Deliverable D2.4: **Robot Companions: Ethical, Legal and Social Issues**

FET Flagship Preparatory Action **CA-RoboCom**

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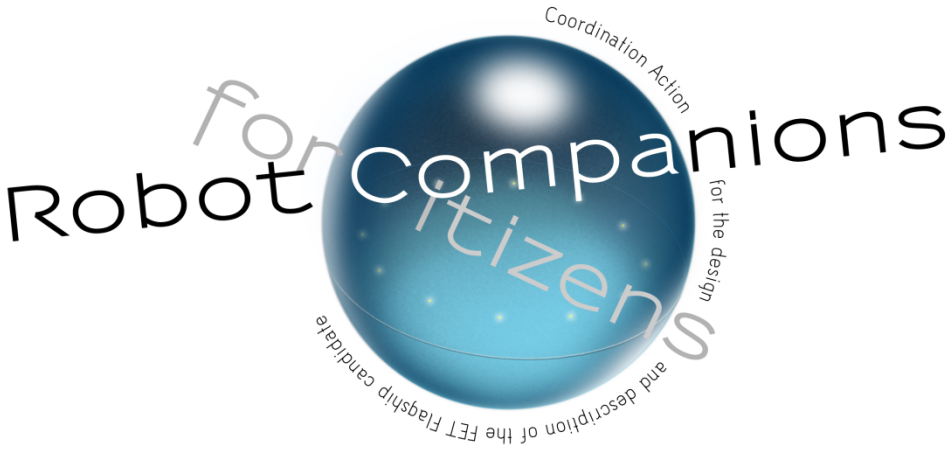

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ROBOT COMPANIONS: ETHICAL, LEGAL AND SOCIAL ISSUES

The FET Flagship Candidate "Robot Companions for Citizens" (RCC) proposes a transformative initiative, addressing a cross-domain grand scientific and technological challenge, to develop a new class of machines and embodied information technologies, called the **Robot Companions for Citizens** (RCCs) that will assist European society to achieve sustainable welfare. The vision, goals, and programme of FET-F RCC are summarised in the *RCC Manifesto*[1]. In this report we address the broader societal issues raised by the flagship project, and outline the ethically-grounded and strategically innovative approach through which we will address them. We also explain how RCC will take a proactive approach in driving the evolution of European and International law towards the safe and responsible introduction of RCCs in society.

Section 1 POTENTIAL SOCIETAL IMPACTS OF RCC

The potential impacts of the RCC Flagship are extremely broad. We envisage impacts in many spheres of human existence—private, social, economic, urban and physical. In the commercial sphere, the economies of Europe are under threat due to the high cost of manufacturing. Across the world, industrialised countries are investing in new generation robot technologies to make factories more efficient. Europe needs to be proactive in science and technology development in order to maintain a position as a field leader. The potential impacts of the Flagship programme in these areas is considered in the RCC *Competitiveness White Paper*[2]. At the physical level we are faced with the challenges of man-made and natural disasters, over-exploitation of natural resources, pollution and environmental degradation. The emerging market of field robotics—robot platforms that can operate in natural or unstructured environments, or that can fly, dive, or climb—will need to be developed to assist with these challenges. New RCC technologies will have transformative impacts in a range of settings that are currently inaccessible to robots. We expect increased efficiency of our agriculture, improvements in resource harvesting and conservation of the natural world, and changes to our emergency services that will make them safer, faster, and more effective.

RCCs will also have major impacts in the personal and social spheres. A critical welfare issue that has motivated the development of the FET-F RCC project is the dramatic demographic shift that will happen in the next fifty years in the age of the European population. By 2060, 30 per cent of the population of Europe will be 65 years of age or over, compared to 17 per cent in 2010[3]. Moreover, the ratio of senior citizens (65 or over) to working citizens (20 to 64)—the "old age dependency ratio"—is expected to change from 28 per cent in 2010 to 58 per cent in 2060. Taking into account dependents under the age of 19, by 2060 there is expected to almost one dependent person (aged under 19 or 65 or over) to every one in work. This is an unprecedented event—never before in human history have older citizens made up such a large proportion of the European populace. Along with a society with a greater number of older citizens we can also anticipate a society with a greater number of disabled citizens since the prevalence of disability increases with age. More specifically, whilst it is estimated that, worldwide, around 15 per cent of adults have some form of a disability, this rises to 46 per cent in those aged 60 and above[4]. We can thus say, with certainty, that this demographic shift will have enormous economic impacts (e.g., health, pensions, long-term care) as well as placing unprecedented demands on younger citizens for the care of their elders. On a more positive side, it is also important to recognise the aspirations and expectations of older citizens to lead active, fulfilling and independent lives and to continue to make a useful contribution to the wider society for as long as possible. Indeed, given good health and welfare, there is evidence that people are happier during this later phase of their life than at earlier stages of adulthood[5].

Whilst a coherent strategy for coping with the demographic shift will require much more than the development of enabling technologies, we see significant potential for using RCCs to address the welfare needs of the ageing society[6]. Indeed, in introducing RCCs that can assist the welfare of older or disabled citizens we also expect to create technologies that are useful to all citizens. Rather than create a targeted technology, we therefore propose new forms of universal and adaptive robot technology that will be useful in the daily lives of all European citizens.

The introduction of RCCs will not solve all societal problems raised by the demographic shift, which must also be addressed through wider political and social actions. However, RCCs *can* address the shortage of skilled labour in the caring professions, assist carers to be more efficient, and allow them to focus more on the human-to-human aspects of their work. We are currently reaching a limit in the introduction of non-robotic ICT technologies in the home. No computer, however smart, can intervene to physically assist with the many daily tasks that must be performed to maintain human health and dignity. At the moment, older and disabled people rely on family, or on carers who are paid privately or by the state, to support them in these aspects of their daily lives. Wages for carers are low, and there are widespread concerns about poor standards of care impacting on the human rights of older citizens[7]. These problems will be exacerbated by the shifting ratio of older to younger people. The recruitment of foreign labour into the European caring professions does not solve this problem since evidence suggests that such immigrants will stay in Europe in old age contributing to the user need. Where such immigrant carers are part of the black economy, there is also evidence of some abuse of workers' human rights[8]. Improved medicine, by itself, is also not a solution to the problems created by the demographic shift. Indeed, medicine, by prolonging life, risks making the problem more acute, where the lives of people are prolonged but their independence remains compromised. We consider that the need to physically act in support of people's welfare, coupled with limited resource of European care systems, implies the need for more intelligent automation of care and assistance in the home. To address this need is one of the primary goals of RCC.

Section 2 PERCEPTIONS AND EXPECTATIONS ABOUT FUTURE ROBOTS—MOVING FROM FEAR OF THE UNKNOWN TO A NEW GENERATION OF FRIENDLY ASSISTIVE ROBOTS

Important new technologies are socially disruptive and always raise significant concerns as to whether or not their impacts will be entirely beneficial. The general answer—that technology itself is neutral, and it is the use of technology by humans that can be for good or bad—is technically correct but not especially helpful. In developing any new technology, the responsible approach must be to consider how it will be used from the outset, striving to create safeguards against improper or damaging uses and directing development efforts to those aspects of the technology that promise the most helpful impacts.

In the 19th century the poet William Wordsworth and the art critic John Ruskin both wrote passionately against the introduction of the steam train in rural England[9]. They feared the destruction of the beauty of the countryside and the ending of a way of life that had persisted for centuries. Ruskin and Wordsworth were right that the train, an important symbol of the ongoing industrial revolution, represented a significant and irreversible break with the past. What they did not foresee, however, was that in the coming century the train would come to be recognised as one of the most effective mass transit technologies—in particular, one of the least polluting and most energy-efficient—and that the steam train itself would eventually be seen as a benign and romantic image of the lost rural idyll.

But we should not dismiss the concerns of latter-day Ruskins and Wordsworths lightly. The visions of artists and poets can give clues as to the likely impacts of our work as scientists and technologists. Since the invention of computers in the 1940s, many writers and

film-makers have imagined the possible impacts of robots on society. In films, these have ranged from the dystopias of the *Terminator (1984)*, *The Matrix (1999)*, or *I Robot (2004)*, where humans create a technology that eventually seeks to replace them, to the positive visions of robots as companions to humans in *Silent Running (1972), Star Wars (1977), Short Circuit (1988),* and *Wall-E (2008)*. In these latter examples, various forms of service and field robots fulfil complementary (to human) roles and work with people to help them achieve their goals.

Thus, art looks at both sides of the coin, imagining both the worst and best for the role of robots in future human societies. Whilst these efforts might give some clues as to our actual future, it is worth noting that fear of technology is also confounded, in many of the more dystopian visions, with fear of ourselves. Indeed, in the 20th century the robot joined the bogeyman, the werewolf, and the extra-terrestrial as images of the unknown, and as exemplifying aspects of human nature that provoke strong fears. In particular, the robot is sometimes used to portray a form of emotionless and non-empathic rationality that has no regard for human values or human life (e.g. *Terminator*), and is therefore wilfully damaging and murderous. In our own future, however, there is no reason why we, as robot developers, should create robots that deploy intelligence in a way that is insensitive to human needs. In other scenarios (such as *Short Circuit* and *Wall-E*), the writers imagine embedding positive human traits in future robots—diligence, hard work, concern for the environment, empathy, and appreciation of others. To devise and build such robots that will work with us, that will understand our needs and intentions, and that will act directly to promote our well-being is the central goal of RCC.

As noted above, the possibility of future AI (Artificial Intelligence) replacing humanity, is a significant theme in current culture, but the scenarios under which this might take place are, in fact, very implausible[10], and we can take straightforward precautions to assure against such outcomes[11]. Other concerns, raised by the possibility of RCCs include the worry that robots will lead people to be more isolated from each other, that robots will replace people in their jobs (leading to loss of income and perhaps a less meaningful existence), that robots will be used by criminals, that robot carers will ultimately lead to a loss of our humanity (the human capacity to care) (see [12] [13] [14] and further below). These are all genuine concerns that we should consider carefully. It is worth noting, however, that many of these worries apply to technology more generally, and that the outcomes are always more complex than first imagined. For instance, the impact of computing itself has been to both create and eliminate jobs (the net effect probably being a net increase in employment), to increase human isolation in some respects (e.g. through home working), but decreasing it in others (e.g. through social networking). Fear of industrial automation has been highlighted as one of the drivers of concern about advanced robots in popular culture[15], however, a recent report by the *International Federation for Robotics* which examined the use of industrial robots in relation to employment in manufacturing in six countries, found no effect of robotics on overall employment (which increased over the period studied) and that robotics itself led, directly or indirectly, to the creation of up to 10 million new jobs[16]. Industrial robots create jobs by allowing precise or consistent performance in a manner that would not be achievable otherwise, by improving working conditions, by making a sector competitive (in world terms) that would otherwise be uncompetitive, and by creating downstream jobs through new products and services. It seems likely similar positive consequences for job creation could flow from the development of RCCs.

Whilst the outlook is positive, there is certainly work to be done, and no room for complacency, in investigating and addressing possible causes of concern about the negative impact of future robots. Studies of various kinds will be required to address these issues (see Section 3) and scientists and technologists will require humility and empathy to understand the concerns of lay people. However, as with any new technology, fears of unintended repercussions have to be balanced against possible positive benefits that, for RCCs, include advances in many areas of human welfare (see above and the *RCC Manifesto*[1]). We contend, therefore, that the development of robot technology in the 21st century should be pursued, but

within an ethical framework that strives to obtain and maintain the broad consent of society, and that includes proactive efforts to recognise and avoid negative outcomes. This approach also envisages a key role for the humanities and the social sciences in helping to identify and evaluate candidate scenarios concerning the future roles of robots, assessing risk, and directing our research efforts in the most promising and beneficial directions.

Understanding how people perceive robots is a fundamental step in assessing how accepting people are likely to be of allowing RCCs into their homes, their lives and their society. Through social science research aimed at understanding what people think and feel about future RCCs, and which particular perceptions influence acceptance of RCCs, the flagship will seek to create RCCs that meet people's *wants* as well as their needs. Furthermore, use of psychological interventions and theoretically informed communication strategies to target key perceptions can promote a balanced appraisal of the costs and benefits of RCCs in prospective users. We have already evaluated the existing literature on attitudes to robots[17] and have conducted some surveys of implicit and explicit attitudes of our own. A key conclusion of this research is that *people can distinguish technological fact from science fiction* and that the dramatic and extreme possibilities highlighted in some cultural representations of robots do not reflect the typical concerns of most people. Although attitudes vary, most people are open-minded and interested in future robot technologies, and the possibility that these might play a more significant role in our lives.

Section 3 THE RCC ETHICS APPROACH—A RESPONSIBLE AND FAR-REACHING INVESTIGATION OF RESEARCH IMPACTS AND A RECEPTIVE DIALOGUE WITH EUROPEAN SOCIETY

In RCC we consider ethical issues along two dimensions as illustrated in Figure 1 (adapted from [18]). The **societal impact** dimension (vertical) is concerned with the effects of RCCs on people and on European society, projected here along the dimension of time from the short-term to the very long-term. In the first 1-10 years we expect significant social and commercial impact of RCCs, in the longer-term—10 years and longer—we expect to see transformational impacts of RCCs on human-machine and human-human relationships. The FET-F ethics programme for RCC will involve studies of *user needs and perceptions*, *robot ethics* approaches, and *science and technology studies* of impacts to ensure that RCCs are developed to promote the positive benefits of RCC technology and to minimise potential negative impacts.

Equally important is the dimension of **research practice** (horizontal axis in Figure 1) and of ethical governance of the FET-F project. Here we consider the relationship of the RCC Consortium to the European public, during the course of the FET-F, and in relation to the manner in which we conduct our research. We plan to be an exemplar large-scale publicly-funded R&D project by demonstrating that research can be pursued in the context of a meaningful dialogue with the wider community[19], in which we continually present and revise the goals, achievements, and methods of RCC through a programme of *open science* and *public engagement* activities. By open science, we mean that we make it possible and straightforward for the public to observe and critique our scientific and technological activities[20], and we establish project management structures that collate and address their advice and criticisms, implementing corrective actions to our objectives and procedures where needed. All researchers in RCC will be trained in open science practices in order to implement this policy. In addition to practising research in the open, we will also proactively initiate and sustain a direct dialogue with society through an extensive programme of *public engagement* activity. We will, of course, address the groups who may be most directly impacted by RCCs—the prospective users, but we will also address non-users who may be impacted by the development of this technology.

A further goal is also to provide the best possible and accurate feedback and advice to stakeholders and policy makers, to ensure that our flagship is well aligned with the broader of objectives of the European Union. To achieve these goals, at all levels of the consortium, including, and especially, the most senior, we will commit to engaging directly with this wider community and we will provide training in the appropriate communication skills to all of our advocates. A primary aim will be to foster a broad understanding of our research agenda, but, as importantly, we will also listen and respond to, the views of European citizens and of the organisations who represent them.

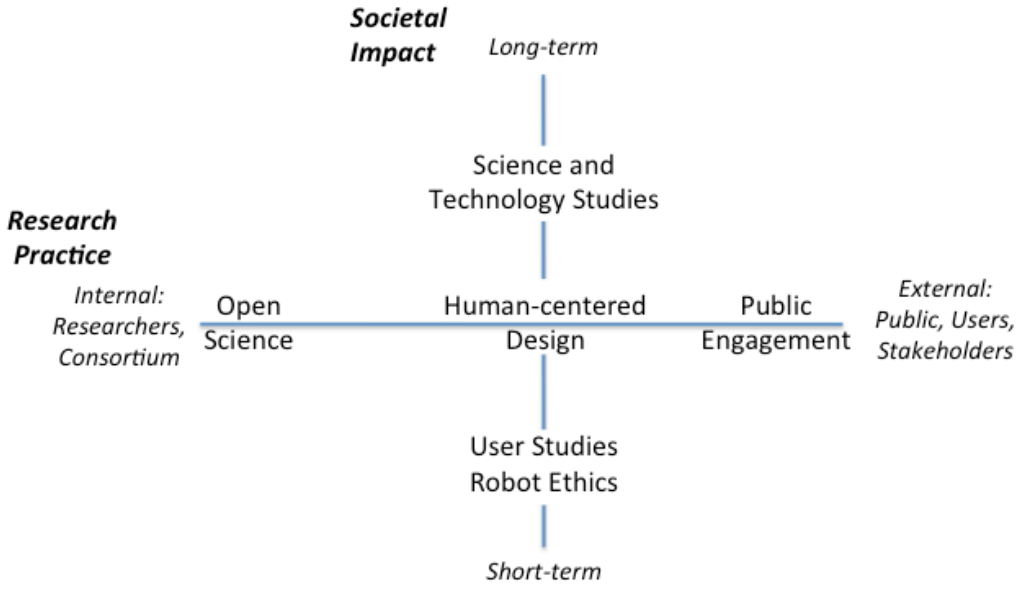

Figure 1. The RCC Ethics Strategy considers societal and ethical issues in the FET-F along two dimensions—investigating societal impacts (vertical) and pursuing research practices that foster a meaningful exchange with the wider European society (horizontal).

The two dimensions of the ethics programme of RCC intersect at the point where consideration of societal impacts, meets with the S&T (Science and Technology) research efforts directed at building candidate RCC platforms that can be deployed in societal settings. We recognise that the development of useful new technologies occurs where bright ideas and scientific insights—*technology push*—intersect with a good understanding of user needs and perceptions, and of the broader social context—*societal pull*. The integration and synthesis of these two forces for change will be achieved through an iterative *human-centred design*[21] approach that will place concern for people at the heart of our technology development process.

The human-centred design process will include all potential user groups as different user groups will have different needs (Figure 2). For instance, RCCs aimed at safety services, will prioritise reliability and ease of use under challenging or stressful conditions, those aimed at older people should support the process of healthy ageing whilst maintaining perceptions of control and empowerment. The approach of designing robots to fit particular roles in human "ecologies" demands new tools, methods and techniques that incorporate and move beyond current conceptions of human-centred design[22]. For instance, understanding the delicate ecology of home life requires design ethnography, home observations, understanding the sense of place and togetherness, and subtle probes to get designers to appreciate the needs and opportunities for robot companions and their owners.

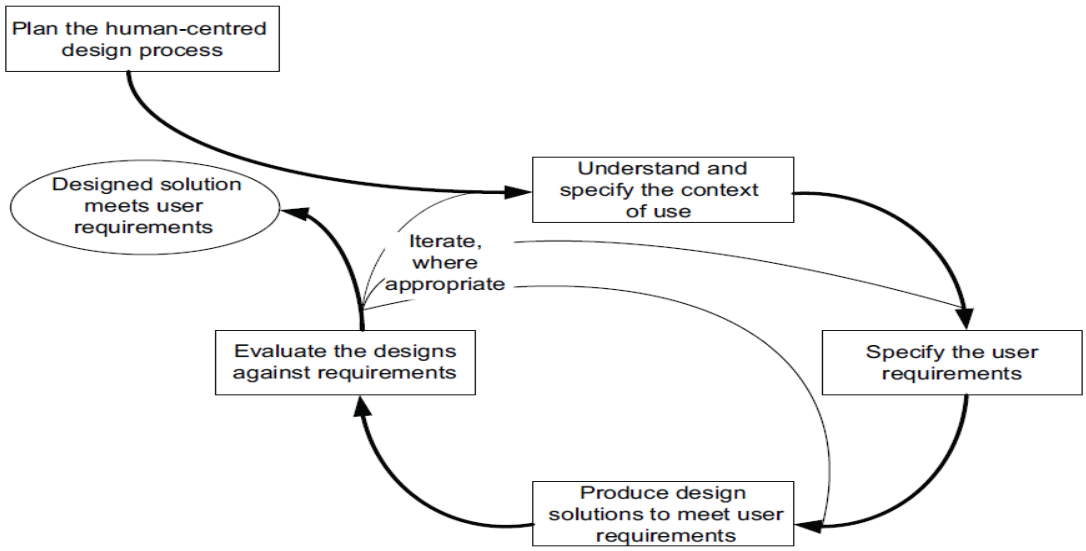

Figure 2. The human-centred design cycle.

Section 4 TAKING A PROACTIVE STANCE ON LEGAL ISSUES

Significant legal issues need to be addressed if RCCs are to be deployed in European society in both its public and the private spheres. These issues include the legal status and capacity of the RC, liability in case of damage or injury, data privacy, standardization and issues regarding intellectual property ownership of RC-generated works.

The RCC Flagship's approach will be proactive, ensuring these issues are carefully examined in advance of steps towards commercial RCC platforms. Members of the consortium are already active in these areas, such as the preparation of a Green Paper on Robotics in Europe[23] and a White Paper on Regulating Robotics.[24]

When RCCs become active in our personal and social spheres, their actions will have legal impact. For an RCC to fulfil its function as a companion it may need to enter into valid legal transactions, such as purchase agreements. Therefore it is to be expected that the RCC will require some legal capacity. On the other hand, if in the course of their activities they cause material or personal damages, the question of liability includes a large range of potential candidates from computer programmers and manufacturers, involved in the production of RCCs, to the users of the RCC themselves. Because the possibility of liability for damages might inhibit the development and discourage the later use of Robot Companions, (compulsory) insurance systems may have to be introduced, thus creating certainty of damage compensation.

At the same time, RCCs with some self-awareness cannot be treated simply as things. Sentience, autonomy and the potential ability to experience frustration, or even suffering, raise issues of legal categorization. The question is whether, and if yes, how degrees of sentience, autonomy and a capacity to "feel" could be assessed as a basis for assigning legal standing to RCCs.

RCCs will also collect personal data about the citizens they serve as companions, which may be processed and stored locally or online, and shared with, or be monitored/observed by third parties. Therefore the privacy-related issues that could arise when RCCs are deployed in society must be investigated, as well as how the processing, storage and protection of private data should be governed.

Another issue that will have to be addressed is the RCC and its potential capacity to create and invent robot-generated works or patentable inventions. This raises fundamental

questions with regard to the objects of intellectual property rights, and to the ownership of these rights.

However, whilst RCCs are unique in some respects it is also important to recognize that many of the potential legal issues surrounding robots are already addressed in existing legislation. For instance, regulations surrounding corporate entities, IT systems, motor vehicles, or even domestic animals could be relevant to the evaluation of the legal status of RCCs. Therefore the RCC Flagship will identify to what extent RCCs will fit into existing legislative frameworks or other regulatory (for instance soft-law) regimes, and where such frameworks will require expansion to take account of RCCs. In doing this, the RCC Flagship will seek to develop appropriate legal instruments to both protect consumer interests (privacy, safety regulations) and contribute to the innovation and acceptance of RCC technology in society, by finding a balance between protection, security and innovation.

Section 5 IMPLEMENTATION—THE INTEGRATION OF RCC S&T WITH SOCIETY

To ensure that our ethically-grounded and societally-focused approach is followed consistently in all areas of the Flagship, we will follow a multi-level approach wherein societal aspects are represented in RCC advisory, management, co-ordination, and S&T activities through the following specific structures and mechanisms:

• The *Ethical Governance and Open Science Advisory Board (EGOS-AB)*. This will be an independent body and a sub-group of our wider *Stakeholders Advisory Board.* The EGOS-AB will advise on the evolution of the project workplan from an ethical standpoint and provide independent and external monitoring of consortium management and S&T activities. The board will also provide external evaluation of our "open lab" (see below), public engagement, and ethics and open science training programmes.

• The *Co-ordination Activity on Ethical Governance and Open Science (COORD-EGOS)* will develop the ethical governance framework for the Flagship and have overall responsibility for its implementation, including internal monitoring of Flagship management and S&T activities from this perspective. The co-ordination activity will also be responsible for the implementation and monitoring of the open science strategy including open lab, public engagement and EGOS training activities. To ensure co-ordinated implementation of the strategy across the Flagship the leader of COORD-EGOS will be a member of the RCC Executive Board.

• The *Society Pillar,* RTD-A5, one of the Flagship's five core research pillars, will focus on the societal aspects of robot companions in relation to: (i) the investigation of societal needs and the development of use cases and RCC designs using the human-centred design approach; (ii) assessing and evaluating the societal and economic impacts of RCC deployment and over short- and long time-frames; (iii) the development of RCC educational programmes; and (iv) the dialogue with policy maker, stakeholders and industry.

• The *Human-RCC Co-existence, Ethics, and Law* activity, RTD-15, will combine experimental and cross-cultural sociological, psychological, ethics and law approaches to investigate three key topics: (i) the human context of RCC use in relation to human-robot social interactions and communication, public attitudes and opinions, social norms and conventions; (ii) ethical principles and guidance around scenarios for future deployment of RCCs; (iii) the legal aspects of RCC deployment and their implications for national and international regulatory frameworks.

• *Flagship-wide activities*. In addition to the above, each S&T activity will also have a task related to the implementation of RCC ethical governance and open science strategies, and each institutional partner in the project will have designated personnel who are responsible for ensuring that the strategy is carried out effectively at the local level. To ensure that the key

ideas and practices permeate to every level, all researchers in the Flagship will attend a short but intensive training course on ethical governance and open science. Every S&T partner will organize "open lab" activities where members of the public will be invited to visit and observe work in progress. A number of key centres will also be designated as sites for year-round open science activities (including public engagement and teaching activities).

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