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# Introduction

# Internal and external recommendations

# Modular governance framework

## CCN structure

## Transversal activities [INOV]

### Partnership instrument [CNR]

### Cybersecurity training and awareness [BUT]

### Sustainable exploitation and IPR [SMILE]

### Certification organization and support [CETIC]

### Dissemination and communication [INOV]

## Scientific and technical activities [L3CE]

SPARTA’s scientific and technical activities activities include the road mapping, research, innovation development and piloting activities. In this section we report on the key governance and management takeaways, with regards to the recommendations that were reported in deliverable *D1.2 Lessons learned from internally assessing a CCN pilot*, as well as to other initiatives that contributed to improving the activities and processes in scope.

As governance and management matured from the project bootstrap year (Year1) to the intermediate year (Year2), the focus also turned decisively towards the future CCN setup and operation. In this vein, it is important to emphasize that the purpose of D1.2 was to assess the governance of the pilot, not that of the project.

The D1.2 recommendations that directly concern the scientific and technical activities are presented in the following table.

| **D1.2 reference** | **WP scope**  **(WP3-WP7)** | **Description (taken from D1.2)** |
| --- | --- | --- |
| GC\_G4 | WP4, WP5, WP6, WP7 | **Cooperations:** Consider co-operation with external initiatives and initiation of independent proposals to extend SPARTA's technological scope. E.g.: calls, projects and initiatives for Secure Society, securing Open Source components, Open Hardware, lowering the barriers to formal verification, changing the "geeky" image of verification into the next cool thing (motto: "programming without verification is something for script kiddies"), etc. |
| GC\_G7 | WP4, WP5, WP6, WP7 | **Alternate Models / Contingency Planning:** Consider experiments for emulating the structure and operation of National Competence Centres and clusters, and for developing corresponding interaction models. One or multiple of the WPs for the technical programs might serve as a conduit:   * The scenarios to be modelled can focus on Lithuania (WP4), Italy resp. Germany (WP5), France (WP6) and Spain (WP7).   All work packages, but notably WP5 and WP7, could use some support from ELSA specialists to determine the respective institutional and legal framework. |
| GC\_I1 | WP4, WP5, WP6, WP7 | **Technical Integration:** Clarify the desirable and feasible level of integration between the technical components and results produced by WP4-WP7. Clarify the achievable level of alignment between the four technical programs on the one hand and both WP8 and WP11 on the other. |
| GC\_I2 | WP4, WP5, WP6, WP7 | **ELSA aspects:** The technical work packages WP4 and WP7 actively address areas of potential ethical, social and political concern. They are low hanging fruits for intensifying WP2 (ELSA related activities). Some effort should be invested to determine whether areas of particular ELSA relevance could be located in WP5 and WP6. |
| GC\_I3 | WP4, WP5, WP6, WP7 | **Synergies:** WP5 develops methods for infrastructure and "systems of systems" analysis. Could the results be beneficial for other technical WPs? E.g., are these methods applicable to analyse parts of the technical setup of WP4 or of task 11.4? |
| GC\_I4 | WP4, WP5, WP6, WP7 | **Open Source:** WP5 and WP6 may need support to engage with the Open Source spectrum in an active and sustainable manner.Could the scope of WP11 be extended by an activity targeting relevant Open Source communities? Are there individuals within the consortium or its group of associates who can and are would act as champions? |
| GC\_M1 | WP3 | Four significant governance aspects are not fully covered yet. They all concern horizontal, co-operative and context-dependent activities:  (a) Interaction with external entities and communities for validation and certification;  (b) Potential joint activities with European agencies, external research programs and projects;  (c) Roadmap updates to reflect new threats and cyber defence technologies;  (d) Adjustments and extension of legal analysis to the (yet unknown) actual objectives of an ECCC / ECCN.  It should be considered to track these four issues regularly and to include them in the list of risks to be managed. |

Table 2: Recommendations regarding scientific and technical activities (WP3, WP4, WP5, WP6, WP7).

In the following sub-sections, a report is provided for each of the roadmap and research programmes activities, detailing the pilot governance and execution improvements in Year 2.

### Roadmap instrument [TUM]

<Please read the introduction of Section 3.3 carefully. You are free to follow any suitable approach for this report. The following suggestions are merely indicative –hope they help. Quality is more important than quantity, but regarding the expected page count: half-page to two-pages is OK.>

<Analyse and report on how the recommendations in Table 2 applied to your WP in Year2, w.r.t. improvements of the activities and processes. Other governance and execution improvements in Year2 may also be relevant, if they contribute to increasing the overall governance maturity in SPARTA.>

**Adherence to SPARTA's research governance activities evolution**

<Describe how the bootstrapping activities evolved and matured in Year2>

**Roadmap sustainability**

<Topic to be developed: roadmapping sustainability and monitoring>

**Roadmap focusing mechanisms**

< Topic to be developed: learnings and further ideas how to handle roadmap under the changing external environment and evolving pilot by itself>

< Topic to be developed: ways to think about future categories / domains, how they should emerge and be incorporated>

**Societally enabled roadmapping of technical research**

<Topics to be developed: roadmapping of “soft” developments, i.e. future skills gaps, policy developments, societal developments (regulatory and other)>

**Friendly coopetition**

<Topic to be developed: integrity cross pilots, SPARTA contribution to cross-pilot workstream>

<Finally, please elaborate how learning from your ongoing experience and insights gathered so far, the “right” governance of EU research and innovation development should be governed in the future perspective and what are the key consideration points (takeaways) for EC while planning CCN governance. What and how EC should implement especially in the means of new/improved ways to govern research projects in the scope of future CCN>

### Programmes [L3CE]

#### Program 1: T-SHARK – Full-spectrum cybersecurity awareness [L3CE]

<Please read the introduction of Section 3.3 carefully. You are free to follow any suitable approach for this report. The following suggestions are merely indicative –hope they help. Quality is more important than quantity, but regarding the expected page count: half-page to two-pages is OK.>

<Analyse and report on how the recommendations in Table 1 applied to your WP in Year2, w.r.t. improvements of the activities and processes. Other governance and execution improvements in Year2 may also be relevant, if they contribute to increasing the overall governance maturity in SPARTA.>

**Adherence to SPARTA's research governance activities evolution**

<Describe how the bootstrapping activities evolved and matured in Year2 from your WP perspective. Impacts of piloting new governance ways, i.e. putting the experts in charge of programmes implementation.>

**Interaction with transversal activities**

< Topics to be considered: relationship between technical work and policy related activities in other WPs’ like certification, exploitation>

< Topics to be considered: directing future knowledge structure establishment, scientific potential development priorities in EU, designing future competence gaps – links to roadmappinig>

**Friendly coopetition**

< Topics to be considered: Friendly coopetation cross-pilot, authorities, national stakeholders. Inside coopetition (within programs, other WPS, among consortium partners. External coopetition with outside entities, leading industry markets, worldwide. International relations through science diplomacy.>

<Major leverage ideas to make it working the best for future research projects>

**Research focusing mechanisms**

< Topics to be considered: incl. different research programme management and governance insights (eg T-SHARK is large-scope, focusing more on national-level while SAFAIR is more focused on technology, niche industry specialization for CAPE, etc.)>

**Time horizon**

<Topics to be considered: time horizons of the research, innovation, SOTA, targeted solution and how to manage it. Is it solving existing (or round the corner) problems or future looking? When developed, will it be on time for market.>

**Societal and ethical perspectives**

<Topics to be considered: Key link with ELSA, towards more technical-societal integrated innovation approach, policy enablement, societally and ethically enabled research >

**Enabling partnerships in research governance**

< Topics to be considered: Engagement of wide stakeholder community (Arbitrage Group, CAPE partners structure). How to make scientific work more open. Going towards more proactive science. Increasing engagement <- explain the complementarity with Partnerships. Development of synergy between scientists, industry and end-users. Place of community and place of diversity in better organized research governance. Science with and for society.>

**Governing research outputs**

< Topics to be considered: early outputs for subsequent innovation or market adoption. Diffusion of innovation components in products, services, processes.>

<Finally, please elaborate how learning from your ongoing experience and insights gathered so far, the “right” governance of EU research and innovation development should be governed in the future perspective and what are the key consideration points (takeaways) for EC while planning CCN governance. What and how EC should implement especially in the means of new/improved ways to govern research projects in the scope of future CCN>

#### Program 2: CAPE – Continuous assessment in polymorphous environments [IMT]

<Please read the introduction of Section 3.3 carefully. You are free to follow any suitable approach for this report. The following suggestions are merely indicative –hope they help. Quality is more important than quantity, but regarding the expected page count: half-page to two-pages is OK.>

<Analyse and report on how the recommendations in Table 1 applied to your WP in Year2, w.r.t. improvements of the activities and processes. Other governance and execution improvements in Year2 may also be relevant, if they contribute to increasing the overall governance maturity in SPARTA.>

| **D1.2 reference** | **Description (taken from D1.2)** | **Impact and implementation in CAPE** |
| --- | --- | --- |
| GC\_G4 | **Cooperations:** Consider co-operation with external initiatives and initiation of independent proposals to extend SPARTA's technological scope. E.g.: calls, projects and initiatives for Secure Society, securing Open Source components, Open Hardware, lowering the barriers to formal verification, changing the "geeky" image of verification into the next cool thing (motto: "programming without verification is something for script kiddies"), etc. | CAPE is already significantly involved in open source and cooperation activities.  Internally, CAPE partners are cooperating in two directions, cooperatively developing the use case testbeds, and integrating their tools in a structured toolchain.  Externally, many of the CAPE tools are available in well-known open-source repositories, for example ECLIPSE.  As a whole, this is extending the reach of CAPE well beyond SPARTA. |
| GC\_G7 | **Alternate Models / Contingency Planning:** Consider experiments for emulating the structure and operation of National Competence Centres and clusters, and for developing corresponding interaction models. One or multiple of the WPs for the technical programs might serve as a conduit:   * The scenarios to be modelled can focus on Lithuania (WP4), Italy resp. Germany (WP5), France (WP6) and Spain (WP7).   All work packages, but notably WP5 and WP7, could use some support from ELSA specialists to determine the respective institutional and legal framework. | In CAPE, the operation model focuses on the gathering of partners around two use-cases, that serve to guide partner R&D efforts. As cybersecurity issues do not operate in a vacuum, this ensures that tools are applicable on a concrete use case and provide a strong incentive for researchers to use the data at hand.  In terms of contingency planning, CAPE is operating in a highly distributed manner, each partner carrying out its tool development, offering interfaces and presentations to others, in regular telcos piloted by the WP and task leaders. Thus, in the event of a missed telco or one of the leaders needing to miss some activities, CAPE continues to operate smoothly. This has for example been the case when for professional reasons the CAPE WP leader took a step back during September-november. |
| GC\_I1 | **Technical Integration:** Clarify the desirable and feasible level of integration between the technical components and results produced by WP4-WP7. Clarify the achievable level of alignment between the four technical programs on the one hand and both WP8 and WP11 on the other. | Integration in CAPE occurs in two ways. Common use cases facilitate integration (because tools handle data of the same origin).  WP5 is strongly aligned with WP11, as CAPE output intends to deliver now tools and methods for assessment, that can be integrated in certification processes. |
| GC\_I2 | **ELSA aspects:** The technical work packages WP4 and WP7 actively address areas of potential ethical, social and political concern. They are low hanging fruits for intensifying WP2 (ELSA related activities). Some effort should be invested to determine whether areas of particular ELSA relevance could be located in WP5 and WP6. | The relevant ELSA aspects in CAPE focus on regulation and legal frameworks. Most of our activities are in and around open source and do not manipulate personal data, hence ethical and social aspects are mostly absent from our research.  CAPE intends at providing tools to certification processes, hence supporting regulations. A by-product of this is insurance and liability, being explored by MRU. |
| GC\_I3 | **Synergies:** WP5 develops methods for infrastructure and "systems of systems" analysis. Could the results be beneficial for other technical WPs? E.g., are these methods applicable to analyse parts of the technical setup of WP4 or of task 11.4? | Clearly, several CAPE tools are relevant for the analysis of open source software. So, any WP that relies on open source repositories, libraries and build processes, should be able to leverage CAPE tools (e.g. STEADY, Project-KB, commit classification, to name a few). |
| GC\_I4 | **Open Source:** WP5 and WP6 may need support to engage with the Open Source spectrum in an active and sustainable manner.Could the scope of WP11 be extended by an activity targeting relevant Open Source communities? Are there individuals within the consortium or its group of associates who can and are would act as champions? | CETIC, TEC and LEO are already acting as de-facto champions of CAPE production into WP11, and the certification community as a whole. |

Table 2: Recommendations regarding scientific and technical activities for CAPE (WP5).

**Adherence to SPARTA's research governance activities evolution**

<Describe how the bootstrapping activities evolved and matured in Year2 from your WP perspective. Impacts of piloting new governance ways, i.e. putting the experts in charge of programmes implementation.>

CAPE has matured in a very flexible governance model. Technical activities are carried out in the tasks, where tools are discussed in T5.1, vertical 1 and security-safety in T5.2, vertical 2 and open-source in T5.3, contribution to certification in T5.4 (started only recently). As a result, telcos are organized every two weeks at task level and monthly at wp-level. This provide a very flexible yet redundant governance model, which naturally maximizes interactions within the program.

All task leaders and WP leaders are experts in the field, and easily delegate presentations to program contributors. This lightweight governance also works because of the quality of the contributions from the program participants.

**Interaction with transversal activities**

< Topics to be considered: relationship between technical work and policy related activities in other WPs’ like certification, exploitation>

< Topics to be considered: directing future knowledge structure establishment, scientific potential development priorities in EU, designing future competence gaps – links to roadmappinig>

Policy activities related to certification are naturally handled with CAPE, as partners involved in WP11 are also present and active in CAPE.

**Friendly coopetition**

< Topics to be considered: Friendly coopetation cross-pilot, authorities, national stakeholders. Inside coopetition (within programs, other WPS, among consortium partners. External coopetition with outside entities, leading industry markets, worldwide. International relations through science diplomacy.>

<Major leverage ideas to make it working the best for future research projects>

The CAPE program demonstrates a cooperative mode of management. Several tools have the same (or very close) assessment targets. Rather than implement two times the same tool (with different techniques), we harmonized the specification of the tools so that they had complementary goals. This implemented a cooperating rather than a competing governance model, focusing on leveraging synergies and competencies between researchers to extend the coverage of our research activities. The joint design and sharing of the two verticals is also representative of the governance of CAPE, where people, competencies and platforms are collaboratively shared to elaborate advanced research platforms.

**Research focusing mechanisms**

< Topics to be considered: incl. different research programme management and governance insights (eg T-SHARK is large-scope, focusing more on national-level while SAFAIR is more focused on technology, niche industry specialization for CAPE, etc.)>

CAPE offers a concrete materialization of cybersecurity and safety assessment and validation in two concrete examples. This prepares the upcoming second cycle of design-implement-validate for the tools in CAPE, as well as the work on certification profiles and cybersecurity certification started earlier in CAPE, in association with WP11.

In terms of governance, deliverables D5.2 and D5.3 provide an example of how CAPE partners have successfully been able to collaborate towards an integrated research and validation workflow. This is particularly important as evaluation and validation is the conclusion and an extremely important part of research. It often is extremely expensive for individual researchers. The mutual exchange and joint elaboration of validation tools and processes is thus an important lessons-learned from CAPE.

In a nutshell, the major research-focusing mechanism in CAPE has been the development of use cases accessible to all project participants, with a sufficiently broad scope and sufficiently easy access that anyone could easily participate.

**Time horizon**

<Topics to be considered: time horizons of the research, innovation, SOTA, targeted solution and how to manage it. Is it solving existing (or round the corner) problems or future looking? When developed, will it be on time for market.>

There are two extremely different time horizons in CAPE.

On one hand, what is done related to use case 2 (“Complex System Assessment including large software and open-source environments, targeting e-Government services”) is extremely close to being usable immediately, by anyone, and has already been opened and made available to a wide community. So in a nutshell, part of CAPE production is already on the market, or very close to being released.

On the other hand, what is done in CAPE related to use case 1 (“Connected and Cooperative Car Cybersecurity”) will only bear fruits much later than the end of the program, for multiple reasons. First, the compromise between security and safety is difficult to establish, and we are barely scratching the surface of what that means, and starting to formulate the initial theoretical models. Second, what is studied in CAPE, the platooning scenario, is very limited. We are, for example, not taking into account cars joining and leaving the platoon. Third, there is a significant effort to bring that, even from an experimental perspective, out of the lab and towards first real life experiments. This in fact is quite exemplary of the difficulties of applying cybersecurity in the context of cyber-physical systems.

**Societal and ethical perspectives**

<Topics to be considered: Key link with ELSA, towards more technical-societal integrated innovation approach, policy enablement, societally and ethically enabled research >

CAPE contributes to the general objective of cybersecurity, increase trust in digital services and promote usage and development. The link with ELSA occurs through involvement of partners in certification development activities (experts contribution to ENISA working groups on the topic), and as such is addressing the legal and regulatory framework.

Another ELSA aspect of CAPE is insurance, for both use cases, to enable tracing responsibilities and failures in systems. For the Connected Car use case, CAPE needs to take into account the insurance aspects related to accidents in case of failure, and the ability to understand where in the cyber-physical system the failure occurred (e.g. which car, which subsystem in the car, etc.). For the Complex Software System use case, CAPE needs to take into account management of new risks, i.e. dealing with vulnerabilities that are discovered in parallel to deployed and operational systems (e.g. vulnerability impact, patch strategy, etc.)

**Enabling partnerships in research governance**

< Topics to be considered: Engagement of wide stakeholder community (Arbitrage Group, CAPE partners structure). How to make scientific work more open. Going towards more proactive science. Increasing engagement <- explain the complementarity with Partnerships. Development of synergy between scientists, industry and end-users. Place of community and place of diversity in better organized research governance. Science with and for society.>

CAPE is successfully engaging a wider community, due to the inclusion of some tools in open platforms, and typically the ECLIPSE platform for at least three of our tools at the time of this writing. This availability of tools impacts the wider computer science community.

**Governing research outputs**

< Topics to be considered: early outputs for subsequent innovation or market adoption. Diffusion of innovation components in products, services, processes.>

As mentioned previously, several outputs are already available as open source.

The other outputs should be considered contributions to long term research.

Another, more difficult to elaborate, output is our use case platforms. We will study plans for preservation of these platforms beyond the project.

<Finally, please elaborate how learning from your ongoing experience and insights gathered so far, the “right” governance of EU research and innovation development should be governed in the future perspective and what are the key consideration points (takeaways) for EC while planning CCN governance. What and how EC should implement especially in the means of new/improved ways to govern research projects in the scope of future CCN>

At this time, several key points appear in CAPE:

* Understanding where one’s research (and others) is positioned is important for fruitful dialogue and integration. In CAPE, this takes the form of the extended V-cycle defined in D5.1. This means that researchers understand what the SoA is and what expectations they have in terms of inputs to their research, and what kind of expectations others have on their research outputs.
  + Recommendation for future CCN: define using a common taxonomy the problem addressed by the tool, its requirements, interfaces and outputs.
* Redundancy in interactions is essential. CAPE maintains five interleaved interaction paths (WP and tasks), with regular interactions planned independently of one another. As a result, there are over 15 monthly telcos and meetings in CAPE, enabling strong a,d continuous engagement of participants without imposing undesirable constraints on their schedules. Interactions are recorded with plaintext minutes, to enable easy catch-up. Absence of one of these paths for a few weeks has little impact on the project as a whole.
  + Recommendation for future CCN: encourage shared responsibility for research and redundancy in research paths and activities.
* Focus on use cases helps interactions, common understanding, and problem solving. The needs of a use case, the data formats and interfaces, the vulnerabilities and attacks that can be deployed, create a common understanding and goal. It creates also the additional difficulty that some tools may not fit the use case. In CAPE, this was dealt with by either selecting only one of the two use cases (the major strategy) or seeking the appropriate content in one of the use cases through a small extension (the minor strategy). The combination of both strategies has successfully enabled all contributions to be deployed in CAPE.
  + Recommendation for future CCN: share use case requirements, interfaces, and possibly datasets, to foster an active research ecosystem.

#### Program 3: HAII-T – High-Assurance Intelligent Infrastructure Toolkit [CINI]

<Please read the introduction of Section 3.3 carefully. You are free to follow any suitable approach for this report. The following suggestions are merely indicative –hope they help. Quality is more important than quantity, but regarding the expected page count: half-page to two-pages is OK.>

<Analyse and report on how the recommendations in Table 1 applied to your WP in Year2, w.r.t. improvements of the activities and processes. Other governance and execution improvements in Year2 may also be relevant, if they contribute to increasing the overall governance maturity in SPARTA.>

**Adherence to SPARTA's research governance activities evolution**

<Describe how the bootstrapping activities evolved and matured in Year2 from your WP perspective. Impacts of piloting new governance ways, i.e. putting the experts in charge of programmes implementation.>

**Interaction with transversal activities**

< Topics to be considered: relationship between technical work and policy related activities in other WPs’ like certification, exploitation>

< Topics to be considered: directing future knowledge structure establishment, scientific potential development priorities in EU, designing future competence gaps – links to roadmappinig>

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**Time horizon**

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**Societal and ethical perspectives**

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#### Program 4: SAFAIR – Secure and Reliable AI Systems for Citizen [ITTI]

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<Analyse and report on how the recommendations in Table 1 applied to your WP in Year2, w.r.t. improvements of the activities and processes. Other governance and execution improvements in Year2 may also be relevant, if they contribute to increasing the overall governance maturity in SPARTA.>

**Adherence to SPARTA's research governance activities evolution**

<Describe how the bootstrapping activities evolved and matured in Year2 from your WP perspective. Impacts of piloting new governance ways, i.e. putting the experts in charge of programmes implementation.>

**Interaction with transversal activities**

< Topics to be considered: relationship between technical work and policy related activities in other WPs’ like certification, exploitation>

< Topics to be considered: directing future knowledge structure establishment, scientific potential development priorities in EU, designing future competence gaps – links to roadmappinig>

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# Lessons learnt

# Conclusions and perspectives