laboratory and into the marketplace, engaging with SMEs and end users[5]. The technical capabilities targeted by this Workprogramme are: systems development; interaction; mechatronics and perception / navigation / cognition. The targeted system abilities are: configurability; adaptability; interaction capability; dependability; motion capability; manipulation and grasping; perception; decisional autonomy and cognitive ability.

This approach is founded on interleaved mix of technology-driven R&D&I to keep Europe at the cutting edge of research and market-driven R&D&I to accelerate take-up and deployment, including by SMEs. These actions will be supported by a critical mass of flanking measures to improve the market and regulatory climate at EU level through e.g. addressing non-technical market barriers (entrepreneurship, ethical / legal / socio-economic issues in a pro-active and forward-looking perspective, skills and training) and through the impetus of a high-profile robotics competition. This approach is built on the priorities of the SPARC Robotics PPP Strategic Research Agenda and Multi-Annual Roadmap (MAR)[6]. All proposals are expected to demonstrate their contribution to this roadmap.

Proposals are invited against the following topic(s):

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[4] "Disruptive technologies: Advances that will transform life, business, and the global economy", McKinsey Global Institute May 2013.

[5] "End users" here are distinct from "users" in that they are typically organisations that own applications or specific functional tasks, whereas users are those who benefit directly from the actions of or interact with a robot system during its operation

[6] SPARC Robotics PPP Strategic research Agenda for robotics in Europe 2014-2020 and Multi-Annual Roadmap http://www.eu-robotics.net/cms/upload/PPP/SRA2020_SPARC.pdf.

ICT-25-2016-2017: Advanced robot capabilities research and take-up

<u>Specific Challenge</u>: RAS technology has evolved significantly in the past decade, moving robots out of constrained environments and into the workplace or home. Technologies ranging from mechatronics to sensing, manipulation and mobility have all contributed to this evolution. However the easy deployment of smart robots in everyday life is still beyond the technical capability of most current laboratory prototypes.

The specific challenge here is to develop robots that respond more flexibly, robustly and efficiently to the everyday needs of workers and citizens in professional or domestic environments, and which will also maintain Europe at the forefront of global research and development. The actions will address the whole research value chain, whether generic technology, developing RAS building blocks in the form of key technical capabilities, or market-led prototypes directly involving end users. End users will help drive Innovation Actions as active partners, setting the operating parameters for a given application as well as testing and validating the prototype solutions.

*<u>Scope</u>: **Research and Innovation Actions** addressing generic advances and technical capabilities:*

a. Open, generic forward-looking research into novel technical advances in robotics – open to all robotics-related research topics and disciplines. Proposals are expected to address technical topics which cut across application domains and which can be developed further with a view to achieving high future impact on markets or societal sectors in Europe.

b. Technology research and development to achieve step changes in the capabilities of the following high priority RAS technologies: systems development, human-robot interaction, mechatronics, perception, navigation and cognition. Step changes are sought through either a multiplicative improvement in technical capability, for example achieving a difference in order of magnitude in the number of everyday objects a robot can recognise or handle, or a categorical advance, for example moving from rigid to intuitive human-robot interfaces.

The Commission considers that the open research and the technical capabilities proposals are expected to require EUR 2 to 4 million each; nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one action will be supported for each bullet (a or b above). Proposals are expected to identify which bullet is their main centre of gravity.

***Innovation Actions** driven by end users:*

c. Improving the deployment prospects of RAS through end user-driven application developments in domains and application areas with significant market potential. Proposals are expected to address system development beyond TRL 5.[7]

The outputs will not be purely technological; actions will generate economic and operational data that will provide a valuable basis for setting operating parameters and for reducing commercial risks for future investors.

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[7] Technology readiness level 5: technology validated in a relevant environment

d. Filling technology or regulatory gaps through end user-driven innovation actions, where the gap represents a challenging market entry barrier. Proposals are expected to address a gap in either technical capability or system ability. The targeted gap and the required steps to tackle the gap must be clearly identified in the proposal.

The Commission considers that End-user proposals are expected to require 2 to 4 million each; nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one action will be supported for each bullet (c or d above). Proposals are expected to identify which bullet is their main centre of gravity.

*Expected Impact: The expected impacts for the **Research and Innovation Actions** are:*

- *Promote excellent science and technology knowledge in Europe, demonstrated by a high standard of research outputs (including publications, open source software or, as appropriate, patents);*

- *Develop a new generation of robotic and autonomous systems with clear and measurable progress over the state of the art in terms of step changes in technical capabilities, as evidenced by improvements in performance (including in terms of affordability, reliability and robustness, energy autonomy and user acceptability);*

- *Greater industrial relevance of research actions and output as demonstrated by deeper involvement of industry and stronger take-up of research results;*

- *Fostering new links between academia and industry, accelerating and broadening technology transfer;*

- *Contributing by 2020 to the strategic vision of a more competitive positioning of European robotics providers in the marketplace, in terms of their penetration in new or emerging robotics sectors.*

*The expected impacts for the **Innovation Actions** on end-user research are:*

- *Increasing the market-readiness of robotics applications including in terms of technological validation outside the laboratory and of sound operational and cost-benefit models;*

- *Lowering of market entry barriers of a business or regulatory nature and increasing industrial and commercial investment in Europe at a rate comparable with other global regions;[8]*

- *Contributing to the faster growth of competitive small and mid-scale robotics companies in Europe.*

Type of Action: Research and Innovation action, Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

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[8] According to the PwC/NVCA MoneyTree Report, capital investments by US venture capital firms rose to about $172 million in 2013, nearly tripling 2011 levels

ICT-26-2016: System abilities, development and pilot installations

Specific Challenge: RAS operate through the integration of a wide range of different technologies, as noted above. In addition to the contribution of each of these technologies, it is also important to characterise the overall performance of an RAS in terms of its ability to perform system functions which traverse specific technological capabilities. The specific challenge here is to increase the system ability levels in terms of configurability, adaptability, motion, manipulation, decisional autonomy, dependability, interaction, perception and cognitive ability. Such system abilities provide a basis for setting performance metrics and for specifying desired levels of system performance. Reaching higher ability levels than currently available allows to advance the state of the art and to set future targets for robotic systems.

Multiple-actor systems are composed of many actors who are able to operate independently but together can perform system functions. These actors may be autonomous entities, people, or static systems, including embedded sensor networks and cloud services, working together in the operational environment. The challenge is to develop complete, robust systems through the interaction of these many actors to carry out the system function.

Integrated sets of common tool chains and real-world test installations are increasingly needed to support the development of complex robotics systems. The challenge resides in the need for open development and dissemination of common development tools and the provision of wide access to realistic testing environments for the end user community, especially SMEs. Robot testing and innovation facilities are starting to emerge in Europe but are underdeveloped in terms of their infrastructure and the facilities they offer.

Scope:

a. Research and Innovation Actions on system abilities

Research & Innovation Actions will focus on advancing the state of the art in the level of smart robotics system abilities. The focus is on the technical challenges; research actions will address cross cutting technology issues that will make a significant contribution to the needs of applications and domains with the highest impact on markets. Proposals are expected to address at least one or a combination of the following prioritised abilities: robot dependability, social interaction ability and cognitive ability.

The Commission considers that System ability proposals requesting a contribution from the EU of between EUR 2 and 4 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one proposal will be supported within actions on system abilities.

b. Research and Innovation Actions *on multiple-actor systems:*

This action focuses on developing advanced multiple-actor systems utilising actors which can operate individually, as members of a team and within a network of other assets in semi-structured, unstructured, dynamic or harsh environments. The system operates through the interaction of diverse independent actors and needs to be robust against errors or the inaction of any specific actor. Proposed multiple-actor systems are expected to demonstrate autonomy over an extended time scale and clearly identify service level gains (compared with current systems) in the application area chosen by the proposal. Systems must be built

around identified end user needs and performance should be measured using relevant end user metrics.

The Commission considers that Multiple-actor proposals requesting a contribution from the EU of between EUR 2 and 7 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one proposal will be supported within actions on multiple-actor systems.

*c. **Innovation Actions** on systems development technology:*

The action will address the open development and dissemination of integrated sets of tool chains and building-block applications which support the construction of complex robotics systems. This will result in a European-level ecosystem of development tools using commonly agreed ways of describing robot systems and system building blocks and their interaction. The ecosystem should be flexible and able to accommodate a diverse range of end application requirements in a broad range of different domains. Proposals must aim at developing such an ecosystem, provide mechanisms for its dissemination and stimulate community engagement in its development and subsequent deployment.

Key to the success of this action will be support for modularity, composability[9], re-usability, ease of use and the adoption of existing and emerging standards within both the system and its components. The action is also expected to build on existing systems and structures.

The action may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the selection process of additional users and suppliers for which financial support will be granted (typically in the order of EUR 50.000 – 250.000[10] per party). Minimum 50% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties.[11]

The Commission considers that System development tools proposals requesting a contribution from the EU of between EUR 5 and 8 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one proposal will be supported within actions on systems development technology.

*d. **Innovation Actions** on pilot installations for robot testing:*

The action will develop and deploy access mechanisms and supporting infrastructure for single-site[12] pilot installations outside the laboratory for robot testing, based on the needs of end users. Proposals will build on an installation supported through existing EU, regional, national or commercial funding to develop a European accessible facility prioritised against

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9 Composability is defined as the ability to combine and recombine building blocks to fulfill different functions. Building blocks may be at different levels of granularity ranging from components to systems of systems. Composability applies to all aspects of the design and development of systems.

10 In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded, and if this is the case proposals should explain why this is necessary to achieve the objectives of the action.

11 It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

12 "Single Site" refers to the need for the site to be fully self-contained and aligned to a specific existing asset. Proposals may cover multiple assets at different geographic locations but each must be a single site asset.

emerging market domains and application areas. In order to ensure real-world conditions, these pilot installations will be based on existing infrastructures such as farms, hospitals / care homes, mines, nuclear sites, undersea sites, collapsed buildings etc. The proposed access mechanisms and infrastructure should provide a low access threshold for SMEs, public bodies and research organisations.

Proposals are expected to provide a support infrastructure including as a minimum: instrumentation of the site; simulation support to allow off-site testing; access to the end user and local site experts, and metrics relating to the functional goals of the end user. The proposal should also address safety certification processes, the development of appropriate performance evaluation measures and application-specific benchmarks. The proposal should identify application-relevant standards and, where relevant, the types of human interaction expected, including the level of social interaction.

Where appropriate, proposals should consider providing sharable standard platforms (hardware and software) to allow organisations offering individual modules or technologies to access the site, rather than limiting access to groups able to deliver whole systems.

Proposals should clearly show how they will assess and, where appropriate, disseminate the results and market impact from trials carried out on the installation. Proposals are encouraged to highlight how deployed system dependability can be enhanced through interaction with the installation.

The action may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the selection process of additional users and suppliers running the experiments to access the installation for which financial support will be granted (typically in the order of EUR 50.000 – 150.000[13] per party). Minimum 60% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties. Third party support is expected to cover the development of end user solutions for use at the pilot installation as well as the development of related service-side support that would enable the deployment of the end user application.[14]

The Commission considers that Pilot installation proposals requesting a contribution from the EU of between EUR 7 and 10 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one proposal will be supported within actions on pilot installations for robot testing.

<u>*Expected Impact*</u>*: The expected impacts for the RIA in system abilities are:*

- *Verifiable increase in the level of system abilities of value in the targeted application domains, in particular improving the innovativeness, robustness and longevity of operations of robots deployed in challenging environments*

The expected impacts for the RIA on multiple-actor systems are:

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[13] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded, and if this is the case proposals should explain why this is necessary to achieve the objectives of the action.

[14] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

- *Contribution to the development of innovative multiple-actor systems which achieve measurable service level gains in new application areas*

- *Measurable improvements in the provision of autonomy over an extended time scale from the current state of the art in the chosen application*

- *Advances in the development and understanding of new metrics characterising the operation of multiple-actor systems.*

The expected impacts of system development tools actions are:

- *Enhanced productivity of RAS through high quality tools*

- *Wide acceptance of new, efficient and flexible system development tools across the development community and in the marketplace.*

The expected impacts of pilot installation actions are:

- *Improved understanding of current technology capability limits in real world situations, to promote higher take-up of new robotics systems and to achieve faster time-to-market for new applications.*

- *Characterisations of the performance of robotics systems in the given installation.*

Type of Action: Research and Innovation action, Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-27-2017: System abilities, SME & benchmarking actions, safety certification

Specific Challenge: Technology capabilities alone are not sufficient to enable future markets development. Robotic technology and systems must be designed, integrated and deployed along functional lines and match much more closely to SME and to general market needs.

Research into promising system abilities such as configurability, adaptability, motion, manipulation, decisional autonomy, dependability, interaction, perception and cognitive ability will play a key role here, as mentioned above.

A key challenge is to revitalise Europe's robot-making capacity.Whilst SMEs are generally regarded as the backbone of EU industry, they are under-contributing to the robotics industry. There is a requirement to stimulate SMEs in the robotics sector to develop novel and innovative technology that has the potential to open new markets.

Underlying these requirements, is a market-driven need for benchmarks as clear markers of progress for any developer, whether SME or large industry. Benchmarking processes that provide consistency and value to the process of technology validation are lacking currently. Developing benchmarks that can be applied across multiple domains or areas of application allowing technical comparison is a priority.

A further underlying need for the robotics community at large is to ensure the safety and security of their developments. Viable safety certification standards and processes (including testing protocols) are critical to the widespread deployment of robotic systems, but are not yet generally available. Such certification processes should cut across different domains and areas of application and need to be developed on a pan-European basis, but with global impact.

Also the take up of robotics systems by public authorities is a challenge, as there are few if any generalised schemes for public procurement. Smart cities will provide a range of different applications where robotics technology may be able to provide opportunities for enhancing the utilisation of existing general infrastructure, ensuring higher levels of service delivery and addressing demographic change.

*Scope: **a. Research and Innovation Actions on system abilities.***

RIAs will focus on advancing the state of the art in the level of smart robotics system abilities. The focus is on the technical challenges; research actions will address cross cutting technology issues that will make a significant contribution to the needs of applications and domains with the highest impact on markets. Proposals are expected to address at least one or a combination of the following prioritised abilities: perception ability which is immune to natural variation (e.g. changing weather conditions); decisional autonomy; increasing dependability levels to the level of graceful degradation; systems that are able to self-verify correct behaviour in safety critical tasks.

The Commission considers that System ability proposals requesting a contribution from the EU of between EUR 2 and 4 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one proposal will be supported for this action.

***b. Research and Innovation Actions** for SME-based research and for benchmarks:*

Proposals should cover one of the following bullet points:

- *This activity will stimulate SMEs in the robotics sector to develop novel and challenging technology and systems applicable to new markets. Proposals should provide SMEs with access to technical and non-technical support services and technology that are relevant to the new market being addressed. Such services should provide SMEs, who are not necessarily in the original consortium, with facilities to carry out their research more efficiently and may include access to specialised development facilities or technology. Proposals should also identify how they will enable SMEs to access stakeholders in new markets. Proposals addressing extended clinical validation for healthcare are specifically excluded.*

The action may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the selection process of additional users and suppliers for which financial support will be granted (typically in the order of EUR

50.000 – 200.000[15] per party). Minimum 50% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties.[16]

- *Development and implementation of robotics application-relevant benchmarks and metrics to assess progress in technologies and systems. These actions should provide qualitative and quantitative information to support the assessment and development of systems addressing step changes and ability levels; they should also help define benchmarks and metrics which are useful to an end user.*

The action may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the selection process of additional users and suppliers for which financial support will be granted (typically in the order of EUR 50.000 – 100.000[17] per party). Minimum 60% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties.

The Commission considers that proposals requesting a contribution from the EU of between EUR 5 and 8 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one action will be supported for each of these two bullets (SME-based research and benchmarking).

*c. **Innovation Actions** on shared facilities for safety certification:*

Development of testing protocols for shared space cooperative and collaborative systems leading to viable safety certification standards. Proposals must cover a range of domains and applications where safety certification is a market barrier. Potential examples include healthcare and elderly or handicapped care applications, infrastructure maintenance, transport and logistics. The development of common approaches and tools is strongly encouraged.

Proposals are expected to not only devise protocols but to carry out realistic trials to validate them. Proposals are also expected to show how the protocols they devise can match the requirements of relevant standards and regulations or inform the creation of new standards and regulations.

The action may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the selection process of additional users and suppliers for which financial support will be granted (typically in the order of EUR

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[15] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded, and if this is the case proposals should explain why this is necessary to achieve the objectives of the action.

[16] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

[17] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded, and if this is the case proposals should explain why this is necessary to achieve the objectives of the action.

50.000 – 100.000[18] per party). Minimum 50% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties.[19]

The Commission considers that Safety certification related proposals requesting a contribution from the EU of between EUR 6 and 11 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

d. Pre-commercial Procurement Actions:

Demand-driven PCP actions will be pursued in the area of smart cities. Actions will aim at but not be limited to one or several of the following topics: waste management, transport (with focus on smart mobility), the provision of city-wide utilities and services, the provision of healthcare, social care and education (including social innovation). Actions will be expected to show how the PCP instrument and procurers will be mobilised to develop new robotics related solutions in a smart cities context.

The Commission considers that PCP proposals requesting a contribution from the EU of between EUR 5 and 7 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The expected impacts for the RIA in system abilities are:

- *Verifiable increase in the level of system abilities of value in the targeted application domains, in particular improving the innovativeness, robustness and longevity of operations of robots deployed in challenging environments*

- *Significant improvements in the technologies or their combination, underlying the chosen system abilities.*

The expected impacts for the RIA on SMEs & benchmarks are:

- *Contribute to overall growth of SMEs targeting new robotics markets*

- *SMEs conducting and utilising research to access new markets*

- *More efficient development of the robotics sector and wide acceptance in both academia and industry of new benchmarking tools*

- *Improved systems characterisation and improved means of robotics system performance evaluation.*

The expected impacts for the Innovation Actions on safety certification are:

- *Broad acceptance of testing protocols and validation processes for a wide range of shared space applications*

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[18] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded, and if this is the case proposals should explain why this is necessary to achieve the objectives of the action.

[19] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

- *New validation processes on which deployment regulations and standards can be based.*

The expected impacts for the PCP are:

- *Proof-of-concept and validation of robotics technology in the smart city context, to encourage procurement by smart city stakeholders of robotics technology for the benefit of citizens in everyday civic applications.*

- *New market opportunities for robotics technology suppliers to the smart city sector.*

- *Inroads into the defragmentation of the market and potential elaboration of standards for public procurement in this domain.*

Type of Action: Pre-Commercial Procurement, Research and Innovation action, Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-28-2017: Robotics Competition, coordination and support

Specific Challenge: The global robotics market will change shape significantly in the next few years. As the deployment of robotics technology increases, it is necessary to ensure that robotics actions are flanked by specific measures to optimise market take-up of European research whilst the window is still open.

There are several challenges including the lack of sustained exchanges about robotics between members of the widespread European stakeholders' community and of coordinated European effort towards global standardisation and regulation. There is also a lack of systematic foresight of developing trends and issues to inform strategy-makers and the robotics community e.g. as relating to a pro-active approach of ethical, legal and socio-economic (ELSE) issues. Understanding and responding to developments in these areas will require engagement with non-robotics experts able to analyse impact within their area of expertise. Robotics-specific strategy can then be developed from this analysis and used to shape the processes of design, development and deployment of market services and applications.

It is also important to disseminate information not only to the robotics community but also externally to those users and organisations impacted by robotics technology. Furthermore it is important to identify and assess socio-economic weaknesses and threats in the European robotics landscape. These will change over time and long term monitoring actions will be critical to the development of a responsive strategy.

Potential issues range from the development of supportive and effective regulatory environments to assessing the public perception of robotics and its socio-economic impact, as well as the underlying imaginaries (e.g. pre-conceptions helping to envisage the future) of robotics developers. Broader technology impact issues such as data privacy, legal rights, liability, responsible innovation and ethical issues concerning vulnerable sections of society will also need to be addressed.

An intense user-engagement in the developments of robots designed to perform social tasks, and a wide public debate around the issues and concerns that these developments may raise are key conditions to ensure a societal and socio-economic uptake of robotic technology in an informed way and to enhance market and community development.

Competitions on smart robotics can also play an important role in increasing the levels of public understanding, as well as helping to accelerate progress in a stimulating way.

*<u>Scope</u>: **Coordination and Support Actions** focusing on one or more of the following topic areas and taking into account ongoing actions:*

a. Non-technical barriers to robotics take-up:

Promotion of entrepreneurship skills specific to robotics and the provision of non-technical early stage support for SMEs and spinouts. Analysis of funding mechanisms, including follow-on funding support for take-up of research results and the effectiveness of public funding;

Addressing non-technical market barriers in a pro-active way such as ethical, legal and socio-economic issues affecting take-up, including the impact of robotics on the labour market, ethical concerns about safety, informed consent, clear legal responsibility and insurance structures. The engagement and coordination with non-robotics experts, for example in law, social sciences and economics, will be sought;

The effective promotion of responsible research and innovation (RRI) in robotics and the assessment of societal readiness for robotics products;

Given the fast-moving evolution of RAS research and innovation, develop dynamic strategies to anticipate new skills requirements, reduce skills shortage and provide responses to economic change through training, skills development, and education from pre-school to university level.

b. Standards and Regulation:

Coordination of standards harmonisation and regulation across Europe in all domains to enable the development of supply chains and certification processes;

Dialogue with regulatory bodies and policy makers to support the market entry of robotics and raise awareness of the impact of robotics.

c. Community support and outreach:

New mechanisms to improve information exchange across the diverse sections of the European robotics community (including networking between EC projects), to provide open access resources, for example brokerage for design information, communicating the outcomes of EC-funded research projects and to improve the public level of understanding and societal uptake of robotics through two-way public engagement activities.

d. Competitions:

Organisation of robotic competitions to speed up the advance towards smarter robots, demonstrating progress in the field and raising the awareness of the general public towards intelligent robots.

The Commission considers that Coordination and Support Actions proposals covering all or an appropriate mix of topic areas (a), (b) or (c) above are expected to require up to EUR 3 million; nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Minimum one proposal will be selected. Competition proposals addressing topic area (d) are expected to require up to EUR 2 million each; nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Minimum one proposal will be selected.

Expected Impact:

- *Strengthen collaboration between diverse robotics communities;*

- *Gain a higher level of European involvement in global robotics regulatory policy and standard-making;*

- *Lower non-technical market barriers to robotics market readiness and take-up; increase the uptake by entrepreneurs and end users through e.g. skills acquisition and training;*

- *Clearer understanding by the community and non-technical experts of the impact of robotics technology through two-way engagement, which helps to better inform related strategy and policy decision-making;*

- *Significant and measurable evolution in the public awareness and understanding of robots, especially amongst broad demographic groups, as shown by surveys, greater media coverage and increased take up of robotic products in domestic applications;*

- *Increase public and private investment interest in robotics technology for all stages of company formation and growth, from start-up to mature company, as measured by levels of grant and investment activity by national, regional or private-sector bodies.*

Type of Action: Coordination and support action

11. Robotics across the various H2020 Workprogrammes

Robotics and autonomous systems or closely related topics appear to a greater or lesser extent in several different H2020 Workprogrammes 2016-2017, which are all listed on the H2020 Web site.

Workprogramme and topic (not exhaustive)
LEIT- ICT (Information and Communication Technologies)
• ICT-25-2016 & 2017 Advanced robot capabilities research and take-up
• ICT-26-2016 System abilities, development and pilot installations
• ICT-27-2017 System abilities, SME & benchmarking actions, safety certification
• ICT-28-2017 Robotics competition, coordination and support
• ICT-35-2016 Enabling responsible ICT-related research and innovation
• EUB-02-2017: EU-Brazil Joint Call. IoT Pilots on smart manufacturing: customisation, focussing on robotics.
LEIT-NMBP (Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing)
• NMBP-09-2016: Biomaterials for diagnosis and treatment of demyelination disorders of the Central Nervous System, including robotics if necessary.
• NMBP-13-2017: Cross-cutting KETs for diagnostics at the point-of-care. Novel technological Micro-Nano–Bio integrated Systems (MNBS) platforms.
LEIT-SPACE
• COMPET-4-2016: SRC - Space Robotics Technologies.
SC 1 Health, demographic change and wellbeing
• PM-14–2016: EU-Japan cooperation on Novel ICT Robotics based solutions for active and healthy ageing at home or in care facilities.
SC 2 Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy
• SFS-05-2017: Robotics Advances for Precision Farming
SC 4 Transport

• Call - 2016-2017 Automated Road Transport, including e.g.
   o ART-02-2016: Automation pilots for passenger cars
   o ART-03-2017: Multi-Brand platooning in real traffic conditions,
   o ART-07-2017: Full-scale demonstration urban road transport automation etc.

SC7 - Secure societies
• SEC-20-BES-2016: Border Security: autonomous systems and control systems.
Science with and for Society
• SwafS-18-2016: The Ethics of technologies with high socio-economic impact
Cross-cutting activities -

• Factories of the Future
   o FOF-02-2016: Machinery & robot systems in dynamic shop floor environments
   o FOF-12-2017: ICT Innovation for Manufacturing SMEs (I4MS) - Robotics: New robot systems that are cost effective at lower lot sizes

• Internet of Things Focus Area – IoT-01-2016: Large Scale Pilots: incl:
   o Smart Farming and Food Security;
   o Wearables for smart ecosystems;
   o Autonomous vehicles in a connected environment.