

EUROPEAN COMMISSION

Thematic Priority:
SIXTH FRAMEWORK PROGRAM



Priority 2.5.3
INFORMATION SOCIETY TECHNOLOGIES
Unit G3 Embedded Systems



Project Acronym:

SOCRADES

Project Full Title:

**Service-Oriented Cross-layer infRAstructure for
Distributed smart Embedded deviceS**

Proposal/Contract No: EU FP6 IST-5-034116 IP SOCRADES

Deliverable 11.2f

Project Progress Report, 6th release

Status:	Draft
Dissemination Level¹:	CONFIDENTIAL
Date:	24.11.2009

Organization Name of the Lead Contractor for this Deliverable: **Schneider Electric Automation**

¹ See p.5 for explanation of Dissemination Levels

Status Description:

Scheduled completion date ² :	28.02.2009	Actual completion date ³ :	23.11.2009
Short document description:	The current project progress report includes Progress Report (main technical and management activities of the reporting period), Dissemination Report, Report on using and disseminating of knowledge and Reactions of the WP Leaders to the questions/remarks of the reviewers from the 5 th and 6 th EU Review Meetings. It covers the reporting period March 2008 – October 2009.		
Author(s) deliverable	Armando W. Colombo Nataliya Popova (Schneider Electric Automation)	Report/deliverable classification: <input type="checkbox"/> Deliverable <input type="checkbox"/> Three-Month Activity Report <input checked="" type="checkbox"/> Six-Month Activity Report	
<input type="checkbox"/> Partner <input type="checkbox"/> Peer reviews <input checked="" type="checkbox"/> Contributions	<input checked="" type="checkbox"/> Schneider Electric <input checked="" type="checkbox"/> ABB <input checked="" type="checkbox"/> APS GmbH <input type="checkbox"/> Boliden AB <input type="checkbox"/> Prodatec Oy. <input checked="" type="checkbox"/> Institut für Automation und Kommunikation e.V. Magdeburg <input type="checkbox"/> Kungliga Tekniska Högskolan	<input checked="" type="checkbox"/> Loughborough University <input type="checkbox"/> Luleå University of Technology <input checked="" type="checkbox"/> Politecnico di Milano <input checked="" type="checkbox"/> SAP AG <input checked="" type="checkbox"/> Siemens AG <input checked="" type="checkbox"/> Tampere University of Technology <input type="checkbox"/> Jaguar Cars Ltd. <input checked="" type="checkbox"/> ARM Ltd. <input checked="" type="checkbox"/> Schneider Electric Industries	
Peer review approval :	<input checked="" type="checkbox"/> Approved <input type="checkbox"/> Rejected (improve as specified hereunder)	Date:	23.11.2009
Suggested improvements:			

Version History:

Version:	Date:	Comments, Changes, Status:	Person(s) ⁴ :
0.1	02.11.2009	First draft	N. Popova (SEA)
0.9	23.11.2009	Compilation of inputs	N. Popova (SEA)
1.0	24.11.2009	Final Version	A. W. Colombo (SEA)

² As defined in the DoW

³ Scheduled date for approval

⁴ A list of company short tags can be found in DoW

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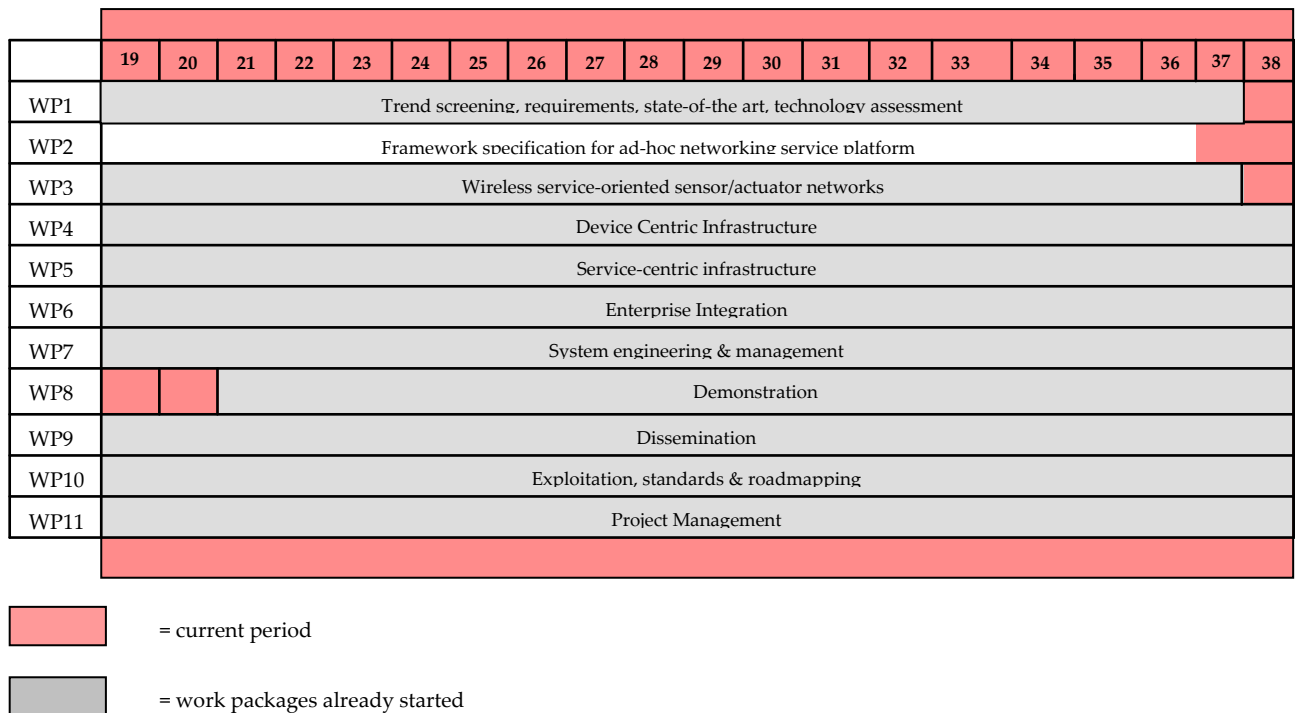
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PUBLIC	Public
PP	Restricted to other programme participants (including the Commission Services)
RESTRICTED	Restricted to a group specified by the consortium (including the Commission Services)
CONFIDENTIAL	Confidential, only for members of the consortium (including the Commission Services)

1. Executive summary

This progress report presents activities and results achieved by the SOCRADES consortium during the fourth 8-monthly reporting period (March 2009 until October 2009). It is based on the Guidelines for preparing project reports for FP6 (<http://cordis.europa.eu/fp6/find-doc-management.htm#reporting>).



Note: WP2 finished in M18 (1 phase of the project).

Figure 1: Work plan schedule - Overview

1.1. Summary of the Objectives of the Reporting Period and Related Activities (Project Coordinator)

Based on the work plan addressed in the Annex1, 4th and 5th Amendments of the SOCRADES DoW, and taking into account the results of the Technical Workshops held in conjunction with PCC meetings, as well as the recommendations of the evaluators after the 5th EC Review / 30-months (June 10th, 2009, Brussels, Belgium) and the 6th EC Review / 36-months (August 27th, 2009, Tampere, Finland) meetings, the following main objectives have been addressed in this period:

- SOCRADES General Framework implementation and integration:
 - Prototype Application Implementations (third project milestone, M24)
 - Integration of Results (fourth project milestone / M36)
- Consolidation of the results obtained after the Second Period (24 months) and of the SOCRADES Early Prototypes (Second and Third Project Milestone).
- Screening of the major RTD values addressed in SOCRADES, against the background of the current market and competition state, as documented in current public reports.

- Final specifications and developments of the necessary steps for demonstrating the innovation aspects of the SOCRADES related technologies:
 - Improvement and modularization of the architecture of the DPWS stack.
 - Application of the SoA paradigm at the device level (for real and virtual devices).
 - Enterprise integration (integration of devices and IT systems) using WS and OPC-UA technologies.
 - Application of a formal (Petri Net-based) modelling and analysis/validation engineering approach to formally specify service orchestration and agent-based service choreography at device level.
 - Development and implementation of a Petri Net-based Orchestration Engine embedded into smart automation devices.
- Implementation and assessment of SOCRADES prototype components coming from the works performed in the individual work packages.
- Implementation and Assessment of the application of the SOCRADES framework integrating prototypes into the three industrial scenarios (electromechanical assembly, car manufacturing, continuous process) and the mechatronics trials.
- Strong publishing activities and dissemination of the research results.
- Dissemination of SOCRADES in international events concerning different Framework Programs like ITEA2 Fair and Conference in conjunction with ARTEMIS (Madrid, Spain, 2009), 13th IFAC Symposium INCOM'09 (Moscow, Russia, 2009), 7th IEEE Conf. on Industrial Informatics INDIN'09 (Cardiff, Wales, 2009).
- External/public demonstrations of project developments/results. Participation of SOCRADES in the ITEA2 Fair (Madrid, Spain, 2009). Publication of videos (per Internet) addressing those demonstrations.
- Follow-up actions for conducting standardization activities focussing on new standardization initiatives, like OASIS.
- Finalization of the SOCRADES Technology Roadmap and publication of a "Public Roadmap Summary" after the realization of an International Consultation Roadmap Workshop (in conjunction with the IEEE INDIN'09 Conference in June 2009, Cardiff, Wales).
- Completion and delivery of a 4th and 5th consecutive amendments of the SOCRADES Annex 1
 - 4th Amendment concerning the transfer of rights and responsibilities of the project co-ordinator - partner #1 (Schneider Electric GmbH) to a new partner #1 Schneider Electric Automation GmbH, Germany. Date of the Amendment: 01. October 2008.
 - 5th Amendment concerning the extension of the project duration from 36 to 38 months. Date of the Amendment: 22. July 2009.

Note_1: The fourth and fifth amendments content also the SOCRADES Annex 1, First Revision of the SOCRADES Work Plan after the first 18-Months project period, PLUS a rescheduling of work packages, due dates for deliverables and milestones according to an extension of the project duration from 36 to 38 months.

From the management point of view, the project consortium's situation, now with 16 partners and a new company (legally spoken) occupying the coordinator position, i.e., legal and financial aspects, has been stabilized.

1.2. Short evaluation of the status achieved & lessons learned (Project Coordinator)

The project's third yearly milestones has been reached and positively evaluated by the external experts.

The project's third and fourth milestones have also been reached with the present report, which confirms the positive evaluation results of the 1st and 2nd years EC review meetings. This status is particularly showing the commitment of the individual partners but also the high degree of integration of work reached within the consortium.

After a first analysis of the market and the state of the competition, the consortium is aware that this initiative is the first (world-wide) to address the application of the SoA paradigm at the device level and the integration of such SoA-compliant devices into enterprise architectures. SOCRADES is a new technology and for that reason, it is in the hands of the partners to spread it as a real innovation. It is worth emphasizing that the SOCRADES consortium is marking the RTD direction (world-wide) in this domain, situation that is confirmed by a big amount of invitations to participate in International Events that the partners started to receiving during the last months, mainly events oriented to define RTD-programs for the next 10-15 years (in the EU, USA, Japan, Korea, etc).

"Road mapping for the adoption of the SOCRADES paradigm and some related technologies" was proposed as one of the essential activities planned for being conducted during the project in work package 10 (Task 10.3). However, due to the innovative aspects of the SOCRADES technology, only a few sets of EFTAs were identified during the first two years. The deadline to conclude the first and second versions of the Roadmap were extended (authorized by the EU PO and the experts) to the end of the 1st 18-months-period and the end of the 2nd year / 24-months-period. The results have been submitted on Month 18th (D10.4a) and on Month 24th (D10.4b). As a matter of fact, it was impossible to define a roadmap for the adoption of a paradigm, as long as the necessary technology roadmap does not exist. At this moment, the first 4 phases to generate the SOCRADES technology roadmap have been finished. Following the recommendations from the experts after the 18-Months and 24-Months EC review meetings, the PCC (during the meeting hold on October 7-8 2008 in Loughborough) decide to concentrate in the 3rd project year on the positioning of the reached results in front of other public existent roadmaps. The results are:

- The publication of a SOCRADES Technology Roadmap-Summary generated after a Public Roadmap-Workshop hold in conjunction with the IEEE INDIN'09 Conference (June 2009, Cardiff, Wales) and
- The Final Release of the SOCRADES Technology Roadmap as Project Deliverable.

The change of the legal name of the co-ordinator and the extension of the duration of the project (in a neutral cost approach), i.e., the completion of two consecutive Amendments of the ANNEX I, is showing a very dynamic consortium structure and of course it shows that a continuous day-to-day management work was necessary for the integration of the major technically oriented work packages. This was mainly due to the broad spectrum of innovative aspects addressed in the different work packages, making it a real challenge to maintain all technical developments under an integrative approach, particularly so because the technical work was mainly being performed in a collaborative manner by the major players/ stakeholders of the automation value chain.

The results reached in the project matched the expectations of the partners and confirmed the initial visions that a collaboration of market-competitors in the R&D-arena is not only possible but extremely productive, particularly when pre-competitive work is performed.

1.3. Matters arisen and measures taken (Project Coordinator)

Technical matters:

The SOA paradigm involves many new concepts and introduces a vocabulary that is now well known in the IT world but difficult to assimilate in the automation area. Consortium-wide technical workshops have been

set up with a period of three months and weekly exchanges of information within work packages have taken place in order to reach a common understanding within the consortium.

The strong commitment of the partners allowed the development of a set of SOCRADES prototypes and applications. This set of prototypes has been incrementally developed and its application to the industrial scenarios has been shown in the 2nd and 3rd years EC review meetings. All those prototypes have been presented in public events, e.g. the ITEA2 fair in Madrid (October 2009). The generation of the prototypes and the application of them to the industrial scenarios have been very useful to address the integrative aspects (technological and organizational) of the project, aspects that are very hard to manage in the kind of heterogeneous consortium and particularly due to the partnership between world-wide competitors.

One difficult matter that arose in the first 6-month period of the 3rd project year was the improvement of the SOCRADES Annex1 (technical work plan) adapting the original version (part of the already approved 2nd Amendment) to the 3rd year. Two special days were scheduled for consortia meeting associated to two PCC meetings (Loughborough, October 2008, and Magdeburg, December 2008), in order to process the 3rd and 4th Amendments of the Annex I. These two face-to-face PCC meetings were complemented with an Extraordinary PCC-meeting held on January 23rd 2009 in Frankfurt, Germany. According to the commitments with the European Commission, the consortium was able to deliver the final (agreed by all partners) version of the 4th Amendment of the DoW-Annex I, which has been accepted by the EC.

During the first months of the project, by screening the SoA-related technologies, the consortium observed a strong correlation between the DPWS and OPC UA technologies. The major SOCRADES technology developers (Schneider Electric, Siemens and ABB) started activities to conduct to a SOCRADES result called DPUA. The topic has been discussed during the last SOCRADES technical workshops and a Working Group was set up, which started analyzing that correlation, also as a part of the plan of activities addressed in WP3, WP4 and WP10. The first results of that activity were essential part of the D3.3 and D3.4.

4th Amendment of the DoW-Annex I:

Despite of the change of the SOCRADES partner #1, which was the major (legal) initial reason for the necessary new (4th Amendment) of the SOCRADES contract, there have been two important technical aspects that played a major role in the definition of new due dates in the project work plan:

1. The integration of results (Pilots/Prototypes) from the different work packages into the Trials planned in WP8 was being delayed by the missing of technological integrative aspects between the WP3 and the WP5 (both work packages were working on a SoA architecture but based on different technologies). The integration of devices exposing services with the two different technologies, i.e., DPWS and OP-UA required the specification and the implementation of a Gateway/Mediator/Translator, and this implementation took more time than the original scheduled.
2. Due to a technological/strategic change of HW platform, Schneider Electric Automation needed to delay the implementation of the DPWS-based control devices that were containing the prototypes developed in WP5. The new HW-Platform, which will be the commercial platform during the differentiation phase of the project results (Exploitation of Results beyond SOCRADES), was completed with approximately two months delay.

As a consequence, the project duration has been extended from 36 to 38 months in a cost-neutral approach. This means, the project finished on October 31st 2009.

The major changes generated in this last reporting period by this extension of the project duration were:

1. The new due date for the 4th Major Project Milestone (Integration of results / concepts and applications) was M36 (August 31st 2009). Results reflected in the contents of the Deliverable D8.1
 2. Some of the Milestones associated to the project work packages, with due date in this 3rd year were delayed:
 - a. MS 5.1 (new due date M33)
 - b. MS 3.4 (new due date M37)
-

- c. MS 5.1 (new due date M33)
- d. MS 7.2 (new due date M36)
- e. MS 7.3 (new due date M37)
- f. MS 8.1 (new due date M38)

From the set of deliverables that were scheduled for M30, the D5.2.2 changed its due date to M33, D6.5 to M38.

5th Amendment of the DoW-Annex I:

Due to a missing official request for the extension of two months of the project duration (in the 4th Amendment), it was necessary to proceed with this 5th Amendment, which was only focussed on this extension aspect.

Organizational matters:

Change of the legal situation and name of the SOCRADES partner #1 (Schneider Electric GmbH, Germany). The new partner #1 is Schneider Electric Automation GmbH (Germany) and it takes all the responsibilities that were associated to the original partner #1, i.e. particularly the project co-ordination. This change was done valid from October 1st 2008.

The budget/funding transferred to the respective partners was the initial one addressed in the SOCRADES EU Contract.

Management matters:

- Due to all legal changes associated to the 2 consecutive 3rd and 4th Amendments of the Annex I and also due to the Audit processes ordered by the EU Court of Auditors, the process for the payment of the 2nd year Funding was delayed.

1.4. Final Steps (Project Coordinator)

Management steps:

- Complete Final Project Reports
- Complete the transfer of the 3rd EC funding
- Preparing the 38-months EC review (already scheduled for December 1st and 2nd, 2009 in Aachen, Germany, at APS premises)

1.5. Analysis of the effort Consumption (Project Coordinator)

The analysis of the efforts and the related costs discovers an uneven consumption for the first reporting period. Concerned are the employed resources as well as the dedicated costs. Compared to the planned efforts some tasks have required less manpower; on the other hand there had to be spent more work on other tasks, partly the efforts are increasing significantly. Compared to the budget, the relevant costs are also varying. Some partners show significant increase in their PM-Rate, some partners have decreased their PM-Rate; in some cases the PM-Rate decrease compensates the PM increase largely.

The overall picture is being delivered as a part of this D11.3c and a brief overview will be presented during the 38-Months EC Review meeting.

Report from the last 8 months:

- The audits and the D11.3b (2nd year) were delivered to the EC. It did not address any special/particular issues.

- The leadership of the Task 5.4 (WP5) was transferred from partner # 1 (Schneider Electric Automation GmbH) to partner # 13 (Tampere University of Technology). This transfer of responsibilities was reflected in the transfer of efforts from partner #1 to partner # 13. This transfer of efforts was addressed in the Amendment 4th of the DoW (Annex I).
- After the authorization from the EC and the acceptance from the PCC, the efforts allocated to the partner # 14 Jaguar/Ford (for the third project year) were completely transferred to the partner # 8 (Loughborough University). This transfer of efforts was addressed in the Amendment 4th of the DoW (Annex I).

2. Work Progress Overview (WP Leaders)

This work package is dedicated to analyzing state-of-the-art of the overall projects subjects, identifying relevant use cases as a basis for requirements specification and finally trend screening throughout the overall project.

2.1.1. Tasks progress

Task 1.3: Trend screening and self-evaluation

Work on Task 1.3 has been continued during the actual reporting period. This work is dedicated to the continuation of the work on state-of-the-art analysis as started within Task 1.1 throughout the overall project duration. Results of this work were documented within D1.3 and D1.4 within the former reporting period. D1.4 was finished at the beginning of this reporting period. Results of the current reporting period were reported within D1.5.

D1.5 is structured into 8 sections, each of them dedicated to another technological field. Each section is related to a single section of D1.1 and its Annex.

Section 1 is aimed at providing an update of the state-of-the-art and trend description on distributed control platforms and solutions followed by section 2 providing the latest trends on agent-based control. The deliverable proceeds with the trends in service oriented architectures for devices (section 3). Whereas section 4 is dedicated to the trends in networked control of physical systems (related to WP4), section 5 describes the progress discovered in wireless technologies and sensor networks. Section 6 describes what is going on related to device profiles. The last two sections of this deliverable describe the ongoing trends in engineering of distributed systems and business process integration.

Each chapter is first introduced by an overview of the technical progress discovered related to the selected technology, followed by a description of the progress and its relation to the SOCRADES approach. Finally the relevant references are provided.

Deliverable D1.5 is a collection of contributions from the experts involved in the project distributed across the different work packages. It shows therefore an update of the state of the art at the current stage of the project. This deliverable is passed back to the technical WPs as well as to the project management to support supervision and evaluation of the projects progress.

Within the latest review meetings, some overlapping was discovered with regards to the road mapping, done within WP10. Co-ordination effort was spent to avoid this for D1.5.

D1.5 is associated with an Annex, which is a joined activity with WP10 to support the self evaluation procedure. For that purpose “Annex 2 of D1.2” (requirements matrix) was used as a starting point to measure the results of the SOCRADES project that are visible within different demonstrations as well as within the final Trial. The “Annex to D1.5” indicated the level of fulfilment of the individual requirements. It also relates requirements to the technological achievements of the project and the EFTAs coming from road mapping.

2.1.2. List of deliverables for the reporting period (if applicable)

Del. no.	Deliverable name	WP no.	Lead partner	Del. type	Security	Due date	Actual date
D1.5	Trend screening report 3	1	ifak	Report	CONFIDENTIAL	M37	M39

2.1.3. List of milestones for the reporting period (if applicable)

There are no WP1 milestones assigned to this reporting period.

2.1.4. Meetings attended (if applicable)

Meeting Title	Objectives/ Results Achieved	Date	Place
PCC phone conference		10.03.09	By phone
WP8 Meeting		13.05.09	Aachen
PCC and Technical WS		27.-28.05.09	Walldorf
Review Meeting		10.06.09	Brussels
SOCRADES Road mapping WS		24.06.09	Cardiff
PCC Meeting		03.09.09	Frankfurt
PCC Meeting		28.10.09	Madrid

2.2. WP2 – Framework specification for ad-hoc networking service platform

This WP finished on M18 (1 phase of the project).

2.3. WP3 – Wireless service-oriented sensor/actuator networks

2.3.1. Work package objectives, starting point of work

For future automation solutions it might be imaginable to equip sensors and actuators with a freely programmable processor each. In such special wired/wireless networked HW/SW systems embedded in distributed smart physical objects, so called “sensor-/actuator networks”, all processors use the same communication medium and are able to communicate directly with each other according to the peer-to-peer-principle – without any coordinating instance. All (or at least the most important of) these processors then could be equipped with corresponding software based on a service oriented architecture concept as e.g. OPC UA or DPWS. This would enable such sensor/actuator networks to provide necessary functionalities for the wished degree of interoperability with the ERP/MES level.

Almost inescapably in context with these sensor-/actuator networks wireless technologies have to be mentioned. Though these from a theoretical point of view are not imperative for sensor-/actuator networks, in practical considerations wired sensor-/actuator networks are not of any relevance as the wiring of a high amount of sensor and actuator nodes would be difficult and not economic.

Against that background, the following research topics were addressed within this work package:

- Node architecture, sensor integration and the interface between sensors and the network,
- Wireless Network topology, self-configuration, self-management, routing, scalability,
- Communication technologies for Wireless Sensor/Actuator Networks (WSN) in industrial environment (e.g. IEEE 802.15.4, 802.15.4a or ZigBee),
- Power supply for the network infrastructure as well as the sensor itself,
- New Services with Wireless Sensor Networks,
- Installation of an industrial experimental setup.

As a starting point of work it can be stated that consortium members are active in a number of relevant working groups which deal with radio communication and industrial communication e.g. the Institute of

Electrical and Electronics Engineers (IEEE), the International Electrotechnical Commission (IEC), the Zentralverband der Elektrotechnik und Elektronikindustrie (ZVEI), the German Commission for Electrical, Electronic & Information Technologies of DIN and VDE (DKE), the German VDI/VDE-Society.

2.3.2. Task progress - Task 3.4: Implementation and Validation

The only running task during this reporting period was Task 3.4 "Implementation and Validation". In this Task an implementation of parts of the architecture developed in Task 3.3 in Siemens' Smart Automation Lab is described, hosting a demo plant for filling small bottles with small pieces similar to processes in the pharmaceutical industry. This implementation focuses on the wireless sensor network, its services and its integration into an automation system via an OPC-UA gateway. Further integration with DPWS is demonstrated in the APS trial described in deliverable D8.1. The implementation of the OPC-UA to DPWS translator as part of WP3 is described in this document as well.

The task was running according to plan without any deviations; the corresponding deliverable was submitted to EU on October 4th 2009 after PCC review.

2.3.3. Deviations of the project work program (if applicable)

n.a.

2.3.4. List of deliverables for the reporting period (if applicable)

Del. no.	Deliverable name	WP no.	Lead partner	Del. type	Security	Due date	Actual date
3.4	Implementation and Validation	3	Siemens	Doc	Confidential	11/09	11/09

2.3.5. List of milestones for the reporting period (if applicable)

MS No.	Milestone name	Lead partner	Due date	Actual date
3.4	Implementation and Validation	Siemens	11/09	11/09

2.3.6. Meetings attended (if applicable)

Meeting Title	Objectives/ Results Achieved	Date	Place
PCC	PCC Topics	10.03.09	Telephone, Nuremberg
PCC	PCC Topics	27./28.05.09	SAP, Walldorf
Review Meeting	Project Review	10.06.09	EC, Brussels
PCC	PCC Topics	28.10.09	Hotel, Madrid

2.3.7. Lessons Learned

n.a. as everything ran according to plan.

2.4. WP4 – Device Centric Infrastructure

2.4.1. Work package objectives, starting point of work

Activities concentrated mainly towards the building of the demonstrator of task T4.5.

However, additional theoretical and tool development activities have been observed during the execution of T4.4 and T4.5.

2.4.2. Tasks progress

Task 4.4: Middleware services for fault-tolerant control applications

Main results of task 4.4 activities are presented in deliverable D4.3. A brief description of the content, as follows:

- Communication scheduling for control purposes. Additional theoretical advances on scheduling control systems where the communication follows TDMA based protocols and the realization of a tool for providing ease of design of WirelessHART systems.
- A new methodology for compensating for communication losses in networked control systems has been developed. The proposed Predictive Outage Compensator (POC) has been shown to give significantly improved performance compared to previously used compensation schemes.
- Middleware procedures for accommodation of communication protocols wireless to wired. The focus has been on connecting WirelessHART networks with Modbus TCP wired networks.
- Component based design methodology. The design process of middleware supporting real-time and wireless communication has been studied and a novel methodology allowing for both hardware and embedded software to be managed as components has been developed.

Task 4.5: Small-scale demonstrator for fault-tolerant wireless control

Main results of task 4.5 activities are presented in deliverable D4.4. A brief description of the content, as follows:

- Definition of a scenario for a constrained plant that will be run over wireless connections
- Setting up a small size wireless system with the plant
- Setting up the control scenario, such that authorized personnel may intervene if the behaviour of the wireless system takes the plant out of the normal running parameters
- Setting up the parameters of the connection towards (remote) management applications
- Interconnecting the wireless network with the existent (wired) system
- Implementing the connectivity to management applications
- Implementing the local monitoring capabilities
- Executing the process
- Collecting and interpreting data from the demonstrator

2.4.3. Deviations of the project work program (if applicable)

WirelessHART devices were unavailable at the date of the trial (24-25.08.09). Hence, the Zigbee protocol has been used for the execution, instead.

2.4.4. List of deliverables for the reporting period (if applicable)

Del. no.	Deliverable name	WP no.	Lead partner	Del. type	Security	Due date	Actual date
D4.3.	Procedural support for implementation	4	ABB	R	CO	31.08.09	04.10.09
D4.4.	Solution deployment at Boliden – Verification & Testing.	4	ABB	R	CO		14.10.09

2.4.5. Meetings attended (if applicable)

Meeting Title	Objectives/ Results Achieved	Date	Place
PCC Meeting	Project follow-up	27-28.05-09	Walldorf, DE

WP8 meeting	Status, technical discussions	13.05.09	Aachen, DE
Review Meeting	5th Review Meeting	9,10.06.09	Bruxelles, BE
Pre-trial test	Set-up for the trial in August	15,16.06.09	Boliden, SE
Trial	The trial of task 4.5.	24-25.08.09	Boliden, SE
PCC Meeting, ITEA Symposium	Presentation of the project, PCC Meeting	28,30.10.09	Madrid, ESP

2.5. WP5 – Service-centric infrastructure

2.5.1. Work package objectives, starting point of work

This WP aimed at bridging application level functionality and device level functionality through a common, unifying technological approach, based on the service oriented architecture (SOA) paradigm, implemented using Web Services and associated technologies, over resource limited devices.

2.5.2. Tasks progress

Task 5.2: Service orchestration engine

This task has been concluded with the specification and implementation of Orchestration Engines using two approaches: High-Level Petri Nets (HLPN) model execution orchestration engine and Business Process Execution Language (BPEL) – based orchestration engine. Both approaches have been implemented and successfully demonstrated in collaboration with SE, SAP, Prodatec and TUT on the Electromechanical Assembly Demonstrator presented during the 6TH EU review meeting in Tampere, Finland. Additionally, the HLPN-based orchestration engine will be presented once more at the final EU review meeting to be held at APS premises in Aachen, Germany.

The HLPN-based orchestration engine has been embedded into a prototype remote IO device (Advantys STB). A local decision component has been embedded with the engine in order to support flexible production systems at runtime, according to specifications in D2.2, D2.4. Though the orchestration engine does not yet communicate to the MAS-based decision support system developed in T5.4 by TUT, the DSS interface for asking for the next service to be performed has been harmonized in both engines. However, both approaches use different semantic. Besides the engine, the implementation of the accompanying tool chain for model design, model composition, generation of deployment files, deployment manager has been further developed, finalized and tested. The embedded engine can be configured by WSDL parsing (previous version was based on generated stubs and skeletons), in order to facilitate interoperability with a wide set of services. This became crucial particularly at the Trials, where different, not interoperating services had to be integrated into a common process. Based on the experience achieved while developing the EAD scenario a more mature and stable version of the embedded engine has been developed. The engine now possesses the capability of managing more complex processes by being able to handle an increased number of service references at the same time. The configuration interface has been harmonized with the management interfaces provided by T5.3. It is based on the dynamic deployment service that is also used as programming interface for the IEC-based embedded execution engine provided by Schneider for the Advantys STB.

The BPEL-based orchestration engine exposes its functionality via a web service interface, which can be used for interaction with the decision-support system if behavioral conflict is detected and/or with other middleware components. Besides the BPEL-based orchestration engine, the implementation of additional software tools has been finalized; such software tools are meant for supporting the orchestration approach that was originally described in the architecture specifications outlined by WP 2. A *Service Explorer* integrated with DPWS was completed and the implementation was tested during this period. The Service Explorer is a complex orchestration tool that allows users to discover services hosted by devices on the

network, and also allows mapping those services to orchestration processes described in BPEL. Several business processes can be loaded and executed by the Service Explorer or their execution can be commanded to an orchestration engine, providing thus the facility for service composition when required.

Task 5.3: Service management tools

This task is now ended. The WS-Management solution, together with generic services, is providing a complete management solution.

This task instantiated the manageability framework specified in WP2, itself based on the WS-Management specification, in a prototype environment. It also specified an extension providing generic services capabilities.

Task 5.4: Service-enabled agent system

This task has been finalized with the specification and implementation an Agent-Based Decision Support System (ABDSS). The ABDSS has been developed using the extension capabilities of the JADE-LEAP agent platform. During this reporting period, the following activities were accomplished:

- Full specification of missing agent descriptions and behaviours required for handling conflict resolution.
- Integration of agent descriptions into ontology-based models. This integration included also interaction with formal models of a production system described by means of OWL ontologies.
- Full integration of the DPWS Java stack into the ABDSS for increasing its discovery capabilities and world model verification.
- Implementation of an agent interaction model for resolving process selection conflicts during runtime. The conflict resolution reply provided a set of operations to be invoked in selected web services.
- Integration of the ABDSS with orchestration engines and other middleware components via a web service interface. This included exposing the decision-making capabilities of the ABDSS as a web service.

The functionality and integration of the ABDSS with a real manufacturing system was successfully demonstrated on the Electromechanical Assembly Demonstrator presented during the 6TH EU review meeting in Tampere, Finland.

Task 5.5: Semantic web services deployment

The work under this task has ended with the implementation of related middleware components. As it has been described in D5.2.2, two main components were developed in order to fulfill the deployment and orchestration of semantic web services: *Ontology Service* and *Ontology Manager*.

The main use of the ontology service is to provide a web service interface through which other middleware components can interact and manipulate ontological models that contain semantic information. This interaction includes the capability for querying processes offered by services hosted on devices, without the need of knowing their access information. An inference engine and SPARQL-based queries are used for this.

OWL ontologies are conventionally created and maintained with off-line editors such as Protégé. The ontology manager is a middleware component that can access ontologies during runtime and can keep them updated with real-time information from a manufacturing system. Ontology updates are performed by verifying matching rules specified by the user on the ontology manager.

Both components mentioned previously are integrated with the remaining SOCRADES architecture. In particular, the ontology service is used by the ABDSS for accessing the ontology models created for the

agents. The components developed for this task were also successfully demonstrated on the 6th EU review meeting.

Task 5.6: Electronic component for service-oriented devices

The task is currently finished for deliverables D5.6.1, D5.6.2, D5.6.3 and D5.6.4. The results of D5.6.1 – D5.6.4 are reported in June 2009 for review. Due to this review, two deliverables D5.6.2 – D5.6.3 have been revised according to 5th EU-review session in Brussels/Belgium with notification of project management and according to EU-reviewers feedback. The revised document D5.6.2 – D5.6.3 (revision 2) have been reviewed again in July/August 2009 timeframe and got finally been accepted by EU-reviewers and project management on the 6th review session in Tampere/Finland on August/26a27/2009.

Achieved results on deliverables D5.6.1, D5.6.2, D5.6.3 and D5.6.4 have significant influence on a new MCU core design, which will be available for commercial licensing business beginning of year 2010. Currently further exploitation plans & projects for achieved SORCADES results are evaluated with several project partners and external companies to generate a market momentum.

2.5.3. Deviations of the project work program (if applicable)

The due dates for the documents D5.2.2 and D5.4.2 were modified according to 4th amendment of DoW.

The delivery of document D5.4.2 to the EU Commission was slightly delayed due to minor complications on the software developments. The final version of this document was officially submitted on 03.07.2009 instead of originally planned deadline (15.06.2009). A letter from the leader of task 5.4 (TUT) explaining the situation was sent to the PC on 16.06.2009.

D5.6.2 – D5.6.3 have been revised again according to EU-reviewers feedback which extended duration.

2.5.4. List of deliverables for the reporting period (if applicable)

Del. no.	Deliverable name	WP no.	Lead partner	Del. type	Security	Due date	Actual date
D5.2.2	Model-based Orchestration Engine – Integrated in SOA Architecture	5	SEA	P, R	CO	31.05.2009	21.07.2009
D5.4.2	Agent-based Decision-making System – Integrated with Orchestration Engine	5	TUT	P, R	CO	30.04.2009	03.07.2009

2.5.5. Meetings attended (if applicable)

Meeting Title	Objectives/ Results Achieved	Date	Place
PCC Meeting		27-28.05.2009	Walldorf
5 th EU Review Meeting		10.06.2009	Brussels
6 th EU Review Meeting	Revision of new deliverables D5.6.2 and D5.6.3. Assessment of deliverables D5.2.2 and D5.4.2. Live demonstration of implemented software/hardware prototypes applied to the domain of Electromechanical Assembly. Review of state of preparation for final review meeting.	27.08.2009	Tampere
PCC Meeting		03.09.2009	Frankfurt

2.5.6. Lessons Learned

The software developments during this reporting period greatly intensified due to the upcoming deadlines and the attention focused specially on prototype demonstrations. During the implementation of prototypes, it was discovered that the current BPEL standard does not support the use of external notifications in order to trigger the process flow. This was required for selecting the execution of certain orchestration processes according to decisions taken and also for controlling the runtime execution of such processes by using event-based notifications. The problem was solved by following a different approach, but this was a feature that stayed open for future research.

2.6. WP6 – Enterprise Integration

2.6.1. Work package objectives, starting point of work

WP6 deals with enterprise integration. In the last months we were dealing mostly with hands-on experiences on our efforts to finalize the implementation adjustments, and use the developed concepts in the trials and demonstrators. WP6 partners were dealing mostly with fine-tuning development and tackling interoperability issues that came up.

2.6.2. Tasks progress

- *Task 6.2: Integration of aggregated services into business applications*
- *Task 6.3: Integration of non Web Service enabled devices into business processes*

There are two tasks active in WP6. Both of them concluded successfully. Connection to the business applications and dynamic integration of web service enabled devices, of REST devices and other non-web service devices has been demonstrated and evaluated.

2.6.3. List of deliverables for the reporting period (if applicable)

Del. no.	Deliverable name	WP no.	Lead partner	Del. type	Security	Due date	Actual date
D6.5	Final specifications and prototype implementation of the enterprise integration architecture	WP6	SAP	R	CO	30 Aug 09	19.10.09
D6.6	SOCRADES Business Evaluation	WP6	SAP	R	RE	30 Oct 09	20.10.09

2.6.4. Meetings attended (if applicable)

Meeting Title	Objectives/ Results Achieved	Date	Place
PCC and Technical WS		27.-28.05.09	Walldorf
Review Meeting		10.06.09	Brussels
6 th EU Review Meeting		27.08.2009	Tampere
PCC Meeting		03.09.2009	Frankfurt

2.7. WP7 – System engineering & management

2.7.1. Work package objectives, starting point of work

The development of the engineering environment as part of WP7 was completed within the last eight months of the project. The developed application engineering toolset provides engineering support for the building of distributed systems based on the SOCRADES architecture.

In this final reporting period of the project, the main efforts in WP7 were focused on the implementation and testing and evaluation of the engineering tools within all the target application domains. Across the project as a whole SOA based application engineering has been investigated in car engine manufacturing, automatic assembly in electronic device manufacturing and the control of continuous processes in the process industry, culminating in the Mechatronic Trails at APS. All project partners have been involved in aspect of this engineering activity. An overview of engineering methods and functionality is provided in D7.7.

The build of the final configuration of the Jaguar/Ford demonstrator rig was completed at Loughborough and a series of videos produced highlighting the component-based engineering approach adopted. These videos cover the demonstrator, application engineering environment and methodology, and the integration of the legacy devices. They were demonstrated in the ITEA2 international exhibition in Madrid.

Three deliverables have been produced and are being compiled and submitted in this reporting period.

Deliverable 7.5, "Generic Service Oriented Device Support and Maintenance System" was prepared by ifak and Lboro and submitted in month 37. This deliverable provides an overview of the application and role of mediator technology in the provision of device support and maintenance. Connectivity and support for the configuration of I/O systems based on Profibus, DPWS and OPC UA are discussed in the context of different application scenarios. Integration of the legacy devices within the applications engineering environment was also investigated and tested on the Jaguar/Ford machine test rig.

Deliverable 7.6, "Prototype Lifecycle Support Environment" was produced and submitted by Lboro in month 38. This document provides an overview of a prototype engineering lifecycle support environment which has been implemented to show the practical application of a DPWS-based distributed control system in the automotive engine assembly domain.

Deliverable 7.7, "Report on the validation and demonstration of the system engineering environment", has been produced to compare, contrast and assess application engineering across the different industrial domains. This deliverable provides a broad overview and evaluation of the engineering methods and tools adopted across all SOCRADES application domains with contributions from all relevant collaborators on the project.

Two members of the Lboro's engineering team attended the meetings on Functional Oriented Modularity (FOM) in Krause Company, which is the world leading provider of automation system for Jaguar/Ford. The aim of these meetings was to relate the potential adoption of a component-based SOA engineering approach to this machine builder's current engineering processes.

The application engineering environment and the concept of SOCRADES project regarding the web-based control tools were demonstrated and promoted in two international events. The ETFA conference and exhibition in Spain (Sept 09) and the Airbus "1st Advanced Manufacturing Technology Forum" (Oct 09). The later exhibition, which is a showcase for new technology in aerospace manufacturing, produced much interest in the potential application of SOCRADES concept and engineering methods in this domain..

Lboro as the leader of the WP7 has also contributed significantly to the engineering aspects of deliverable 8.2, "Evaluation of the trials performed at the selected SOCRADES prototype applications and assessment of the results", in the domain of car engine manufacturing.

2.7.2. Tasks progress

Task 7.3 - Application description and configuration

An overview study was carried out across all relevant project partners' related industries to highlight the features and capabilities of all the applications engineering tools used and being developed within the project. All partners contributed in a co-ordinated data capture activity by the Lboro team to collect and structure the information.

A set of evaluation criteria were defined to assess the capabilities of the application description, configuration and support methods used against the user requirements defined previously in WP1 and WP7. The evaluation was based on qualitative and quantitative study of the used engineering methods and tools. Key engineering aspects included (re)configuration, process description and validation, device support & maintenance, real to virtual connectivity and process to business connectivity. This evaluation is documented in D7.7 and this deliverable, along with D7.6, also details the application engineering environment and methodology developed by Lboro as part of WP7.

In addition to the web-service based interfaces between system device components and the engineering tools, the capability of various engineering environment was considered in terms of required connectivity to the legacy devices and integration with the high level management systems. See D7.5 for further details.

Task 7.4 - Simulation and verification

Development of the engineering application environment to support SOCRADES concept was completed as part of Task 7.4. This includes capabilities for machine simulation and verification, e.g., via the Lboro PDE (Process Definition Environment) and SOA interfaces to Delmia Automation.

The implementation and test phases were categorized into: a) application of web-services to integrate real and virtual system components with the engineering tools, b) modelling and visualization of application behavior and c) the simulation and verification of application with real and/or virtual distributed components. These capabilities are reviewed in D7.6 and D7.7. Such capabilities have been implemented in support of the assembly automation in the manufacturing of electronic components applying Petri-net based techniques and an external SOA interface to Delmia. For use of the PDE tools was focused on modeling an engine assembly application for Jaguar / Ford.

The developed simulation and verification capabilities of the engineering environment were demonstrated (in form of video) at the ITEA2 2009 symposium in Madrid. In addition to the core engineering environment, the integration to the legacy devices and the migration of virtual designs to physical SOA components were also demonstrated.

Task 7.5 – Device support and maintenance

Within the task 7.5, the need for a generic service oriented support for automation devices was highlighted as part of the SOCRADES SOA concept. Investigating the research results from other projects such as SIRENA, the capability of the existing SOA mechanisms were proved insufficient to meet the requirement of complex automation systems. In particular the inability to interface to existing networked automation devices (i.e., legacy devices) on current fieldbus systems to SOA systems.

The application of ifak Mediator on Lboro’s demonstrator was developed and tested to examine the integration of the Profibus devices onto the Ford/Jaguar manufacturing application test scenario developed and demonstrated by Ford engineering demonstrator. Furthermore, the specification of the OPC UA server, offering a more generic interface, configured by an Electronic Device Description (EDD) was tested and documented within deliverable D7.5 as part of this task. This deliverable also includes consideration of how to integrate OPC UA server functionality into the DPWS-based SOA approach of SOCRADES.

2.7.3. Deviations of the project work program (if applicable)

2.7.4. List of deliverables for the reporting period (if applicable)

Del. no.	Deliverable name	WP no.	Lead partner	Del. type	Security	Due date	Actual date
D7.5	Generic Service Oriented Device	WP7	ifak	Report	CO	M37	Sept 09

Support and Maintenance System							
D7.6	Prototype Lifecycle Support Environment	WP7	Lboro	Prototype (with summary report)	CO	M38	Oct 09
D7.7	Report on the validation and demonstration of the system engineering environment	WP7	Lboro	Report	CO	M38	Nov 09

2.7.5. Meetings attended (if applicable)

Meeting Title	Objectives/ Results Achieved	Date	Place
All PCC meetings	Project progress and co-ordination		
ETFA exhibition centre	Promotion of SOCRADES concept	Sept 09	Spain
Airbus Advanced Manufacturing Technology Forum	Promotion of SOCRADES concept	Oct 09	UK
Krause machine modularity meetings	Application of SOA concepts and methods to assembly automation	Oct 09	UK & Germany

2.8. WP8 – Application pilots, demonstrators

2.8.1. Workpackage objectives; starting point of work

The main objectives of WP 8 addressed during the reporting period are:

- To apply the SOCRADES framework to the pilot applications and trials
- To set up the pilot applications and the trial scenario
- To run trials with tests of real world situations like automatic set-up and system start; device or system failure; staff failure; control failure; control at hard real-time conditions, plug & play situations, change of production, as well as process monitoring and diagnostic capabilities.
- To evaluate and assess the results achieved

Based on end user requirements evaluated in WP 1 and on the results achieved so far in WP 2 -7 four industrial pilot applications have been selected to prove the technical feasibility of the SOCRADES technology. The application scenarios are:

- Car engine manufacturing
- Assembly automation in manufacturing of electronic components
- Fault-tolerant wireless control of continuous processes
- Integration of legacy systems into SoA.

Complementary to the industrial pilot applications in WP 8, a laboratory prototype set up has been established to run “Mechatronic Trials” at the APS Labs. The set provides an experimental platform open to run selected use cases of different functional issues and complexity in cooperation with the SOCRADES partners. The test and demonstration environment integrates heterogeneous mechatronic devices (robots,

gantry, sensors, controllers, PCs, tools, etc.) of different types and vendors, control loops with different real-time constraints, WS-enabled I/O devices (STB) for pallet management activities, wireless sensors for pallet position detection operations, and interaction capabilities for cross-layer enterprise integration via WebServices.

The project work within WP 8 has started in May 2008 (month 21).

2.8.2. Tasks progress

Task 8.1: Specification of the application prototypes and trials

With special focus on the application of the SOCRADES framework developed in the project, the WP 8 partners specified HW and SW requirements as well as the IT infrastructure to set-up the industrial pilot applications and the trial site at APS.

While the pilot applications were planned to be built up from existing production equipment at the end user sites, the trial scenario was designed to integrate heterogeneous mechatronic devices like robots, sensors of different type and complexity, distributed controllers, and tools with embedded intelligence in a SoA-based experimental platform. This platform should be able to test defined use cases and to study the interoperability of the system components. on device level at real world situations of different functional complexity as well as a synchronisation with business processes

Task 8.2: Application of the SOCRADES Framework to the prototypes and trials

The work in Task 8.2 has concentrated on the application of the SOCRADES technology to the industrial pilot applications and on demonstration activities to prove the applicability the SOCRADES technology implemented for device—to—device interaction and for the synchronization of device activity with selected business processes via IP-based WebServices.

With regard to the trials, special consideration has been given to the different control loops involved in the automation scenario and to the time constraints that are of relevance for a proper performance of the system.

In this context a service-based, even-driven interaction concept was implemented to meet the different dynamic constraints. Key elements are a specially tailored Device Profile Stack embedded in each Mechatronic device and the Choreography Engine to specify invocation, subscription and termination processes during operation.

The Choreography Engine will start any activity through a stimulation by work orders which are provided by a business process. Each work order will initiate a service deployment process and the subscription of devices to a given event. The registered subscriptions are used for invoking services and enable the propagation of events to the subscribers.

While the mechatronic devices will interact event-driven to meet the time constraints of the control loops, a DPWS-interface was foreseen to assure also direct peer-to-peer interaction via Web Services with WS enabled devices from the SOCRADES partners. This is of relevance for pallet management as well as for data exchange across an integrated wireless sensor network, and for the integration of the devices into business processes.

For the wireless operating sensors binary OPC-UA was considered for the exchange of service messages. To couple the wireless sensors to the IP-based trial network a gateway and a translator from OPC-UA to DPWS standard was implemented.

Task 8.3 Trials to real-world situations

Since August 2009 the functionality of the prototype installation at APS was available and first trials have been started to study the performance of the system and of the SOCRADES technology by means of eight Use Cases with certain performance goals and varying technical complexity.

The industrial pilot applications have also been finalized during the reporting period. Some results were demonstrated during the review meeting in Tampere in August and have been documented as a video presentation.

Additionally, the WP 8 partners have prepared the first deliverable (D 8.1) of WP 8 about the technical details of each of the industrial pilot applications and of the trial scenario concept. It was submitted on September 17th.

Task 8.4 Trail records, evaluation and assessment of results

A second document (D 8.2) is currently in preparation. Focus will be given to the evaluation and assessment of results gained from the industrial pilot applications as well as and from the different use cases defined for the mechatronic trials. Planned date for submission is Nov 20th.

In parallel APS and the WP 8 partners have started to prepare the final review at APS premises with demonstrations of video documents from the industrial pilot applications and with a life demonstration of the mechatronic trials.

2.8.3. Deviations of the project work program

There is no deviation from the project work program to consider.

2.8.4. List of deliverables for the reporting period (if applicable)

Del. no.	Deliverable name	WP no.	Lead partner	Del. type	Security	Due date	Actual date
D 8.1	Implementation of the SOCRADES framework in selected application pilots and trials	8	APS	Report	Confidential	Aug 30	Sept 17
D 8.2	Evaluation of the trials performed at the selected SOCRADES prototype applications and assessment of results	8	APS	Report	Confidential	Oct 30	Nov 20

2.8.5. List of milestones for the reporting period

M36 milestone → D8.1, industrial pilot applications and trials finalized

M38 milestone → D8.2, assessment of results

2.8.6. Meetings attended (if applicable)

Meeting Title	Objectives/ Results Achieved	Date	Place
Bilateral technical meeting	Trials: Functionality and system integration	08-05-09	Seligenstadt
WP 8 technical meeting	Functional issues and interoperability of the sub systems in the trial scenario	13-05-09	Aachen
PCC meeting	Coordination of WP 8 activities, Preparation	27/28-05-09	Waldorf

	of review		
Review Meeting	Review	10-06-09	Brussels
Bilateral technical meeting	Trials: Integration of SE components	20/21-08-09	Aachen
Bilateral technical meeting	Trials: Integration of Siemens components	24-08-09	Aachen
Review Meeting at TUT	Review: Report about WP 8 status	27-08-09	Tampere
PCC, Meeting	Coordination of WP 8 activities	03-09-09	Frankfurt
Bilateral meeting	Preparation of D8.1, technical issues	14/16-09-09	Aachen
Bilateral technical meeting	Trials: Interoperability of devices, Exchange of WS with STB devices	22/23-10-09	Aachen
PCC Meeting	Preparation of Final Review	28-10-09	Madrid
Bilateral technical meeting	Preparation of D8.2, technical issues	11.11.2009	Aachen

2.8.7. Lessons Learned

The SOCRADES technology is able to meet many of the user requirements collected in WP 1.

The interoperability of heterogeneous devices across SoA-based interaction infrastructure was proven and could be demonstrated successfully for selected application scenarios in the domains of process control and collaborative automation. To point out is that interaction through IP-based WebServices opens new perspectives for next generation automation systems in terms of standardized interfaces, plug&play capabilities, fast system reconfiguration, easy reuse of services, and a direct synchronization of device level activities with business processes. The coexistence of WS-based wireless and wired communication and interaction is possible and can be applied as integral parts of a SoA. To recognize from the trials with use cases of different functional complexity was that WS-based interaction currently prevents from time critical applications in process control and automation. This is especially true if WS-based wireless control loops are concerned. Therefore, time critical control tasks and SoA-based interaction are to recommend in combination with event-based approaches (real-time SoA) as it is implemented in the mechatronic trial concept, while WS-based interaction on device level and with business processes is to propose only for less time critical control tasks.

2.9. WP9 Dissemination

2.9.1. Work package objectives, starting point of work

This WP is concerned with the dissemination and promotion of the project results. There are three major strands to the activity in this WP, scientific dissemination, industrial promotion and dissemination via centres and networks of excellence. This WP complements the standardisation and road mapping work being carried out in WP10. Synchronization has been guaranteed with WP10 through regular meetings and phone conferences. Moreover an international road mapping workshop has been carried out within an international conference (INDIN 2009) with two synchronized purposes: to develop the SOCRADES roadmap and to disseminate SOCRADES results.

Dissemination of SOCRADES results are performed by the project partners through an active participation in fairs and conference. For a detailed and comprehensive list see section 4.

2.9.2. Tasks progress

Task 9.1: Scientific, technical and general dissemination

Dissemination, promotion and assessment activities include the following:

Publications dedicated to results of this project have been generated for presentation at international conferences or in journals. For a detailed and comprehensive list see section 4.

1. Workshops and/or special sessions within international conferences were organised to promote SOCRADES. A special session organized within INCOM 2009 and a road mapping workshop has been carried out within IEEE INDIN 2009. For a detailed and comprehensive list see section 4.
2. An important article on SOCRADES results has been published in Projects of British Publishers. The article is available on-line through SOCRADES website or through this link: <http://viewer.zmags.com/publication/4c086127#/4c086127/22>.
3. A public version of SOCRADES roadmap has been produced. The aim of this document is to describe the project, its results and to show the next steps required in the area of SOA-based Factory Automation.
4. Several videos are available on-line on You Tube showing the features enabled by the technologies developed in SOCRADES (demonstrators): <http://www.youtube.com/user/fp7socrades>

Task 9.2: Industrial promotion

During the last reporting period (M31-M38), results of SOCRADES project have been presented in fairs such as ITEA 2 Symposium 2009. This fair addressed both industrial and scientific communities. Several videos are available on-line on YouTube showing the features enabled by the technologies developed in SOCRADES (demonstrators). These videos show how industrial needs can be addressed through the adoption of SOCRADES technologies.

Moreover, internal dissemination especially within the larger industrial partners of the project is continuously being carried out.

Task 9.3: Dissemination centres and networks Activities in this strand of work included the following:

- An interactive website has been developed to support both external dissemination and interaction between the project partners. This website is kept updated presenting all relevant news related to SOCRADES.
- A road mapping workshop has been organized within an international conference (IEEE INDIN 2009), involving representatives from other invited related projects and experts. A special session was organized within INCOM 2009 (IFAC Symposium on Information Control Problems In Manufacturing).

2.9.3. List of deliverables for the reporting period

Del. no.	Deliverable name	WP no.	Lead partner	Del. type	Security	Due date	Actual date
D9.2b	Dissemination Final report	9	10	R	CO	38	39

- This is the final report of the dissemination activities carried out in the last 20 months (M19-M38) of the project. All detailed information on the dissemination activities done in second part of the project can be found there.

2.9.4. Meetings attended (if applicable)

Meeting Title	Objectives/ Results Achieved	Date	Place
PCC Meeting	PCC topics	27-28 May 2009	Walldorf
Review Meeting	Review Meeting topics	10 June 2009	Brussels
PCC Meeting	PCC topics	3 September 2009	Frankfurt
PCC Meeting	PCC topics	28 October 2009	Madrid

Review Meeting	Review Meeting topics	27 August 2009	Brussels
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2.9.5. Lessons Learned

- Dissemination activities of an Integrated Project require strong attention in the planning and control phases. Moreover, the provision of adequate financial resources is required to guarantee the cover of the expenses referred to the participation of fairs during the project period. The main lesson learned of SOCRADES is that a precise definition of a budget dedicate to fairs, etc. can help the participation to these event as complete consortium (instead of participation through single partners).
- Since all the objectives have been reached within the project duration, we can say that the approach used in SOCRADES for Dissemination activities showed good results.

2.10. WP10 – Exploitation, standards & road mapping

Work package objectives, starting point of work

The work package targeted to prepare proper actions to make the exploitation as successful as possible and help supplier, vendors and system integrators and the users to easily adopt and implement the SOCRADES paradigm. Therefore 3 main objectives have been defined. First, prepare a detailed exploitation plan of the results of the project.

Secondly to derive from the SOCRADES technological innovation a set of specifications to be introduced for international standardisation bodies with the purpose to spread the results worldwide and facilitate the adoption of the service-oriented devices.

And finally to propose a roadmap, which starts from the SOCRADES results and could explore the gap between the current available technologies and the new paradigms resulting by SOCRADES.

2.10.1. Tasks progress

Task 10.1: Exploitation plan

During the project phase some key demonstrators have been implemented and grouped around the major technological areas while focusing on major customer values such as efficient system engineering, interoperability, adaptability and easy reconfiguration of systems or to manage the complexity of systems provided by SOCRADES. To illustrate the link between such customer values and the potential business opportunities based on the SOCRADES results and to integrate intermediate project results a stepwise approach was developed to deploy results incrementally to add new features continuously for demonstrations of the SOCRADES project.

Task 10.2: Specifications for Standards

Regarding DPWS, the OASIS standardization has been completed mid of 2009: the DPWS standard has been approved on June 30, 2009.

This standard has been proposed to the OASIS WS-DD TC (*Web Services Discovery and Web Services Devices Profile Technical Committee*) http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=ws-dd, by CA, Canon, Lexmark, **Microsoft**, Nortel, Novell, Progress Software, Red Hat, Ricoh, **Schneider Electric**, Software AG, and WSO2. Some partners from the previous ITEA SIRENA project (such as MATERNA) also joined the WS-DD TC in order to help achieving this standardization.

This approved standard covers DPWS, WS-Discovery, and SOAP-over-UDP.

Task 10.3: Road mapping for the adoption of the SOCRADES paradigm

The SOCRADES roadmap was done by several studies and workshops. In order to improve the road mapping activity carried out until now and to consolidate the results, both a internet-based survey and a

road mapping workshop have been organized. The Road mapping workshop was organized within the 7th IEEE International Conference on Industrial Informatics (INDIN 2009), June the 24-26th 2009. The purpose was to spread the results of SOCRADES technology and to define next steps in development and application. The internet-based survey was available for six months through SOCRADES Website. The purpose was to prioritize the Expected Features of Technology Areas.

Finally, a public version of SOCRADES roadmap has been produced. This is a complete pamphlet whose aim is to describe the project, its results and to show the next steps required in the area of SOA-based Factory Automation.

2.10.2. Deviations of the project work program (if applicable)

2.10.3. List of deliverables for the reporting period (if applicable)

Del. no.	Deliverable name	WP no.	Lead partner	Del. type	Security	Due date	Actual date
10.1d	Exploitation Plan	10	SEA	R	CO	31.10.09	24.11.09
10.3c	Report on Standardization Activities	10	SEI	R	CO	31.10.09	24.11.09
D10.4c (M38)	(Technology) Roadmap of the SOCRADES paradigm, Final release	WP10	SE	R	PU	31.10.09	24.11.09

2.10.4. Meetings attended (if applicable)

Meeting Title	Objectives/ Results Achieved	Date	Place
PCC Meeting	PCC topics	27-28 May 2009	Walldorf
Review Meeting	Review Meeting topics	10 June 2009	Brussels
PCC Meeting	PCC topics	3 September 2009	Frankfurt
PCC Meeting	PCC topics	28 October 2009	Madrid
Review Meeting	Review Meeting topics	27 August 2009	Brussels

3. Consortium management (WP11 – Project management)

3.1.1. Work package objectives, starting point of work

Note: This section remains unchanged in comparison to the latest 6M-project progress report (M30 - D11.2e).

This WP is concerned with ensuring that the project remains on course and that it is effectively and correctly managed. This includes the following detailed objectives:

- Monitoring, tracking and controlling deviations due to progress, costs, financial and scheduling changes.
- Managing the project according to approved plans.
- Ensuring that the required reporting is prepared and delivered in a timely manner.
- Implementing procedures for quality management.

- Implementing an administration and communication infrastructure to establish a basis for efficient and easy communication within the project. To also ensure that external communication (project Web site, dissemination and exploitation) is done and controlled by the project management.

3.1.2. Tasks progress

Note: This section remains unchanged in comparison to the latest 6M-project progress report (M30 - D11.2e).

Task 11.2: Progress and cost reporting

The objective is to establish a clear reporting structure and processes to the European Commission and for the project activities within the project.

Activities performed in this task were:

- Provide templates for the reporting instances to all concerned participants
- Maintain a document repository for incremental reporting
- Create periodic reports.
 - 6-Monthly Project Progress Report. It is an official deliverable to the EU Commission. This report includes 6-monthly financial report based on the yearly financial report template that is being audited each year. Note: In this case, this D11.2f doesn't content that section because a separated deliverable D11.3c is covering the project financial reports.

Task 11.3: Monitoring, control and quality management

Activities performed include:

- Progress control
- Cost control
- Checking schedules and milestones
- Risk management
 - Identification of risks and risk management strategies for each WP (included as a part of the 6-monthly report)
 - Identification of risks and risk management strategies for the project as a whole (included as a part of the 6-monthly project report)
- Quality assessment for deliverables and WPs
 - Definition of the assessment procedure for each deliverable and for the assessment of work packages (included in the first version of the project handbook).

Task 11.4: Communication management and administration infrastructure

To perform fast and effective communication in the project, different procedures and tools have been implemented:

- Groove Communication Platform
- Project Webpage (www.socrades.eu)
- Project e-mailing lists (partners, PCC, WPLeaders)

3.1.3. Deviations of the project work program (if applicable)

n.a.

3.1.4. List of deliverables for the reporting period (if applicable)

Del. no.	Deliverable name	WP no.	Lead partner	Del. type*	Security	Due date	Actual date
D11.2f	Project Report	11	1	CO		31.10.2009	27.11.2009
D11.3c	3 rd Yearly Cost Statements	11	1	CO		31.10.2009	15.12.2009

3.1.5. List of milestones for the reporting period (if applicable)

3.1.6. Meetings attended (if applicable)

Meeting Title	Objectives/ Results Achieved	Date	Place
Extraordinary PCC	Organizational and Technical	10.03.2009	Phone-meeting
PCC	Organizational and Technical	27-28. 05. 2009	Waldorf
5 th EC Review meeting	30 Months Review Meeting	10.06.2009	Brussels
6 th EC Review meeting	36 Months Interim Review Meeting	27.08.2009	Tampere
PCC	Organizational and Technical	03.09.2009	Frankfurt
PCC	Organizational	28.10.2009	Madrid
7 th EC Review meeting	38 Months (Final) Review Meeting	01-02.12.2009	Aachen

4. Dissemination report (*Dissemination leader*)

All detailed information can be found in the Dissemination Report D9.2b. This section presents a summary the most relevant information. These are the most important activities:

- SOCRADES project was presented at the ITEA 2 Symposium 2009, held in Madrid, Spain, 29-30th October 2009. Several posters, representing the various aspects and achievements of the project, were presented to ITEA officials, to representatives of the public authorities and to the press. Moreover, four videos showing different demonstrators of SOCRADES application were presented.
- Several new videos have been produced in the reporting period (M31-M38) concerning the implementation results. They are available on SOCRADES website (under Pilot section) and have been published on YouTube. These are the videos:
 - **Use of Web Services for Industrial Automation and Enterprise Integration.**
This set of 5 videos has been presented at ITEA2 Symposium 2009. These videos present different features of the Electronic Assembly Demonstrator developed in SOCRADES. Video available through this link: <http://www.youtube.com/TampereUniTechFAST>.
 - **Introducing a Service-Oriented Infrastructure for Industry.**
This video has been presented at ITEA2 Symposium 2009. Video available through this link: <http://www.youtube.com/user/fp7socrades#p/u/0/BCcqb8cumDg>.

- SOCRADES Wireless system in process industry.**
 This video has been presented at ITEA2 Symposium 2009. Video available through this link:
<http://www.youtube.com/user/fp7socrates#p/u/1/1vhps27qjxM>
- SOCRADES Application Engineering Environment.**
 These two videos have been presented at ITEA2 Symposium 2009. Video available through these links: <http://www.youtube.com/user/fp7socrates#p/u/1/SO3lmJJH80s> and <http://www.youtube.com/watch?v=06RmoKSvVIQ>
- A special session was organized during INCOM 2009 to present SOCRADES results. A special session on “Service-Oriented Cross-layer infrastructure for distributed smart embedded devices” has been organized at 13th IFAC Symposium on Information Control Problems in Manufacturing (INCOM 2009), Moscow, Russia, June 3 - 5, 2009. SOCRADES Project has been presented during the conference; moreover, several papers focusing on different aspect of the project were presented by the partners of SOCRADES Consortium.
- A Roadmapping workshop was organized within the 7th IEEE International Conference on Industrial Informatics (INDIN 2009), June the 24-26th 2009. The purpose was to spread the results of SOCRADES technology and to define next steps in development and application.
- An important article on SOCRADES results has been published in Projects of British Publishers. The article is available on-line through SOCRADES website or through this link:
<http://viewer.zmags.com/publication/4c086127#/4c086127/22>.
<http://viewer.zmags.com/publication/4c086127#/4c086127/12>
- A public version of SOCRADES roadmap has been produced. The aim of this document is to describe the project, its results and to show the next steps required in the area of SOA-based Factory Automation.

Industrial fairs:

- CeBit09 – March 2nd - 7th 2009 Hannover - Research exhibits - SOCRADES Technologies were used for an Energy demo.
- Photovoltaic Community Meeting - SAP - DeLoitte Event – May 7th 2009 Hamburg - SOCRADES was introduced.
- Internet of Things / Internet of the Future, Nice, 6-7 Oct 2009, France, SOCRADES Demo Booth
- ICT 2020 Energy Efficiency. 19-20 Mar 2009, Brussels, Belgium. Demo Booth showing SOCRADES technologies in the energy domain with FP7 project SmartHouse/SmartGrid.

Moreover, several papers have been presented and published and other dissemination activities have been carried out during the reporting period. In Table 1 we present a incomplete but representative list of these activities. To have complete information on publications and dissemination activities please refer to the D9.2b Dissemination Final report.

Actual dates	Type	Type of audience	Countries addressed	Partner involved
2009	<i>Paper:</i> “Statistical analysis and prioritization of alarms in mobile networks”. / Wallin, Stefan ; Leijon, Viktor ; Landén, Leif. I: International journal of business intelligence and data mining. 2009	Research	International	LTU

2009	<i>Journal paper:</i> M. Rabi, L. Stabellini, A. Proutiere and M. Johansson, "Networked estimation under contention-based medium access", to appear in the inter. Jnl. of Robust and nonlinear control	Research and industry	International	KTH
2009	<i>Paper:</i> J. Wiklander, J. Eliasson, A. Kruglyak, P. Lindgren, J. Nordlander, "Enabling Component-Based Design for Embedded Real-Time Software", Accepted for publication in Journal of Computers (JCP), ISSN : 1796-203X	Research and industry	International	LTU
2009	<i>Journal Paper:</i> S. Wallin, V. Leijon, L. Landén, "Statistical analysis and prioritization of alarms in mobile networks". International journal of business intelligence and data mining, 2009.	Research and industry	International	LTU
2009	<i>Journal Paper:</i> Gonçalo Cândido, José Barata, Armando W. Colombo, François Jammes, "SOA in Reconfigurable Supply Chains: a Research Roadmap", Engineering Applications of Artificial Intelligence, 2009	Research and industry	International	SE
2009	<i>Journal Paper:</i> Daniel Cachapa, Dr. Robert Harrison, Dr. Armando Colombo, "Configuration of SoA-Based Devices in Virtual Production Cells", International Journal of Production Research	Research and industry	International	SE
2009	Wiklander, Jimmie, Jens Eliasson, Andrey Kruglyak, Per Lindgren och Johan Nordlander. "Enabling component-based design for embedded real-time software." Journal of computers : JCP. 2009.	Research and industry	International	LTU
2009	<i>Book Chapter:</i> Armando W. Colombo, Stamatis Karnouskos, and J. Marco Mendes. Artificial Intelligence Techniques for Networked Manufacturing Enterprises Management, chapter Factory of the Future: A Service-Oriented System of Modular, Dynamic Reconfigurable and Collaborative Systems. Springer (in press), 2009.	Research and industry	International	SAP/SE
2009	<i>Book Chapter:</i> Stamatis Karnouskos, Domnic Savio, Patrik Spiess, Dominique Guinard, Vlad Trifa, and Oliver Baecker. Artificial Intelligence Techniques for Networked Manufacturing Enterprises Management, chapter Real World Service Interaction with Enterprise Systems in Dynamic Manufacturing Environments. Springer (in press), 2009.	Research and industry	International	SAP
2009	<i>Paper:</i> Hans Gellersen, Carl Fischer, Dominique Guinard, Roswitha Gostner, Gerd Kortuem, Christian Krey, Enrico Rukzio, Sara Streng: "Supporting Device Discovery and Spontaneous Interaction with Spatial References." Journal for Personal and Ubiquitous Computing (Springer PUC), 2009	Research and industry	International	SAP
01/04/2009	<i>Paper:</i> Dominique Guinard, Vlad Trifa: "Towards the Web of Things: Web Mashups for Embedded Devices." Workshop on Mashups, Enterprise Mashups and Lightweight Composition on the Web (MEM 2009), in proceedings of WWW (International World Wide Web Conferences). Madrid, Spain, April 2009	Research and industry	International	SAP

07/04/2009	<i>Presentation:</i> "The Web of Things", Dominique Guinard, Tuesday 7th of April 2009, Presented at the Web Mardi developers workshop, Fribourg, Switzerland.	Research and industry	International	SAP
01/05/2009	<i>Paper:</i> Dominique Guinard, Markus Weiss, Vlad Trifa: "Are you Energy-Efficient? Sense it on the Web!" Adjunct Proceedings of Pervasive 2009 (International Conference on Pervasive Computing). Nara, Japan, May 2009	Research and industry	International	SAP
20/05/2009	<i>Presentation:</i> "Towards the Web of Things", Dominique Guinard, Wednesday 20th May 2009 Colloquium at the University of Fribourg, Switzerland.	Research and industry	International	SAP
01/06/2009	<i>Journal Paper:</i> A. Lobov and J. L. Martinez Lastra. "Structural Reasoning: An Approach to the Evaluation of System State Spaces". International Journal of Computational Intelligence in Control (IJCIC), vol. 1, no. 1, 2009.	International Journal on Computational Intelligence in Control	International	TUT
01/06/2009	<i>Paper:</i> M. Rabi and K. H. Johansson, Optimal stopping for updating controls, International Workshop on Sequential Methods, UTT, Troyes, France, June 2009.	Research and industry	International	LTU / ABB / KTH
01/06/2009	<i>Paper:</i> Dominique Guinard, Vlad Trifa, Thomas Pham, Olivier Liechti: "Towards Physical Mashups in the Web of Things." Proceedings of INSS 2009 (IEEE Sixth International Conference on Networked Sensing Systems). Pittsburgh, USA, June 2009.	Research and industry	International	SAP
01/06/2009	<i>Presentation:</i> "The Web of Things: Applying REST to Sensor and Actuator Networks", Dominique Guinard, Vlad Trifa, Domnic Savio. Presentation at Jazoon 2009, the International Conference on Java Technologies, June 2009, Zurich.	Research and industry	International	SAP
03/06/2009	<i>Paper:</i> "Integration of Cross-layer Web-based Service-oriented Architecture and Collaborative Automation Technologies: The SOCRADES Approach" presented at INCOM'09 the 13th IFAC Symposium on Information Control Problems in Manufacturing, Moscow, Russia	Research & Industry	International	SE
03/06/2009	<i>Paper:</i> Rudolf Sollacher, Christoph Niedermeier, Norbert Vicari and Maxim Osipov, "Towards a Service Oriented Architecture for Wireless Sensor Networks in Industrial Applications" presented at INCOM'09 the 13th IFAC Symposium on Information Control Problems in Manufacturing, Moscow, Russia	Research & Industry	International	SIEMENS
03/06/2009	<i>Presentation and Publication:</i> Villaseñor Herrera, V., Vidales Ramos, A. and Martinez Lastra, J. L. "Developing Communications between a Service-Enabled Manufacturing system and a Multi-Agent System". 13th IFAC Symposium on Information Control Problems in Manufacturing (INCOM 2009), Moscow, Russia.	Research & Industry	International	TUT
03/06/2009	<i>Paper:</i> R. Harrison, A. Colombo, A. Bepperling, C.S Mcleod, T. Kirkham "A Service Enabled Approach to Automation Management" presented at INCOM'09 the 13th IFAC Symposium on Information Control Problems in Manufacturing, Moscow, Russia	Research and industry	International	LBORO/SE

03/06/2009	<p><i>Paper:</i> Stamatis Karnouskos, Dominique Guinard, Domnic Savio, Patrik Spiess, Oliver Baecker, Vlad Trifa, and Luciana Moreira S'a de Souza. Towards the real-time enterprise: Service-based integration of heterogeneous soa-ready industrial devices with enterprise applications. In 13th IFAC Symposium on Information Control Problems in Manufacturing (INCOM), Moscow, Russia., 3-5 June 2009.</p>	Research and industry	International	SAP
03/06/2009	<p><i>Paper:</i> D. Savio, S. Karnouskos, L. Moreira Sa de Souza, V. Trifa, D. Guinard, and P. Spiess. Reactive business processes for factory automation. In Proc. 7th IEEE International Conference on Industrial Informatics INDIN 2009, Cardiff, UK, pages 620–625, June 23–26, 2009.</p>	Research and industry	International	SAP
23/06/2009	<p><i>Paper:</i> P. Spiess, S. Karnouskos, L. Souza, D. Savio, D. Guinard, V. Trifa, O. Baecker, and M. Koehler. Reliable execution of business processes on dynamic networks of service-enabled devices. In Proc. 7th IEEE International Conference on Industrial Informatics INDIN 2009, Cardiff, UK, pages 533–538, June 23–26, 2009.</p>	Research and industry	International	SAP
25/06/2009	<p><i>Paper:</i> V. Barot, R. Harrison, C.S. McLeod "An architectural description of a prototype supporting real-time remote data"" to be presented at INDIN'09 the 7th IEEE International Conference on Industrial Informatics, Cardiff, UK</p>	Research & Industry	International	LBORO
01/07/2009	<p><i>Paper:</i> Implementing Agile and Collaborative Automation using Web Service Orchestration, Y.S.Park, T.Kirkham, P.Phaithoonbuathong, R.Harrison, ISIE 2009 - IEEE International Symposium on Industrial Electronics – July 2009, Seoul</p>	Research & Industry	International	Lboro
03/07/2009	<p><i>Paper:</i> Patrik Spiess, Stamatis Karnouskos, Dominique Guinard, Domnic Savio, Oliver Baecker, Luciana Moreira Sá de Souza, and Vlad Trifa. Soa-based integration of the internet of things in enterprise services. In IEEE International Conference on Web Services, ICWS 2009 , Los Angeles, CA, USA, pages 968–975, July 6–10, 2009.</p>	Research and industry	International	SAP
20/07/2009	<p><i>Paper:</i> J. Marco Mendes, Axel Bepperling, João Pinto, Paulo Leitão, Francisco Restivo, Armando W. Colombo "Software Methodologies for the Engineering of Service-Oriented Industrial Automation: The Continuum Project", Proceedings of the 33rd Annual IEEE International Computer Software and Applications Conference, 2009</p>	Research and industry	International	SE
01/08/2009	<p><i>Paper:</i> C. Ramesh, H. Sandberg, and K. H. Johansson, Multiple access with attention-based tournaments for monitoring over wireless networks, ECC, Budapest, Hungary, August 2009.</p>	Research and industry	International	KTH
01/08/2009	<p><i>Paper:</i> P. Soldati and M. Johansson, "Deadline-constrained transmission scheduling and data evacuation in wirelessHART networks", in ECC 2009.</p>	Research and industry	International	KTH
23/08/2009	<p><i>Paper:</i> M. Rabi and K. H. Johansson, Scheduling packets for event-triggered control, ECC, Budapest, Hungary, July 2009. To appear.</p>	Research and industry	International	KTH

01/09/2009	<i>Paper:</i> Business Driven Engineering for Powertrain Industry, R.Harrison, R.P.Monfared, L.Lee, 14th IEEE Int.Conf. on Emerging Technologies and Factory Automation - ETFA 2009, Spain	Research & Industry	International	Lboro/Ford
01/09/2009	<i>Presentation and publication,</i> topic: Orchestration of Service-enabled Manufacturing Systems (IT Revolutions 2008)	Research & Industry	Worldwide	TUT
01/09/2009	<i>Presentation:</i> Karl H. Johansson is Keynote Speaker and Invited Lecturer presenting SOCRADES work at: German PhD School on Control Theory of Digitally Networked Dynamical Systems, Dortmund, Germany,	Research		KTH
10/09/2009	<i>Presentation:</i> presentation of Socrates and of the Boliden demo at the 8th Meeting of the Wireless Sensing Interest Group (WiSIG), Coventry University, UK	Research and industry	International	LTU
10/09/2009	<i>Presentation:</i> of Socrates and the Boliden demo at WiSIG in Coventry, UK with the title "A SOA architecture for closed loop process control - results from the Socrates project"	Research and industry	International	LTU
22/09/2009	<i>Presentation and Publication:</i> Puttonen, J. Lobov, A. and Martinez Lastra, J. L. "An Application of BPEL for Service Orchestration in an Industrial Environment," IEEE International Conference on Emerging Technologies and Factory Automation, 2008 (ETFA 2008), Hamburg, Germany.	Research & Industry	International	TUT
22/09/2009	<i>Paper:</i> G. Fiori, V. Ercoli, A. J. Isaksson, K. Landernas, M. D. Di Benedetto "Multihop Multi-Channel Scheduling for Wireless Control in WirelessHART Networks" to be presented at ETFA09 the 14th IEEE International conference on emerging technologies and factory automation	Research and industry	International	ABB
13/10/2009	<i>Presentation:</i> at the Embedded Conference Scandinavia "ECS09", Stockholm, Sweden with the title ""Wireless control using 802.15.4 radio with substantial radio disturbances in a heavy industrial""	Research and industry	International	LTU
03/11/2009	<i>Paper:</i> Alessandro Cannata, Stamatis Karnouskos, and Marco Taisch. Energy efficiency driven process analysis and optimization in discrete manufacturing. In 35th Annual Conference of the IEEE Industrial Electronics Society (IECON 2009), Porto, Portugal, 3-5 November 2009.	Research and industry	International	POLIMI/SAP
7-10/2009	<i>Presentation:</i> at Processteknik fair Guthenburg, Sweden. En SOA arkitektur som supportar reglering över trådlös länk (A SOA architecture supporting control over wireless link)	Research and industry	International	LTU
16/12/2009	<i>Paper:</i> Peter Almström, Maben Rabi, Mikael Johansson, "Networked state estimation over a Gilbert-Elliot type channel," Submitted to the 2009 IEEE CDC.	Research and industry	International	KTH
22/10/2009	<i>Paper:</i> Viktor Leijon, "FIFO Networking: Punctual Event-Triggered Communication", in Proceedings of the 14th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA), (2009).	Research and industry	International	LTU

23/03/2009	<i>Paper:</i> S. Karnouskos and M. M. J. Tariq. Using multi-agent systems to simulate dynamic infrastructures populated with large numbers of web service enabled devices. In Proc. International Symposium on Autonomous Decentralized Systems ISADS '09, Athens, Greece, pages 1–7, March 23–25, 2009.	Research and industry	International	SAP
23/06/2009	<i>Paper:</i> S. Karnouskos, A. W. Colombo, J. L. M. Lastra, and C. Popescu. Towards the energy efficient future factory. In Proc. 7th IEEE International Conference on Industrial Informatics INDIN 2009, Cardiff, UK, pages 367–371, June 23–26, 2009.	Research and industry	International	SAP/TUT
23/06/2009	<i>Paper:</i> S. Karnouskos and A. Izmaylova. Simulation of web service enabled smart meters in an event-based infrastructure. In Proc. 7th IEEE International Conference on Industrial Informatics INDIN 2009, Cardiff, UK, pages 125–130, June 23–26, 2009.	Research and industry	International	SAP
23/06/2009	<i>Paper:</i> João Pinto, J. Marco Mendes, Paulo Leitão, Armando W. Colombo, Axel Bepperling, Francisco Restivo "Decision Support System for Petri Nets Enabled Automation Components", in the Proceedings of the 7th IEEE International Conference on Industrial Informatics, 2009	Research and industry	International	SE
23/06/2009	<i>Paper:</i> Paulo Leitao, J. Marco Mendes, Armando W. Colombo "Smooth Migration from the Virtual Design to the Real Manufacturing Control", in the Proceedings of the 7th IEEE International Conference on Industrial Informatics, 2009	Research and industry	International	SE
25/11/2009	<i>Paper:</i> Stamatis Karnouskos and Thiago Nass de Holanda. Simulation of a smart grid city with software agents. In European Modelling Symposium (EMS 2009), Athens, Greece, 25-27 November 2009.	Research and industry	International	SAP
28-10-2009	<i>Paper:</i> Alessandro Cannata, Stamatis Karnouskos, and Marco Taisch. Dynamic e-maintenance in the era of SOA-ready device dominated industrial environments. In World Congress on Engineering Asset Management, Athens, Greece, 28-30 September 2009.	Research and industry	International	POLIMI/SAP
30/07/2009	<i>Presentation and paper:</i> Daniel Wuwer, Thomas Bangemann, Armando-Walter Colombo, Stamatis Karnouskos "SOCRADES - Die Integration klassischer Automatisierungskomponenten in Service orientierte Architekturen" within the track "Automation" at the "9. Magdeburger Maschinenbautage" (9th Machine Building Days at Magdeburg University)	Research and industry	International	Ifak/SAP/Schneider
03/06/2009	<i>Paper and presentation:</i> Stamatis Karnouskos, Thomas Bangemann, Christian Diedrich, "Integration of Legacy Devices in the Future SOA-based Factory" presented at INCOM'09 the 13th IFAC Symposium on Information Control Problems in Manufacturing, Moscow, Russia	Research and industry	International	Ifak/SAP
03/11/2009	<i>Paper:</i> G. Cândido, F. Jammes, J. Barata, Armando W. Colombo, "Generic Management Services for DPWS-enabled devices", in 35th Annual Conference of the IEEE Industrial Electronics Society (IECON 2009), Porto, Portugal, 3-5 November 2009.	Research and industry	International	SE

06/07/2009	<i>Paper:</i> Dominique Guinard, Vlad Trifa, Patrick Spiess, Bettina Dober, and Stamatis Karnouskos. Discovery and on-demand provisioning of real-world web services. In IEEE International Conference on Web Services, ICWS 2009 , Los Angeles, CA, USA, Los Angeles, CA, USA, 6–10 July 2009.	Research and industry	International	SAP
01/12/2009	<i>Paper:</i> E. Henriksson, H. Sandberg, and K. H. Johansson, Reduced-order predictive outage compensators for networked systems, IEEE CDC, Shanghai, China. Submitted	Research and industry	International	KTH
01/02/2009	<i>Paper:</i> Stamatis Karnouskos. Efficient Sensor Data Inclusion in Enterprise Services. Datenbank-Spektrum, 9(28):5–10, February 2009.	Research and industry	International	SAP
01/06/2009	<i>PhD Thesis:</i> Luciana Moreira Sá de Souza. Pattern Based Fault Diagnosis for Wireless Sensor Networks applied in Business Processes. PhD thesis, University of Karlsruhe, Germany, June 2009.	Research and industry	International	SAP
12-10-2009	<i>Paper:</i> Matthias Riedl, Thomas Bangemann, Christian Diedrich, Robert Harrison, Radmehr Monfared, Daniel Wuwer "Integration of Automation Devices in Web Service supporting Systems", at 30th IFAC Workshop on Real-Time Programming and 4th International Workshop on Real-Time Software (WRTP/RTS'09)	Research and industry	International	Ifak/LBORO

4.1. Internal dissemination activities

Internal dissemination has been carried out by Industrial partners in particular. ABB in April 2009 presented SOCRADES WP4 demo to the R&D team of the company.

4.2. Training activities

A number of activities have been carried out with regards to training.

- Siemens introduced ifak and APS into the usage of our OPC UA gateway and SIEMENS Sensor Network.
- Training sessions on the use of Mediator for integrating legacy systems into Web Service architectures (DPWS, OPCUA, Configuration based on EDD) have been done by ifak
- Training session on Timber – SW development for real time event driven system, Feb. 2009.
- TUT is developing an “Available on-line training material on the use of BPEL-based Service Orchestration tools and Agent-based Decision-making System”
- Jaguar/Ford, Lboro: Functional Oriented Modularity (FOM) training, Oct. 09. Countries addressed: UK, Germany.

4.3. Planned activities

After the end of the project a number of dissemination activities are planned. The detailed plan for future dissemination activities are included in the final report in the Annex “Plan for using and disseminating the knowledge”. Please refer to this document for more information on this.

5. Risk management

This section addresses key risks that have been identified for the whole project and summarizes the main risks related to each work package (if applicable), concerning the current face of the project life cycle.

5.1. Risk analysis at project level (Project Coordinator)

Description of Risk	Consequences and Seriousness	Risk evaluation (H/M/L)	Response actions	WP No	Undertaken actions from the last 6M report
Delay in delivering Final Project Reports	The final payment of the EC Contributions could be delayed	L	Making pressure to the partners for delivering their contributions	All	

5.2. Risk analysis per WP (WP Leaders)

Description of Risk	Consequences and Seriousness	Risk evaluation (H/M/L)	Response actions	WP No	Undertaken actions from the last 6M report
Implementations not running	Task 3.4 not fulfilled and drawback for exploitation	M	Early start of implementation work and several in between tests	3	n.a.
Validation not successful	Task 3.4 not fulfilled, drawback for exploitation, and endangering of WP8 success	M	Severe matching of real achievements and requirements	3	n.a.
DPUA not running	Endangering of WP8 success	L	Very serious development process	8	n.a.
Insufficient Dissemination	Failure to achieve a widespread diffusion of the project results	L	Provide a valid Dissemination Plan and follow it	9	Adoption of "Push" technique to improve dissemination and participation to events. Organization of special tracks in conferences and participation to industrial fairs.

Table 1 Risks analysis

6. Reactions on the Recommendations of the EU Reviewers

Recommendation	Reaction	Responsible
<p>Recommendation 1 5th EC review: High emphasis on exploitation planning and dissemination during the final project phase is required. The industrial stakeholders' intentions (individually and/or collectively) concerning future exploitation of SOCRADES results including patenting options need to be clarified. A draft of the exploitation plan deliverable available in the time frame of the Tampere review would be welcomed by the reviewers.</p>	<p>See final reports and presentations in Aachen about exploitation and dissemination</p>	
<p>Recommendation 2 5th EC review: A revision of D5.6.2 is required. According to the original goals and title it should describe in detail the tests of the DPWS stack on the pre-prototype hardware (see items at the end of the review section on D5.6.2) as well as evaluation, analysis and conclusions for the architecture. The existing text version could be the final part, as a result from the foregoing analysis.</p>	<p>Done</p>	
<p>Recommendation 3 5th EC review: D5.6.3 is required to express from the beginning the really used hardware (pre-prototype instead of prototype), and to distinguish between anyway available software tools on one side and special developments or adaptations for the project on the other side. But it has to be separated from the test descriptions belonging to D5.6.2 (see recommendation 2).</p>	<p>Done</p>	
<p>Recommendation 4 5th EC review: Take care that the devices and software needed for the application pilots will be delivered as soon as possible, such that enough time remains for implementation and evaluation of the application pilots. Especially, the translator between OPC-UA and DPWS seems to be on a time-critical path.</p>	<p>The success of the trial demonstrations in Aachen on Dec 1 and 2 will demonstrate that we took sufficiently into account this recommendation.</p>	<p>APS presentation of trials during the Aachen final meeting</p>
<p>Recommendation 5 5th EC review: Implementation, test and evaluation of the planned test scenarios are very important as a proof of interoperability of devices and practicability of the SOCRADES architecture. The evaluation should include positive as well</p>	<p>Addressed through deliverable D8.2</p>	<p>APS presentation of D8.2 during the Aachen final meeting</p>

<p>as negative experiences, and also should include the needed engineering efforts and tools. Precise evaluation of the DPUA translator is also required.</p>		
<p>Recommendation 6 5th EC review: (it corresponds to recommendations 3, 6 and 9 of the 4th review report) Describe and communicate the customer benefits of the SOCRADES architecture, especially in comparison with conventional architectures.</p>	<p>Several presentations were made in public conferences, as well as several dissemination white papers were presented in several major conferences, showing the major customer benefits of the SOA architecture compared to traditional architecture: Interoperability, Plug and Play and Integration capability.</p>	<p>Technical Manager to present again these customer values during the Aachen final meeting.</p>
<p>Recommendation 6 5th EC review: For this, not only functionality, but also clear descriptions of engineering methodologies (and tools) are of utmost importance.</p>	<p>See WP7 deliverables</p>	<p>Lboro</p>
<p>Recommendation 6 5th EC review: One particular aspect might be the flexibility during run-time (e.g. in case of failures, change of devices, automatic reconfiguration, etc.).</p>	<p>Flexibility at run-time is provided by dynamic (re)configuration and deployment capabilities as well as by plug and play mechanisms at the device level. Changes and updates are automatically detected and managed by upper level systems and tools.</p>	
<p>Recommendation 7 5th EC review: (identical to recommendation 1 of the 4th review report, November 2008) Harmonise the state-of-the-art descriptions in WP1 (D1.5) and D10.4. A possible remedy could be as follows: The pure technical aspects, as far as they are not yet contained in WP1, should be shifted to WP1 (into future D1.5). The next version of D10.4 should concentrate more on the roadmap aspects of the SOCRADES technologies only, i.e. existing and expected future meaning, acceptance and use of these technologies, their markets, and necessary products (as a vision).</p>	<p>Whereas D1.5, which is the successor of D1.4, is dedicated to the current state-of-the-art analysis, D10.4c is focused on vision and future outlook of SOA technologies. The responsible author of D10.4c participated in the preparation of D1.5.</p>	<p>IFAK - POLIMI</p>
<p>Recommendation 8: Revise carefully the road mapping for the adoption of the SOCRADES paradigm. Expected Features of the Technology Area (EFTA) are to be identified. Enabling the interoperability between SOCRADES architecture and legacy devices is regarded as a key factor for exploitation.</p>	<p>EFTAs have been identified. Deliverable 10.4c describes and prioritizes them. Interoperability with legacy devices is addressed.</p>	<p>POLIMI</p>
<p>Recommendation 9 5th EC review: The web site correctly presents SOCRADES as an FP6 project under IST. This gives the impression of</p>	<p>Done. The website has been modified as suggested. Moreover in the home page it presents several news related</p>	<p>POLIMI</p>

<p>some old-fashioned project in comparison with well-known on-going FP7 ICT. The overlap of the timeframe between FP6 and FP7 should be exhibited somewhere to clearly point out that the project is up to date and on the way to deliver outstanding technical results. A suggestion would be to replace “Welcome to SOCRADES” by “Welcome to SOCRADES 2006-2009” in the home page.</p>	<p>to 2009.</p>	
<p>Recommendation 10 5th EC review: A nice bunch of papers is available on the project website, providing technical details on different facets of the developed technology. However, the sections "downloads" and 'standardisation" are left empty. It would be useful to include at least references (with hyperlinks) to external information sources (e.g. links to OASIS DPWS-related pages). In addition, in all publications acknowledgements are to be included that the reported work is partially/totally financed by the IST SOCRADES project of the European Commission.</p>	<p>“Downloads” and “Standardisation sections have been updated. Publications present the acknowledgments as requested.</p>	<p>POLIMI</p>
<p>Recommendation 11 5th EC review: In order to complement recommendation 9, please implement statistics about the web site visitors (number, country, accessed pages).</p>	<p>Due to cost related to this modification, the decision was to avoid providing this piece of information that was not considered essential to be published.</p>	<p>POLIMI</p>
<p>Recommendation 12 5th EC review: Concerning the financial figures, please explain cost shifts between partners in the final cost statement.</p>	<p>See Annex 1</p>	<p>Herman Hauser</p>
<p>Recommendation 13 5th EC review: Provide more details on the status/readiness level of the components developed in WP5 and relationships between these components.</p>	<p>Done in latest release notes of the components</p>	
<p>Recommendation 14 5th EC review: Provide the detailed specification of the DPUA translator that will be implemented by ifak as early as possible.</p>	<p>Done through Deliverables D3.4 and D8.1</p>	
<p>Recommendation 15 5th EC review: Clarify how the exploitation of results from previous projects such as ITEA projects SODA, SIRENA, LOMS and OSAMI in the framework of SoA is being used in this particular project. Ensure that the project brings tangible results, as at this stage it is still unclear how an understandable description of the application</p>	<p>Done in D5.2.2 and D8.1</p>	

of SOCRADES concepts from the functionality and engineering point of view will be given by the stakeholders.		
Recommendation 1 6th EC review: High emphasis on exploitation planning and dissemination during the last two months of the project is required. The industrial stakeholders' intentions (individually and/or collectively) concerning future exploitation of SOCRADES results including patenting options need to be clarified.	See final reports and presentations in Aachen about exploitation and dissemination	
Recommendation 2 6th EC review: Implementation, test and evaluation of the planned test scenarios are very important as a proof of interoperability of devices and practicability of the SOCRADES architecture. The evaluation should include positive as well as negative experiences, and also should include the needed engineering efforts and tools. Precise evaluation of the DPUA translator is also required.	See D8.2	
Recommendation 3 6th EC review:	Same as Recom 6 5th EC Review	
Recommendation 4 6th EC review	Same as Recom 8 5th EC Review	
Recommendation 5 6th EC review: Deliver a first version of D8.1 on due time then improvements should come later.	Done	
Recommendation 6 6th EC review	Same as Recom 10 5th EC Review	
Recommendation 7 6th EC review	Same as Recom 13 5th EC Review	
Recommendation 8 6th EC review	Same as Recom 15 5th EC Review	

7. Annex 1: Recommendation 12 – Explanation



Shift of Tasks between Partners

Partner No. Name	Efforts / Costs	Activity				Total
		RTD	Demonstration	Training	Management	
1 SEA	Efforts (PM)	-5,0				-5,0
	Eligible Costs (€)	-67.200,00				-67.200,00
	EC Contribution (€)	-33.600,00				-33.600,00
8 Lboro	Efforts (PM)		4,9		0,2	5,1
	Eligible Costs (€)		17.493,00		2.040,00	19.533,00
	EC Contribution (€)		17.493,00		2.040,00	19.533,00
13 TUT	Efforts (PM)	5,0				5,0
	Eligible Costs (€)	33.600,00				33.600,00
	EC Contribution (€)	33.600,00				33.600,00
14 Jaguar	Efforts (PM)		-4,9		-0,2	-5,1
	Eligible Costs (€)		-49.980,00		-2.040,00	-52.020,00
	EC Contribution (€)		-17.493,00		-2.040,00	-19.533,00
Total	Efforts (PM)	0,0	0,0	0,0	0,0	0,0
	Eligible Costs (€)	-33.600,00	-32.487,00	0,00	0,00	-66.087,00
	EC Contribution (€)	0,00	0,00	0,00	0,00	0,00

Remark: Essential condition of these shifts = no increase of total EC Contribution