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Dynamic countering of cyber-attacks
SU-ICT-2018



Cyber security 4.0: Protecting the Industrial Internet of Things

D7.1: <Project Handbook>[†]

Abstract: This document describes the general management procedures of the C4IIoT project, including quality assurance and risk analysis. It includes information about all work packages, responsibilities and consortium agreement information, risks and contingency plans. It is intended to be a living document that will be updated whenever required to reflect up-to-date information.

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List of Abbreviations

EC	European Commission
WP	Work Package
WPL	Work Package Leader
DoW	Description of Work
TL	Task Leader
EAB	External Advisory Board
GA	General Assembly
PC	Project Coordinator
PTC	Project Technical Committee
QM	Quality Manager
STPM	Scientific and Technical Project Manager
IIoT	Industrial Internet of Things
IoT	Internet of Things
IM	Innovation Manager
IPR	Intellectual Property Rights
LP	Lead Partner of Deliverable

1 Introduction

This handbook was developed by the C4IIoT Project to document the procedures to be adopted for its effective management and needs to be followed in all work packages of the project. The handbook contains the project management structure and procedures, partner contact information, document review and submission procedures, procedures for dispute resolution and reporting procedures. Before we go into the details of the management procedures, we would like to quickly give the reader an overview of what the project topic and goals are. Furthermore, we illustrate the project's objectives, along with its relation to the work programme.

1.1 Project executive summary

Recent trends in industrial technology and the adaptation of Industrial Internet of Things (IIoT), has emerged by the convergence of Operations Technology (i.e., traditional hardware and software systems) and Information Technology (i.e., advanced computing, data aggregation/analysis, and ubiquitous communication systems). IIoT has great potential to enable significant advances in optimizing operations among large number of increasingly autonomous control systems and devices, and can have a profound impact on many industry domains, where smart factories and logistics are among the most notable cases. However, a major barrier towards IIoT adoption lies in cybersecurity issues that makes it extremely difficult to harness its full potential: IIoT systems dramatically increase the attack surface (introducing new security threats due to newly connected devices and protocols, making them more vulnerable to interference), the disruption of process controls, the theft of intellectual property, the loss of corporate data, and the industrial espionage. C4IIoT will build and demonstrate a novel and unified IIoT cybersecurity framework for malicious and anomalous behavior anticipation, detection, mitigation, and end-user informing. The framework provides a holistic and disruptive security-enabling solution for minimizing attack surfaces in IIoT systems, by exploiting i) emerging security software and hardware protection mechanisms; ii) state of the art machine and deep learning and privacy-aware analytics; iii) novel encrypted network flow analysis; iv) secure-by-design IIoT device fabrication; and v) blockchain technologies, to provide a viable scheme for enabling security and accountability, preserving privacy, enabling reliability and ensuring trustworthiness within IIoT applications. The C4IIoT framework will be demonstrated and validated on two carefully selected use cases in real world environments, namely Enabling security IIoT in i) Inbound Logistics and ii) a Smart Factory

1.2 Objectives

Briefly, the objectives of the C4IIoT project are the following:

Objective 1: Develop, validate, demonstrate, and support a holistic and disruptive security-enabling solution for prevention & protection against attacks targeting modern IoT components, complex Industrial IoT infrastructures and emerging technologies.

Objective 2: Explore recent progress and converge very diverse and novel ICT engineering paradigms in cyber assurance and protection, machine (deep) learning, edge/cloud computing,

blockchain and Big Data technologies, to establish an end-to-end (edge-to-cloud) Cybersecurity 4.0 framework to provide breakthroughs in the fight against Industrial IoT cyber-attacks.

Objective 3: Leverage innovative secure execution environments, empowered by novel mechanisms related to security, privacy, accountability and trustworthiness, to offer almost real-time malicious and anomalous behaviour anticipation, detection, tracking, mitigation, and end user informing, within evolving IIoT applications and processes.

Objective 4: Allow a secure exploration of IIoT's full potential in the automotive industry and realize societal and industrial opportunities by validating C4IIOT framework in real-world settings.

Objective 5: Consolidate international and European links, raise awareness, collaborate with standardization bodies and ensure transferability of project's results.

Objective 6: Boost the effectiveness of the European Security Union against cyber-attacks in Industrial IoT infrastructures, by offering almost ready to market solutions (TRL 6) and by ensuring business continuity and long-term sustainability.

1.3 Relation to the work programme

C4IIoT relation to the work programme is described as follows:

- C4IIoT will execute two demonstrators in automotive manufacturing industry (Logistics 4.0 and Smart manufacturing), validating the solution in real-world settings. The selected demonstration area is named by ECSO SRIA as one of the most critical and complex infrastructure to deploy security solutions.
- C4IIoT will offer a viable scheme for enabling security and accountability, preserving privacy, ensuring encrypted traffic analysis, enabling reliability and assuring trustworthiness within evolving IIoT applications and processes. Among others, indicative tools, services and platforms are: (i) anomalous patterns in sensor data or in network traffic flows; (ii) privacy-aware ML/DL modules; (iii) an end-to-end secure execution environment (Andromeda trusted execution environment); (iv) blockchains and smart contracts; (v) access control mechanisms; (vi) an identity management platform.
- C4IIoT will offer an unified cybersecurity 4.0 framework that implements an innovative IoT architecture paradigm to provide an end-to-end holistic and disruptive security-enabling solution for minimizing the attack surfaces in Industrial IoT systems. Most of the proposed tools and technologies are part of this framework (e.g. three levels of security consisted of several tools and platforms, a security assurance and verification platform, IIoT secure-by-device fabrication devices and a mitigation engine).
- C4IIoT bridges cyber assurance and protection, machine (deep) learning, edge/cloud computing, blockchain and Big Data technologies, to offer security and privacy in an end-to-end industrial IoT environment.

- C4IIoT will provide several innovations that are based on Deep Learning technology. Indicative examples are: (i) a behavioural analysis and cognitive security tool (ii) a security-aware dynamic offloading decision mechanism; (iii) partitioned ML/DL models pushed at the field gateway (intermediate complexity anomaly detection) and at the device (lightweight anomaly detection for almost real-time critical security decisions at all levels of IIoT infrastructure).
- C4IIoT will provide a comprehensive solution (significant hidden information will be revealed in a dashboard-style presentation) for security and non-security experts that among others can deal with threat hunting trial cases (digital forensics investigations) on-the-fly. C4IIOT also distinguishes between “pure” users of the data (nominal data users) and data operators (data federation partners).
- C4IIoT will address the recommendation for the outcome of the proposal which is expected to lead to development up to Technology Readiness Level (TRL) 6.

2 Management structure and procedures

The project management structure aims at guaranteeing the proper progress and control of the project with respect to the project objectives and plans and to ensure both the technical coordination amongst the partners and the strict enforcing of the max expenses budget. It was defined to clearly identify the responsible members of the various organisms of the consortium as well as to optimise the communication between the various partners and coordinating committees.

The management structure has been defined in order to secure reaching the project objectives within the given schedule while trying to reduce the management effort in the project to its minimum taking into account the number of partners. Although all the partners in the project will actively participate in the management activities and are represented at the appropriate level, we have tried to allocate to them a minimum manpower effort.

The project's Consortium Agreement will include among others, preventive measures for arrangement of Intellectual Property Rights (IPR), exploitation rights, confidentiality, decision-making and change-procedures, cooperation and exploitation after the project.

The structure of the project management is shown in Figure 1: Project Management Structure and described in detail hereafter. It reviews conceptually the major parts of the project management structure, how the individual building blocks are interlinked and how management functions work.

The project management structure is composed of the following three groups, all chaired by the Project Coordinator:

- **General Assembly (GA)**, for general/administrative management.
- **Project Technical Committee (PTC)**, for scientific/technical management.
- **External Advisory Board (EAB)**, a panel of independent experts that evaluates the project progress with respect to the main objectives and technological developments, as well as the dissemination and exploitation efforts.

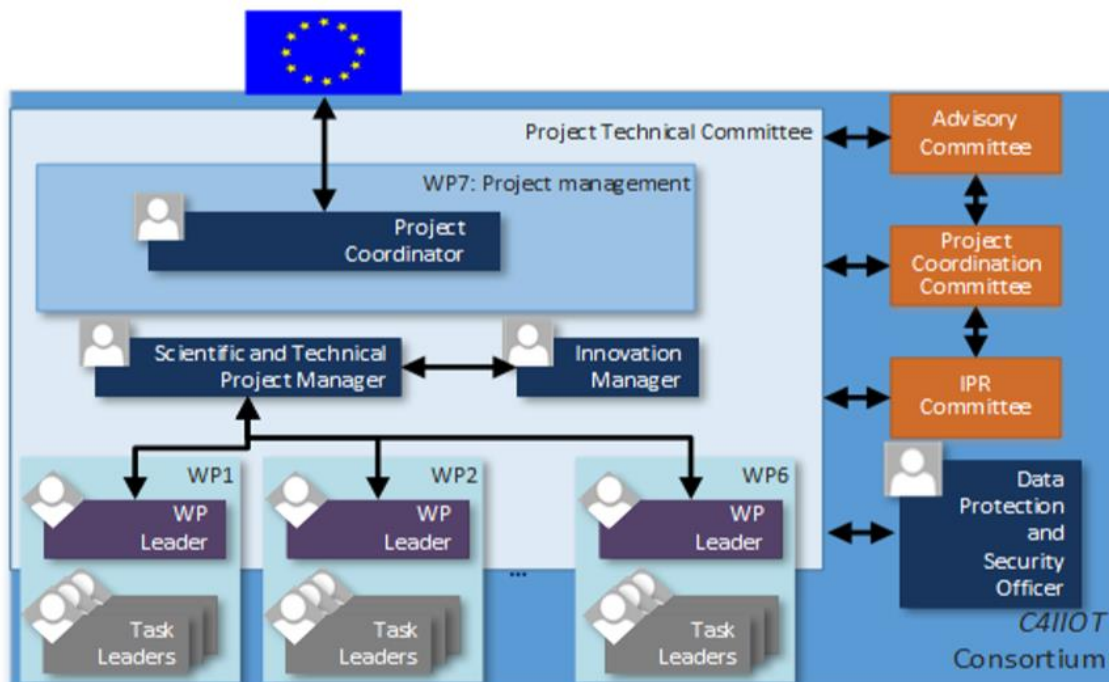


Figure 1: Project Management Structure

2.1 Roles

2.1.1 Project coordinator

The Project Coordinator (PC) is responsible for both the general and administrative management, and the scientific and technical management of the entire project. The PC monitors the planning, progress, and deliverables issues of the project with respect to the objectives and plans described in the project's Description of Work (DoW). If necessary, PC will initiate corrective actions for the deviations. The PC is responsible for the knowledge management within the project, the management of innovation related activities and IPR, the dissemination and exploitation activities. The PC is also the unique interface between the project and the European Commission. The PC manages all the communications to/from the EU Commission, the periodic reporting and he will organize the review meetings with the Project Officer. The PC is also responsible for collecting financial statements and audit certificates, as required by the contract. The PC is responsible for reporting the periodic financial summaries and resource efforts spent by each partner. The PC manages the granted EU contribution and the distribution of the funds to each partner according with the actual allocated efforts. The PC will convene the GA. Regarding the scientific/technical management activities, the PC leads the PTC and will assist, when necessary, the Work Package Leaders and makes sure that the communication between the various work packages proceeds as smoothly as possible for a successful integration of the various components of the project.

- Sotiris Ioannidis is the PC for the project.

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Table 2-1 Project Coordinator information

2.1.2 Project office

The Project Office (from coordinator's staff) assists the PC in the administrative management and is located at the Coordinator's site. The Office will be staffed by the Project Coordinator, a secretary, and a technical support person. The main responsibilities include:

- Ensure efficient communication among the partners using tools such as mailing lists, wiki, websites, plenary project meetings, etc.
- Prepare the project meetings, including scheduling, agenda preparation, minute taking, etc.
- Collect documentation for monitoring the activities within the work packages and for the preparation of the Annual Reports.
- Collect deliverables for submission to the Commission.
- Prepare and submit the Consortium Agreement.
- Promotion of gender equality.
- Handle the financial tasks, such as cost statements, payment distribution, obtaining audit certificates from each participant, etc.
- Preparing and updating of the project calendar, establishing mailing lists, setting up a secure internet platform for the exchange of project data and information.
- Support of the management of knowledge.

2.1.3 General Assembly

The General Assembly (GA) is a body consisting of one representative from each partner in the Consortium, with the task to supervise the project and will be chaired by the Project Coordinator. The GA will meet every four months or, if necessary, more often for project progress. Meetings can also be held as phone-conferences. The GA will provide a forum for the discussion of administrative and strategic management of the project and for the monitoring of dissemination and exploitation activities. In addition, the GA will decide on approving major modifications to project plans, allocated efforts, budget issues and possible addition of new partners. The GA will provide a forum for the discussion of major changes in the project work plan and directions in response to new problems or new situations. In voting at the GA, each partner shall have one vote and decisions will be taken by consensus. Modifications to the work plans in the DoW will require the consensus or the qualified majority (e.g. 2/3).

No.	Partner	Member	Alternate
1	FORTH	Sotiris Ioannidis	Giorgos Vasiliadis
2	VIP	Bojan Kovačević	Dragan Danilović
3	UNSPMF	Dusan Jakovetic	Srdjan Skrbic
4	ITML	George Bravos	Eleftheria Marini
5	CEA	Sébastien Bardin	Richard Bonichon
6	HPE	Marco Di Girolamo	Alberto Terzi
7	IBM	Omri Soceanu	Gilad Ezov

8	IFAG	Antonio Escobar	Zheng Ji
9	UOG	Georgia Sakellari	George Loukas
10	UP1PS	Jacques Robin	Carine Souveyet
11	AEGIS	Ilias Spais	Leonidas Kallipolitis
12	CRF	Giuseppe D'Angelo	Julien Mascolo
13	TSG	Pascal Bisson	Marie-Noelle Lepareux
14	STS	Georgios Spanoudakis	Kwstas Fussarakis

Table 2-2: General Assembly members

2.1.4 Project Technical Committee

The Project Technical Committee (PTC) consists of the PC and the Work Package Leaders (WPL). The PTC is responsible for progress monitoring, quality assurance, and management of scientific and technical activities. The PTC will meet as required, between 4 to 6 times per year. Meetings can also be held as phone-conferences.

2.1.5 Work Package Leader and Task Leaders

The **Work Package Leader (WPL)** are appointed by the partner responsible for the respective work package. Their role is to coordinate the day-to-day work carried out in the work package (WP) and ensure the communication and collaboration of the WP contributors. The WPLs are responsible for the planning and monitoring of the WP activities, as well as for ensuring the scheduled write-up of the WP deliverables via close collaboration with the Task Leaders (see below). The WPL has to organize WP Meetings for scientific/technical discussions for that specific WP. The WP Meetings will be between 4 to 6 times per year or more frequently if special issues need to be handled. WP Meetings can also be held as phone conferences. The WPL has to coordinate the interaction and collaboration with other WPs and to facilitate the communication in and between WPs. The WPL will report the progresses and criticisms (if any) to the PTC. In more detail, the WPL responsibilities are:

- To coordinate, monitor and manage the activities under their responsibility, and to ensure the timely achievement of the objectives and milestones of the work packages.
- To prepare the internal and external reports (deliverables) expected for the work package, and assist in the production of the overall management reports of the project.
- To meet or hold conference calls regularly with the Project Coordinator and arrange regular technical meetings or conference calls of the work package members.
- To ensure the accurate recording of times, costs and resources, and report any discrepancies immediately to the Project Coordinator.
- To organize technical presentations of the work package activities, and to ensure proper involvement and visibility of the active members.
- To inform the PTC about progress of activities and possible critical issues.
- To identify the need for creation of separate tasks in the work package.

- Horizontal information flow to other work package leaders.
- To identify and report any technical or managerial problems that arise in their work package.

No.	Name	Leader	Organization
WP1	Setting the scene: project set up	Jacques Robin	UP1PS
WP2	Edge computing cybersecurity technologies	Antonio Escobar	IFAG
WP3	Cyber assurance and protection in an industrial cloud infrastructure	Patrizia Ciampoli	HPE
WP4	An end-to-end integrated industrial IoT cybersecurity framework	George Bravos	ITML
WP5	Real-life industrial demonstrations in smart manufacturing	Giuseppe D'Angelo	CRF
WP6	Exploitation, sustainability and business continuity	Marie-Noelle Lepareux	TSG
WP7	Project Management	Sotiris Ioannidis	FORTH

Table 2-3: Work Package leaders

Task Leaders (TLs) are appointed by the partner responsible for each work package task. The TLs of tasks belonging to the same work package are coordinated by the respective WPL. Their objective is to coordinate the day-to-day work carried out in each task and to ensure communication among the task participants. The TLs are also responsible for the planning and monitoring of the task activities and for ensuring the scheduled issue of the task outcomes (deliverables). For each task, multiple people from contributing partners may be responsible for driving the work. However, typically, the bulk of the work is carried out by the organization of the TL.

2.1.6 Scientific and Technical Project Manager

The Scientific and Technical Manager (STPM) is appointed by the PC and will be responsible for the overall technical project management and coordination of the work packages. The STPM is also the first deputy of the PC for all non- administrative issues and project representation.

- Dusan Jakovetic (UNSPMF dusan.jakovetic@gmail.com) has been assigned as STPM for the project

2.1.7 Quality Manager

The Quality Manager (QM) is appointed by the PC and will be responsible for the coordination of the C4IIoT evaluation process, by coordinating and giving guiding support to the evaluation activity of each of the participating partners. The evaluation work will be planned, co-ordinated and monitored from the start of the project. A mechanism for reviewing progress against the success criteria identified by the PTC will be defined in the Project Handbook. The QM will ensure that goals set by the PTC and GA are fully implemented on a day-to-day basis.

2.1.8 Innovation Management

The Innovation Manager (IM) is appointed by the PC and will be responsible for the coordination of the C4IIoT exploitation process, by coordinating the outcomes of the technical process and matching them to business opportunities. The innovation activities will be planned, co-ordinated and monitored from the start of the project. The IM will be responsible for linking with industry beyond the consortium.

- HPE has been assigned as IM for the project.

2.1.9 External Advisory Board

Member	Position	Company
Robert Sayers	Principal Systems Engineer	UK Ministry of Defence
Dr Haris Gaćanin	Head of Department of AI-driven communication systems	Nokia Bell Labs
Vladimir Strezoski	Counsellor for power engineering	Schneider Electric DMS NS LLC
Dr Leyla Bilge	Technical Director	Symantec Research Labs
Dr Claudio Soriente	Senior Researcher	NEC Laboratories Europe
Prof Diego Pedro Morales Santos	Tenured Professor	Department of Electronics and Computer Technology, University of Granada

Table 2-4: External Advisory Board members

The External Advisory Board (EAB) includes a panel of independent experts not involved in the day-to-day project work. This panel will provide an outside view on C4IIoT and evaluate the overall progress with respect to the high-level objectives. We expect these experts to contribute significant ideas regarding the challenges and opportunities of the emerging research field of end-to-end security from an industrial perspective and thus ensure maximum impact of the C4IIoT project. In addition to the EAB members, we will invite the responsible EU project officer as guest member to the EAB meetings. At the annual EAB meetings, the PC will present

the achievements and the status of the project. All EAB members are invited to provide comments and modifications regarding requirements, objectives, and development, as well as exploitation and dissemination activities. The EAB will not make any decisions but issue recommendations that will be discussed and processed at the following GA meeting. The EAB can also recommend calling additional EAB meetings that focus on specific topics, or inviting additional experts to join the EAB.

2.2 Decision-making mechanisms

The Work Package Leader (WPL) will take technical decisions at WP level. If technical decisions with consequences for the work in other WPs have to be taken, the WPL will take these decisions after consulting the Project Coordinator and all other WPLs. The PTC will take technical decisions at project level. Decisions of the GA are binding for the project.

Activity	Decision by	Main input
Change workplan, shift project activities between partners, assign tasks of defaulting partners to others.	GA	PC+WPL
Approval of activity reports and deliverables to the EC	QM	PC+WPL
Inclusion or withdrawal of partners.	GA	PC+WPL
Appointment of PTC members.	GA	PC+WPL
Appointment of new WPL.	PTC	PC+WPL

Table 2-5: Decision-making responsibilities

2.3 Plenary Meetings

It has been demonstrated from past experience of the Consortium members that the needed interventions during the lifecycle of the project can be accurate, fast, and efficient. A fluent internal communication in the Consortium is foreseen to timely identify unexpected problems and purpose its effective handling, as described above. The Project Technical Committee will meet between 4 to 6 times per year, or whenever required during the implementation of Consortium activities as described in the Consortium work plan. Additional meetings may be organized if needed. The meetings will normally be scheduled to rotate between the Contractors home base or in any other way that is convenient for the Contractors. The Coordinator will organize the kickoff meeting with all partners. The purpose of the project kick-off meeting is to check the effective beginning of the work detecting and preventing in the very beginning phase possible problems like, for example, delays in the personnel hiring procedures or device ordering.

Additionally, the Contractors have scheduled monthly teleconferences at the last week of every month to synchronize and monitor the progress of the project.

2.4 Intellectual Property Rights and Publications Management

As we mentioned in the beginning of this section, IPR management procedures, along with the management of joint publications, will be further discussed and defined in the Consortium Agreement.

2.5 Conflict resolution, consensus building and corrective actions

The problem handling and corrective actions philosophy of the consortiums in the first place based on prevention. In case a problem arises, it will be tackled as soon as possible and at the lowest possible level, meanwhile bringing it to the immediate attention of the PC. Each partner of the consortium is responsible (liable) for the performance of any part of its share of the project or other EU contract obligation. In case, however, that a partner miss- or under-performs, this will be promptly documented.

Based on our experience with previous IST/ICT projects in FP6/FP7, the consortium has decided to adopt a conflict resolution template that has served very well in the past. The procedure works as follows:

The Project Coordinator will try to solve the problem immediately by all possible means and, if necessary, an official letter will be sent by the PC to this partner (with notification to GA and maybe the EU Project Officer). Important decisions on different issues, technical or otherwise, pertaining to the project will be reached by consensus decision-making in the General Assembly. Meanwhile, if necessary, an extra PTC meeting will be organised in order to solve such a problem and limit the impact for the Project. When serious disputes arise, red-flag procedures can be initiated by any member of the consortium after alerting the Project Coordinator about the issue that needs resolution.

All serious conflicts between consortium members will be handled and resolved by the General Assembly, allowing a maximum of 21 days from the identification of a conflict to the attempted final resolution. The Project Coordinator is responsible for arranging a General Assembly meeting at its premises within this period. At least 75% of the partner representatives should be present at this meeting. Otherwise, the PC will intervene to settle the case. In the first instance, negotiation will seek to resolve the dispute(s). Should consensus not result, a majority vote will be used. Each General Assembly member has one vote and the coordinator, if necessary, will cast the tie-breaking vote. In the case of persistent or exceptional disputes which threaten the continuation of the project, the consortium will inform the project officer, solicit external advice, and call for a full meeting of the consortium members.

2.6 Effectiveness of the proposed management structure

We believe that the proposed management structure will lead to an effective and efficient implementation of the proposed project for several reasons:

- Its small size will allow decisions to be reached quickly and implemented as soon as they are reached.
- By including all core partners in the main decision making body (i.e. the General Assembly) we give all the partners the right of participation, a feeling that they do not only contribute to the technical work, but that they also have a direct and immediate saying in the governance of the network, a feeling that they themselves are responsible for the future of the project. This usually works as an invaluable incentive for people to work harder towards achieving the goals of the project.
- Using the proposed management structure, (most of) the partners have collaborated effectively in past and ongoing projects, such as CIPSEC, ForToo, SMESEC, THREAT-ARREST, I-BiDaaS, SHARCS and others. We expect that the management structure will enable them to achieve another success in the implementation of C4IIoT.
- The operation of the Quality Manager and the Technical Program Committee will safeguard and ensure the high quality of the project's results.

3 Document Management

Subversion (SVN) was selected as the software for the repository of the C4IIoT documents. The Project Coordinator will be responsible for maintaining the following on the server:

- Quarterly reports
- Cost Claims
- Meeting Minutes/Action Items
- Teleconference Meeting Minutes
- Annual Project Reports
- Contractual Documentation
- Deliverables
- Technical Reports
- Technical Papers
- Market Studies

3.1 Language

The official document and emails language will be English. In case of official deliverables, effort shall be made to have a native English speaker review the deliverables when possible.

3.2 Web Server

The web server will be set-up and hosted by FORTH. The domain name registered for the project is c4iiot.eu.

The web server will consist of a public part, accessible by all visitors and a password protected part accessible only by the C4IIoT partners if necessary. The public deliverables list will appear at the public part. The confidential deliverables will be password protected or be kept in the SVN.

3.3 Document Templates

The Coordinator has created templates for different uses within the project. For documents such as deliverables, Microsoft Word and LaTeX templates have been provided. Both can be found in the project SVN repository as in c4iiot-dx.x.docx and c4iiot-dx.x (directory) respectively. For the case of project deliverables, it has been decided that it's up to the Deliverable leader to choose between LaTeX and Microsoft Word.

Furthermore, for project-related presentations in external events as well as internal meetings, a PowerPoint template was created. It can be found in file c4iiot-WP#-WPNAME-yyyy-mm-dd-LOCATION-PARTNERNAME.pptx in the SVN repository.

Finally, the Coordinator has provided a template reporting form, which will be used by the consortium partners to report on their progress on a quarterly basis. These quarterly report will

be annually compiled by the Coordinator into the project progress report. The reporting form template is in Word format and can be found in file c4iiot-technical-template.doc

3.4 Document Exchange Methods

Documents will be exchanged primarily via upload to the SVN repository. After a successful document upload, the partner should also send an email with the document title and link. In case document uploading is not feasible or desirable (e.g., short-lived documents), email exchange will take place instead.

3.5 Document Naming

Proper document naming is required to keep track of the project technical and administrative resources. The official deliverable will be named using the naming format c4iiot-dx.y.ext where x and y are the numbers designating the deliverable as per the DoW, and ext is the extension (.doc,.pdf,.ppt,.xls,.exe,.zip).

3.6 Documents Software Tools

For documents processing, the following tools are recommended:

- Document Processing: LaTeX or Microsoft Word (2010 or newer, for Mac or PC)
- Spreadsheet Processing: Microsoft Excel (2010 or newer, for Mac or PC)
- Presentation Processing: Microsoft PowerPoint (2010 or newer, for Mac or PC)
- Portable Document Format: Adobe Acrobat (2010 or newer, for Mac or PC)

In case a partner aims to use a different software tool, they have to ensure that the outcome is compatible with the above tools.

4 Communication

Ensuring good communication among project partners and towards outside entities represents a key of success for the project and a fundamental practice to manage the project properly. The establishment of a fast, reliable, and easily accessible communications infrastructure is vital to the proper operation of a European project. This can only be achieved through the proper use of electronic communications (e.g., email, web based exchanges). A project website will also be used to enable fast and efficient exchanges of information.

The main communication channels of C4IIoT are:

- Email
- web-based services/chats
- SVN
- bilateral telephone/VoIP calls
- telephone conferences
- voice teleconferences supported by desktop sharing tools (e.g. Adobe)
- physical meetings

The internal communication includes physical quarterly meetings, starting with a 2 day kick-off meeting to guarantee in depth knowledge exchange (see Section 6.1). Meetings are accompanied by monthly teleconferences to discuss project progress and to take decisions. Also C4IIoT heavily relies on the exchange of emails and use of the project SVN repository for document collaboration and other tasks. The solution to share knowledge will be SVN. The advantages of these tools lie in their functions of allowing the sharing of documents, contact details, white boards, discussion rooms etc.

External communication includes the dissemination of all project results through publications, a project website, conferences, events, the EAB, and the establishment of links to related projects and SME associations. It is well known that systematic and timely implementation of information flow is central for any Consortium based project. Nevertheless, information overload should obviously also be avoided. The communication flow between C4IIoT members will be implemented by:

- Periodic meetings of the Project Management Board
- Periodic meetings of the Technical Committee
- Individual working meetings of members of each WP
- Phone and e-mail interchanges (day to day cooperative working infrastructure)

The Project Coordinator will be in a day-by-day communication, and have the duty to communicate on a systematic and frequent basis. All ordinary messages related to a certain work package will be communicated among all partners involved in that work package. Any special issues or problems within the frame of a WP are going to be forwarded to the WP leader and to the Technical Project Committee members. Of course, this formal and detailed hierarchical communication flow, does not exclude by any means ad hoc direct communication between any partner participants, whenever this is important for the project success. The experience in running research projects and having previously worked together successfully and with good relationships almost ensures the avoidance of problems regarding communication and information flow along the development of the C4IIoT Project.

4.1 Email Communication

FORTH has set-up and maintains the following email lists:

- c4iiot-partners@c4iiot.eu for all the members working on the project. This list is used for discussing all matters of the project.

We have also set up WP specific mail lists for the WP leaders which requested it:

- c4iiot-partners-wp1@c4iiot.eu
- c4iiot-partners-wp2@c4iiot.eu
- c4iiot-partners-wp3@c4iiot.eu
- c4iiot-partners-wp6@c4iiot.eu

We have tried to keep a flat mailing list structure on purpose. We opted to have one general mailing list for everyone to be involved and per work package for those that required it.

In case a new participant needs to be added to a list send an email to: sotiris@ics.forth.gr

5 Resource Management, Reporting and Deliverables

For appropriate resource management, resources will be monitored every three months, during quarterly reports. The reports will be internal, but will give a good approximation of the overall resource spending. Once per year, a signed full cost statement will be delivered to the coordinator.

5.1 Quarterly Reports

The quarterly reports should be sent to the coordinator 5 working days after the end of the reporting period. An appropriate template has already been created by the Coordinator for this (see Section 3.3). The quarterly reports will include at least the following issues:

- Major Achievements per partner
- Progress per work package
- Status of deliverables
- Deviations from the workplan
- Project Meetings/Teleconferences attended
- Conferences/Standardization Meetings Attended
- Status of publications
- Status of talks given by the partner
- Any other important achievements related to the project

5.2 Cost Claim Reports

The Yearly Cost Claim reports should be sent to the coordinator and the work package leaders 5 working days after the end of the reporting period for the technical issues, and 2 weeks for the financial part. The coordinator will provide appropriate template. The Cost Claim Reports will include at least the following issues:

- Planned Resources per activity per work package
- Actual Resources per activity per work package
- Cumulative Resources per activity per work package
- Consumables
- Hardware/Software expenses
- Audit Reports

5.3 Responsibility Assignment

Based on the C4IIoT Description of Work (DoW) the Project Coordinator will assign and manage the Work Package Leaders to achieve the objective of each work package. The Project

Coordinator will keep an action items list, detailing the open issues of the work packages, task, the deadline, the partner that has been assigned the task, a small description and the issue status (open, assigned, closed, postponed, delayed). The tasks will be assigned to the partners based on their contributions to the DoW, their area of expertise and their resources in the project as reflected by the relevant Man Months (MM).

5.4 Deliverables

Project deliverables to the European Commission (with the exception of the Periodic or Final Reports) serve as the outcome of Work Package technical progress. They consist of a combination of documents such as written reports as well as potential non-document prototype releases. The European Commission requires that all non-document deliverables be documented appropriately as a written report. The intention of the deliverable review process is to ensure that the document has been reviewed by a broad spectrum of individuals.

5.4.1 Responsibilities and Components

The term Owner refers to a member of the C4IIoT partner that is responsible for the completion of the deliverable, as described in the DoW. The term Reviewer refers to the C4IIoT partner that is responsible for the completion of the internal review of the deliverable (prior to sending it to the EC). Moreover, the external Reviewer that is appointed by the EC for the periodic project reviews shall be referred to as the EC Reviewer.

5.4.2 Procedure and Timing

Table 5-1 illustrates the timing and procedures that each partner ought to follow regarding each deliverable. Each deliverable is first examined by the WPL and the STPM, followed by the internal reviewers when it is complete. Subsequently, it is re-examined by the WPL in order to confirm that reviewer's comments have been successfully addressed and by the QM in order to confirm that the review process has been followed. Finally, it is approved by the PC who submits the deliverable to the EC website. The deadlines (when) indicated in Table 5-1 are indicative but strongly recommended and correspond to a minimum number of weeks/days in advance of formal submission deadlines. They may be customised, in agreement between the role bearing responsibility (Person Assigned) and the roles monitoring adherence to each step (Task), for documented reasons, such as the size of the deliverable, actual work progress or other unforeseen circumstances. In all cases, however, deliverables should be ready at least one week in advance of their formal deadlines. It is expected that each deliverable will use its own dedicated space on the shared SVN repository, where draft versions, final versions before review, reviews, and final version to be submitted will be uploaded and stored. It is particularly important that all partners make active use of SVN. It is expected that LPs will keep uploading draft versions of their deliverables on a regular basis to help other partners stay in touch with ongoing work and how it develops, identify any possible issues early, and so on.

In order to reject a deliverable, the QM or the Reviewers must provide constructive suggestions for improvement in writing to the deliverable Owner and Project Coordinator. Upon receiving the suggestions for improvement, the Project Coordinator works with the deliverable Owner to determine the schedule to complete the deliverable.

Step	When	Person Assigned	Task
1	10 Weeks	LP	Submits Table of Contents (ToC), sections contents in bullet form with brief explanation, writing allocation (who is writing each section) and writing deadlines (when each contribution is due) for the deliverable to WPL, STPM.
2	9 Weeks	WPL, STPM	Provide comments / feedback to LP.
3	5 Weeks	LP	Submits final draft of the deliverable to Internal Reviewers, copying QM, WPL, STPM.
4	4 Weeks	Internal Reviewers	Provide comments / feedback to LP, copying QM.
5	3 Weeks	LP	Submits final version of the deliverable for submission to PC, copying WPL and QM
6	2 Weeks	PC	Approves and uploads the deliverable to the EC services.

Table 5-1: Overview of deliverable preparation, review and submission process

6 Meetings

6.1 Plenary Project Meetings

The plenary project meetings will take place periodically every four (4) months, or ad hoc in case an outstanding technical issue calls for an additional meeting. The meetings will be initiated by the Project Coordinator. In some cases, it may be initiated by a Work Package Leader, but approved a priori by the Project Coordinator. Scheduled meetings will be announced at least 3 weeks in advance, and an effort will be made to be scheduled at the end of the current plenary meeting. In outstanding circumstances, they will be notified 1 week in advance, given that at least 75% of the participating partners are available. Other important items about the plenary meeting include:

- Agenda and supporting documentation will be available to all attendees at least 1 week before the meeting. Issuing of all documents will be via the Project Coordinator.
- All meetings will have minutes written by the Project Coordinator (or a substitute if necessary) or the respective Work Package Leader if the meeting concerns a specific work package. Unless otherwise agreed in the meeting, minutes will be issued within 10 working days of the completion of the meeting. Minutes will take the form of action items in order to keep things short and to the point.
- The action items list will be maintained in a file in the SVN, available for all project partners.
- The first task in each meeting will be the agreement on the agenda and the last one agreement on the date and place of the next meeting.

6.2 General Assembly

A General Assembly Meeting will take place in case very important administrative or technical issues have to be faced. A General Assembly meeting may result in modifying the project consortium, change the project objectives or even terminate the project. The General Assembly Meeting will be initiated by the Project Coordinator.

- All partners will be notified at least 3 weeks in advance.
- Agenda and supporting documentation will be available to all attendees at least 1 week before the meeting. Issuing of all documents will be via the Coordinator, who is responsible for compiling all submissions from partners.
- All meetings will have minutes written by the Project Coordinator or his representative. Unless otherwise agreed in the meeting, minutes will be issued within 2 working days of the completion of the meeting.

To minimize expenses and save time, General Assembly meetings will take place in parallel to plenary meetings, if feasible. The first task in each meeting will be the agreement on the agenda and the last one agreement on the date and place of the next meeting.

6.3 Review Preparation Meetings

Review Preparation Meetings are expected to take place the day(s) before the project reviews. The Project Coordinator and all Work Package Leaders are expected to attend the Review Preparation Meetings. Other members of the project will be expected to attend when required. As the Review Preparation Meetings will form a major forum for the exchange of information in addition to the management of the project, all consortium members will be encouraged to attend. The Review Preparation Meetings will also review progress against the project success criteria and will report to the General Assembly all deviations from planned progress, together with an action plan to recover any shortfalls or exploit any gains in the programme. All meetings will have minutes written by the Project Coordinator. To minimize expenses and save time, General Assembly meetings will take place in parallel to plenary meetings, if feasible.

6.4 Conferences/Presentations/Exhibitions

C4IIoT will try to promote the visibility of the project. Thus participation in conferences, dissemination activities and standardization bodies will be actively pursued. The following rules should be applied:

- When the expenses are claimed during cost claims, the project has to be officially mentioned and this has to be proven by official documentation/contribution, e.g. an acknowledgement in a paper, use the proper logos in posters, etc.
- The conference/presentation/contribution documentation has to be uploaded on the web server.
- When the project is official mentioned or presented the Project Coordinator should be notified 2 weeks before the event. The reason for this is to homogenize potential duplication or conflicting contributions/presentations.

7 Risk Management

7.1 Risk management and contingency plans

Working at the frontier of new technologies usually implies accounting for some partial risks; research is not a deterministic discipline, percentage of success and temporal requirements for completing some portions of the work may vary depending on the problem being addressed. This is particularly true in projects requiring the interaction of several industrial partners operating in similar business sectors and the participation of SMEs to the R&D activities. C4IIoT may present some of these risks, which may endanger a successful conclusion of the project or an incomplete achievement of some of the planned objectives. As such, appropriate contingency plans must be defined up-front, and clear rules for their application must be set beforehand to allow a successful termination of the major sections of the project in spite of some delays or failures in small, specific parts of the work-plan.

Modern working protocols have demonstrated that a proper work distribution is the key to success, as this approach facilitates concentration in small groups or sites of very focused and homogeneous competence, thus minimizing the burden of handling and coordinating huge teams. Communication technologies help in keeping the work synchronized and in cutting away redundancies that may arise when the group at work is too large or distributed across continents. Obviously, each site should offer enough resources to allow the performance of self-contained portions of the development. This is definitely the case of the consortium.

7.2 Administrative risks and contingency plans

Such risks refer to the possibility of a partner withdrawal from the C4IIoT consortium or various IPR-related issues. However, such risks are really minimised for C4IIoT consortium since all partners come from credible organisations where long co-operation and faith have been established and are all committed to the project's objectives. Furthermore, the Consortium Agreement of the project will take care of handling various such administrative risks in the unlikely case that might happen including procedures for finding another partner to execute the remaining work.

7.3 Financial risks and contingency plans

As mentioned before, all partners come from credible organisations and the risk of someone to become bankrupt is really minimal. However contingency plans are also foreseen, and risk will be mitigated within the Consortium Agreement that will include the provision for immediate actions by the Project Coordinator by blocking further payments by the Commission to this partner and by initiating relevant procedures to find another partner to take over the remaining work.

7.4 Technical risks and contingency plans

The main risk in the project is that critical results could be delayed due to critical dependencies or unexpected extra-complexity due to the highly innovative rate of those challenges. Table 7-1 identifies the potential risks that we have identified in the work packages and the contingency actions we have planned:

Risk	WPs	Proposed mitigation measures
Underperforming partner	WP1, WP1, WP3, WP4, WP5, WP6, WP7	All consortium partners are highly committed to the project and it is hard to expect this situation. If it occurs, the flexible project management structure and Consortium Agreement allow a quick shift of resources to alternative project partners (see also below)
Partner leaving the project	WP1, WP1, WP3, WP4, WP5, WP6, WP7	In this unlikely case, it would only have a temporary disruptive effect, as the consortium is well balanced and the affected tasks can be allocated to another partner. Otherwise, the flexible management structure allows quick inclusion of new partners in the consortium if necessary
Key-person left or is temporarily not available	WP1, WP1, WP3, WP4, WP5, WP6, WP7	Consortium partners are involved in the related areas with more than one staff member, ensuring an immediate substitution. Furthermore, the project as a whole has technical excellence in related disciplines spread across the partners, providing additional substitution possibilities.
Needed partners' resources are underestimated	WP1, WP1, WP3, WP4, WP5, WP6, WP7	In this case, the project management bodies will analyse the following possibilities to ensure that planned work can be completed: (i) rearranging resources among the partners as needed,(ii) committing further internal resources of organizations in project activities (if possible),and (iii) replanning work on the activities in accordance with previous measures.
Project schedule is partly not appropriate	WP1, WP1, WP3, WP4, WP5, WP6, WP7	The project management structure and measures continuously monitor performed work vs. project plan and are entitled to perform corrective actions change of the project plan if necessary, which also apply for this case (see also below). In crucial cases, the PC will work on the plan adaptation in close cooperation with EC
Project milestones or deliverables are delayed	WP1, WP1, WP3, WP4, WP5, WP6, WP7	In the scope of project management monitoring activities, detailed analysis will be done on both global project and lower (WP/Task) project implementation levels. Thus, it will be ensured that such cases are recognized in early stages, ensuring timely and effective implementation of necessary corrections in the work plan
Agreement among partners is difficult to achieve	WP1, WP1, WP3, WP4, WP5, WP6, WP7	The collaboration spirit in the consortium targets to achieve consensus among all partners on the open issues and the project management bodies will work in this direction. However, in order to avoid too long consensus making processes, which might affect the project plan, the related management procedures for decision making and conflict resolution will be timely applied.

Not satisfactory interaction among WP's and tasks	WP1, WP1, WP3, WP4, WP5, WP6, WP7	The regular synchronization of work among WP's (as well as among tasks within WP's) will be performed in the scope of project management activities, so that these cases should not occur or should be timely recognized allowing implementation of corrective actions without significant impact on the project plan. If the problems continue, the PC together with STPM and WP leaders will analyse problems in interactions and propose additional procedures for improvement of the interactions
Necessary coordination level is not achieved	WP1, WP1, WP3, WP4, WP5, WP6, WP7	Similar as it will be done for monitoring of the technical project activities, including analysis of work done and implementation of the corrective actions, the project coordination and management will be observed as well. Thus, if necessary the responsible management bodies will propose the corrective actions improving overall project coordination. If needed, management of the Coordinator organization will be involved to solve the problems.
Problems in integrating the different components in a common platform	WP4	An agile approach has been proposed for the C4IIOT implementation lifecycle to ensure efficient integration; C4IIOT technical partners have significant expertise in platforms' integration.
Low technical quality of deliverables	WP1, WP1, WP3, WP4, WP5, WP6, WP7	Addressed through regular quality reviews and assignment of peer reviews for each deliverable.
C4IIOT modules do not perform as expected in terms of cyber threats identification and mitigation	WP2, WP3, WP4, WP5	C4IIOT modules rely on a number of existing technologies and tools that have been validated and are brought in by the consortium partners(see Sect.1.3.2); On top of that, C4IIOT agile development schedule has foreseen the deployment of 2 versions of the components, facilitating thus their continuous improvement and validation by the C4IIOT end users throughout the project's duration.
The C4IIOT platform is not user-friendly	WP5	Advanced visualization techniques will be utilized by highly experienced partners (AEGIS, HPE,ITML) to ensure the implementation of a user-friendly training platform
Not enough stakeholders are reached to exploit C4IIOT & ensure sustainability	WP6	C4IIOT consortium already comprises critical stakeholders in the fields of IoT and manufacturing. On top of that, a specific task (T6.2) has been allocated to ensure stakeholders' engagement; all C4IIOT partners have existing communication channels to ensure the project's sustainability.
Market's rapid changes jeopardise C4IIOT sustainability and expected impact	WP6	Market will be continuously analysed throughout the project and the necessary adaptation will be made to the C4IIOT business plan in order to ensure that the platform's impact in the market is maximized.

Table 7-1: Critical risks for the successful implementation of the C4IIoT project.