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14	Jaguar Cars Ltd.	JAGUAR
15	ARM Ltd.	ARM

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1. Document objective

This document is a reminder of the project objectives, and of the WP objectives (as defined in the DoW), and provides a detailed definition of the quality assessment criteria for the first 18 month deliverables, according to the objectives.

2. Project objectives

The goal of the SOCRADES project is to create new methodologies, technologies and tools for the modelling, design, implementation and operation of networked hardware/software systems embedded in smart physical objects. The smart embedded system is to be applied in perception and control systems in intelligent environments, in which enhanced system intelligence is achieved by co-operation of smart embedded devices pursuing common goals. These devices with embedded intelligence and sensing/actuating capabilities are expected to be heterogeneous yet they need to interact seamlessly and intensively over a network (wired/wireless).

The middleware technologies to be developed in this project will be based on the Service-Oriented Architecture approach, will be generic to any networking technology or transmission medium, and will provide open interfaces that enable interoperability at the semantic level to any third party. A SOCRADES service will be implemented as a software component that encapsulates device-specific functionality. This functionality is advertised to the outside world, in order to be located and invoked by other networked devices and/or applications, without the latter being aware in any way of how the functionality is implemented.

The SOCRADES approach is to create system intelligence by a large population of small and smart networked embedded devices at a high level of granularity, as opposed to the traditional approach of focusing intelligence on a few large and monolithic applications. This increased granularity of intelligence distributed among loosely coupled intelligent physical objects facilitates the adaptability and reconfigurability of the system, allowing it to meet business demands not foreseen at the time of design. Focus from a functional perspective will be in managing the vastly increased number of intelligent devices and the associated complexity. Focus from a run-time infrastructure view will be on a new breed of very flexible real-time embedded devices (wired/wireless) that are fault-tolerant, reconfigurable, safe and secure.

Scientific and technological objectives	The scientific and technological objectives of SOCRADES are to create a service-oriented ecosystem where intelligent networked systems are composed of wired/wireless smart embedded devices that interact with the physical environment and with the enterprise environment pursuing well-defined system goals. By taking the granularity of intelligence to the device level, intelligent system behaviour is achieved by composing configurations of devices that introduce incremental fractions of the required intelligence. This approach enhances rapid reconfigurability, as there is no need for software re-programming of large monolithic systems but rather a reconfiguration of loosely coupled embedded units. Auto-configuration management is a new challenge, but it is based on basic plug-and-play and plug-and-run mechanisms. These are known from fieldbus and PC systems. In order to improve the agility of deployment and reconfiguration, wireless technology for embedded devices is of particular interest, with emphasis on low power consumption and predictable QoS. Interoperability of widely heterogeneous devices is provided by following a ubiquitous service-oriented approach, which provides opaque interfaces and facilitates discovery and composition of resources. Interoperability at the semantic level is enabled by employing machine-interpretable semantic mark-up, which is used by intelligent physical agents to reason and infer the skills and services offered by other devices, and collaborate towards common goals. Managing semantic interoperability and auto-configuration is definitely an ambitious task. Starting points are fieldbus device profiles, which have a common foundation in the IEC 62390 Device Profile Guideline.

Wireless technology

Wireless technologies can significantly facilitate deployment and reconfiguration by eliminating the need for installing and maintaining cabling, reducing both costs and time. The shortfall of industrial adoption of wireless technology is due to its lack of maturity, failure to provide real-time performance and lack of reliability metrics comparable to those of wired networks.

One of the main objectives of the project is therefore to specify new wireless communication protocols that provide the required reliability, safety, security and real-time parameters for embedded devices. Associated to this objective is the specification of middleware that encapsulates the different mechanisms to offer specific QoS provisions and the different underlying wireless technologies.

Web Services for intelligent embedded devices

The umbrella paradigm underpinning novel collaborative system design approaches is to consider the set of intelligent system units as a conglomerate of distributed, autonomous, intelligent, pro-active, fault-tolerant and reusable units, which operate as a set of co-operating entities. Typically, each entity is constituted of hardware, sensing/actuating resources, control software and embedded intelligence. These entities are capable of working in a pro-active manner, initiating collaborative actions and dynamically interacting with each other in order to achieve both local and global objectives, down from the physical machine control level up to the higher levels of the business process management system.

The use of the service-oriented architecture (SOA) paradigm, implemented through Web Services technologies, at the ad hoc device network level enables the adoption of a unifying technology for all levels of the enterprise, from sensors and actuators to enterprise business processes. The benefits of service-orientation are conveyed all the way to the device level, facilitating the discovery and composition of applications by re-configuration rather than re-programming. Dynamic self-configuration of smart embedded devices using loosely-coupled services provides significant advantages for highly dynamic and ad hoc distributed applications, as opposed to the use of more rigid technologies such as those based on distributed objects.

A key goal of SOCRADES is therefore to specify a service-oriented framework for device-level infrastructures, where system intelligence is implemented by intelligent physical agents embedded in smart devices.

To realise this goal, it is necessary to:

- Specify and implement an enhanced version of the device-level SOA infrastructure – based on the Devices Profile for Web Services (DPWS) – for encapsulating intelligence and sensing/actuating skills as services, as well as to specify associated frameworks for management and orchestration of device-level services.
- Define a methodology for describing services with semantic mark-up that can be interpreted and processed by agents (Semantic Web Services), for the discovery, selection and composition of resources.
- Specify a framework for service-enabled intelligent physical agents.

Under the premises addressed above, the role and extent of control will be:

- Discrete sequence control (PLC/ SCADA)
    - Efficiency of DPWS (performance, latency, security…)
    - DPWS interface to WSN / wireless nodes
- Closed-loop control (DCS)
    - Networked wireless control
    - Device-level control and communication design and architecture

Enterprise integration	The application of the SOA paradigm and Web Services technology, as proposed in SOCRADES, results in a single unifying application-level communications technology across the enterprise. *A fundamental goal of SOCRADES is to enable the integration of device-level services with enterprise systems.* This goal will require the definition of new integration concepts taking into account the emerging requirements of business applications and the explosion of available information from the device level. Of particular interest is the availability of real-time event information, which will be used to specify new enterprise integration approaches for applications such as business activity monitoring, overall equipment effectiveness optimisation, maintenance optimisation, etc. In this context, control at higher level than real-time front-end will facilitate that enterprise-level systems (ERP, MES …) send non real-time asynchronous commands to the automation system (such as manufacturing orders) and receive events (such as diagnostic information).
System engineering	Considering the users of the type of distributed embedded systems covered by SOCRADES, it is necessary to support application design, simulation and monitoring of real-time intelligent embedded components. Simultaneously, it is necessary to support the integration of these devices with higher-level business process systems (enterprise dimension), with supply chain partners (value/supply-chain dimension) and within a lifecycle engineering context (lifecycle dimension). Furthermore, the explosion in number of embedded devices will require new tools and methods for managing a new degree of complexity. *Within this area, a goal of SOCRADES is to specify systematic approaches and engineering tools that will facilitate the engineering of the overall system behaviour. In agile and mobile embedded systems, the borderline between engineering and run time blurs, that is, the run time system and the engineering system are mutually related parts of a single system. Additionally, the semantic level of configuration has to be supported by the engineering platform. Starting points for these tasks are device models and meta-models combined with knowledge-oriented information representation.*

2.1. Work package 1: Trend screening, requirements, state-of-the-art, technology assessment

The main goal of WP1 is to work out the overall requirements as well as specific requirements for the primary application domains targeted by the project and to elaborate the baselines for the internal benchmarking (self-evaluation) process. Additionally, the benchmarking process will be supported by a revolving trend screening activity.

The focus is set to communication between and integration of heterogeneous embedded systems and devices, with particular emphasis on platform independence, real-time requirements, robustness and security. The underlying tendency is that the increasing availability of affordable, high-performance, low-power electronic components allows incorporating unprecedented horsepower into ever-tinier components. At the same time, Internet and (wired or wireless) Ethernet technologies are emerging as the basic carriers for interconnecting electronic devices. These technologies can be leveraged to build advanced functionality into embedded devices, thus enabling new distributed application paradigms based on interconnected "smart devices" with a high level of autonomy. This applies to many types of embedded devices, whether used in industrial automation systems, automotive electronics, telecommunications equipment, building controls, home automation, medical instrumentation, etc. The SOCRADES project will operate in this sense of general applicability across a broad range of application domains, while using as its application cornerstone one of the most prominent embedded systems domains, viz. manufacturing and process automation.

The umbrella paradigm of SOCRADES is called "collaborative automation". The aim is to effectively utilise this paradigm, and to develop the corresponding tools and methods, so as to achieve flexible, re-configurable, scalable, interoperable network-enabled collaboration between decentralised and distributed embedded systems. Applying device-level Service-Oriented Architecture (SOA), it is expected to contribute to the creation of an open, flexible and agile environment, by extending the scope of the collaborative architecture approach through the application of a unique communications infrastructure, down from the lowest levels of the device hierarchy up into the manufacturing enterprise's higher-level business process management systems. Business application systems increasingly benefit from the adoption of SOA, allowing to flexibly compose components of heterogeneous software systems across traditional system boundaries and to swiftly adopt business processes to changing requirements. Therefore, the device platform has to be very flexible, using both wireless and wireline communication media, scalable embedded systems, and appropriate engineering methods and tools.

Web Services technology constitutes the preferred implementation vehicle for service-oriented architectures. A Web Service is platform-independent and can communicate with and/or be aggregated with other Web Services. As each service encapsulates its own complexity, scalability becomes a built-in feature. Additionally, manageability and maintainability are greatly enhanced, especially as each device presents a high-level management interface in order to facilitate configuration, monitoring, fault diagnosis, etc.

The above considerations will guide the investigations of the present WP, which will cover the following activities:

- Survey of wireless and wired technologies on the market
- Survey of use of networked embedded systems in collaborative environments
- Survey of technologies for distributed applications
- Survey of usage of IP-based networks for connecting embedded systems
- Survey of enabling technologies, tools and methods relevant to the engineering environment
- Classification of application requirements with regard to real-time distributed automation and control, integration with higher level systems and engineering support
- Security and safety solutions in embedded system applications

As far as possible, these subjects will be treated in their generality. When too wide a scope would thus be addressed, they would be more particularly examined from the viewpoint of industrial and automation systems, the primary application domain considered by the project.

The state-of-the-art as a technical background together with the trends and the available relevant technologies will be described as the basis for the project work. Any additional requirements due to national particularities will also be considered.

2.2. Work package 2: Framework specification for ad-hoc networking service platform

This WP will define an infrastructure framework for service-based ad hoc networking to enable communications between embedded devices at the application level. Devices will be able to discover each other by peer-to-peer interactions that are able to adapt to any ad hoc configuration, without need for any pre-configured server- or registry-based mechanism. In order to provide semantic interoperability, the service descriptions will be enriched with semantic content, enabling smart embedded devices to discover and invoke other devices that implement different taxonomies, syntax and/or morphology, but equivalent semantics. The framework will also provide facilities for the management, administration, monitoring, and reconfiguring of the system.

An important aspect of this framework will be to facilitate the integration of non-service-enabled devices by providing bridging or gatewaying mechanisms for embedded devices such as wireless sensors. This is where the device-centric infrastructure and the service-centric infrastructure of the SOCRADES project will meet. The boundary between where devices can be fully service-enabled and where they cannot because of cost-effectiveness, legacy preservation or other considerations and constraints must be kept variable, so that it can be shifted as technology makes further strides and device capabilities evolve accordingly.

The use of the Service-Oriented Architecture paradigm implemented through Web Services technologies, at the ad hoc device network level enables the adoption of a unifying technology for all levels of the enterprise, from sensors and actuators to enterprise business processes. The benefits of service-orientation are conveyed all the way to the device level, facilitating the discovery and composition of applications by re-configuration rather than re-programming. Dynamic self-configuration of smart embedded devices using loosely-coupled services provides significant advantages for highly dynamic and ad hoc distributed applications, as opposed to the use of more rigid technologies such as those based on distributed objects.

2.3. Work package 3: Wireless sensor/actuator networking infrastructure

As mentioned before, the goal of the SOCRADES project is to create new methodologies, technologies and tools for the modelling, design, implementation and operation of networked hardware/software systems embedded in smart physical objects. It can be noted that wireless technology currently conquers the embedded systems field in a wide range of applications. As one of these application areas, the domain of industrial communication follows this trend and adopts wireless technologies to networked embedded automation devices. Against this background, especially solutions for the very special conditions in the harsh environment of automation installations are of high interest – wireless industrial communications based on WLAN and IEEE 802.15 standards are in the focus of this kind of research and development. Combining this with SOCRADES' objective of distributed smart embedded systems to be applied in perception and control systems in intelligent environments – enhanced with system intelligence achieved by cooperation of smart embedded devices towards common goals – especially wireless sensor/actuator networks (WSN) are a research area to be investigated more closely: The mobility and flexibility required in most application fields nowadays (e.g. industrial communication) is definitely fostered by WSN. The natural features of wireless technologies enable greater opportunities for reconfiguration/upgrading, maintenance, and fault tolerance. Due to the existence of lots of legacy wired communication systems, particularly in industrial communication, suitable transitions between the wired and wireless approaches have to be elaborated. With regard to the different wireless technologies within the enterprise hierarchy, furthermore, suitable transitions among these approaches have to be investigated. This also concerns the access to Wide Area Networks. Finally, the merging of the DPWS application models (see WP 2, 5 and 6) with the latest architectures used in wireless technologies is a focal point of this WP.

Consortium members are active in a number of relevant working groups dealing 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. The continuous contact to these panels increases the acceptance of a later standardisation following in this area.

Against that background, the following research topics are addressed within this WP:

- 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;
- Demonstrator set-up.

2.4. Work package 4: Device-centric infrastructure

Automatic control is a central component of any modern process and manufacturing industry. The information flows between sensor, actuator and control nodes have traditionally been hardwired asynchronous communication. Over the last decade, there has been a transition to communication buses, such as fieldbus and Ethernet technology, in these control systems. Currently there is a major drive to take the next step in this evolution by moving to wireless communication. More efficient and lower costs for installation and commissioning are important factors. There is also a large potential for major technological advances due to increased flexibility and mobility, which may lead to totally new system designs.

Wireless technology is however subject to major uncertainties with respect to availability and reliability. Wireless communication is not only sensitive to interference from background noise, but also to competing wireless networks. If wireless communication finds its way into industrial communication, which we believe, we must handle the situation where several different wireless networks will compete for the shared media. A possible solution to this particular situation would be to use standards and have friendly co-existence of various wireless protocols. We do not believe this will happen due to the fact that so many different wireless protocols will be used to meet different kinds of requirements that it will virtually be impossible to guarantee compatibility. Instead, any new technology needs to have a built-in robustness and adaptation to cope with the major uncertainties and variations the wireless communication presents.

Traditional control design is based on ideal assumptions concerning the amount, type and accuracy of the data flow that can be circulated across the control system. Inherent limitations of control performance are considered with respect to bounds on controller resources, such as actuator authority and sensor dynamics. Unfortunately, real implementations often invalidate assumptions on ideal transmission and networking, and as a result, the system's closed-loop performance can be severely affected.

The basis for this WP is a networked control approach, in which a holistic view on control over wireless networks is taken. By combining expertise in automatic control, communication systems and wireless sensor networks, integrated and adaptive solutions will be developed and tested for achieving suitable control performance despite communication uncertainties and variations. See Figure 1.

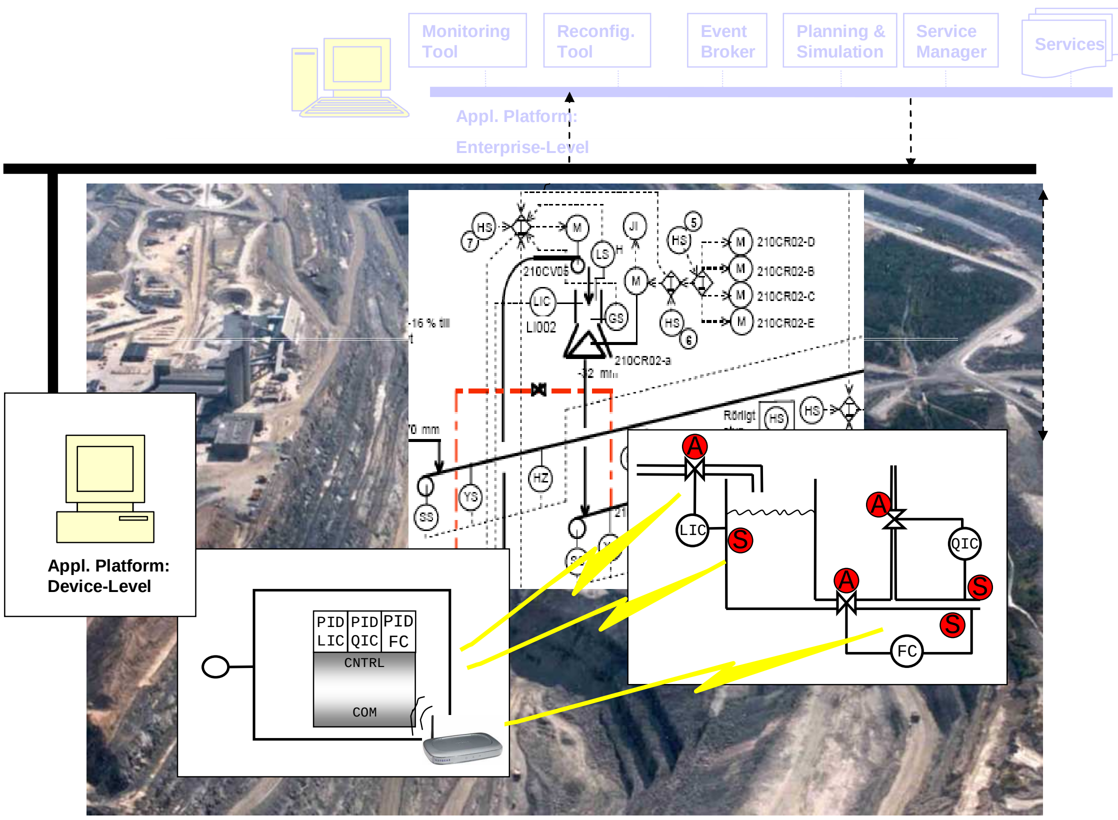

Figure 1. The SOCRADES component for closed loop control over a wireless link encapsulates the control functionality offering high level services to the system.

The goal of this WP is to address the challenges of networked control over a wireless link and to incorporate the functionality into a service-oriented architecture.

The objectives of the WP include:

- Development of architecture for fault tolerant control;
- Control under uncertain sensor and actuator communication;
- Wireless communication for control purposes;
- Implementation of a component, which embodies the developed control and communication theories and algorithms and provides a DPWS interface;
- Demonstration of the feasibility of the technology.

The fundamental corner stones of the envisioned component are (see Figure 4):

- The component service interface, offering high level services to the system
- Networked control over wireless sensor and actuator links and networks
- A middleware for closed-loop control application development
- Control application engineering and development methods to retain traditional deployment paradigms (e.g. PID).

2.5. Work package 5: Service-centric infrastructure

This WP aims 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.

In essence, it will implement the service-centric infrastructure according to the framework specifications produced by WP2.

2.6. Work package 6: Enterprise integration

This WP aims at the integration of aggregated device-level services with higher-level Web Services and business processes situated at the level of business applications - in particular Enterprise Resource Planning (ERP) systems - in order to demonstrate seamless integration of device level functionality into higher-order business application scenarios in manufacturing, logistics, or similar areas. The integration should not require changes to business application code, but be based on and leverage the Web Service-enablement of device networks as addressed by SOCRADES. See Figure 2.

Business application systems increasingly benefit from the adoption of service oriented architectures (SOAs) allowing to flexibly compose components of heterogeneous software systems across traditional system boundaries and swiftly adapt business processes to changing requirements. SAP's NetWeaver platform provides a rich foundation of infrastructure services and tools supporting the development and execution of Web Services. Of particular relevance for this WP is the Exchange Infrastructure (XI) which addresses service composition, business process orchestration and application integration, thereby enabling an Enterprise Service Architecture (ESA), SAP's blueprint and implementation of a SOA.

The convergence of solutions and products towards the SOA paradigm adopted for smart embedded devices contributes to the improvement of the reactivity and performance of industrial processes, such as manufacturing, logistics and others. This will lead to information being available "on demand" and in business-level applications that are able to use high-level information for various purposes, such as diagnostics, performance indicators, traceability, etc. These future vertical integration capabilities will also help to reduce the effort required for integration of the affected systems in the sense of the given business scenario.

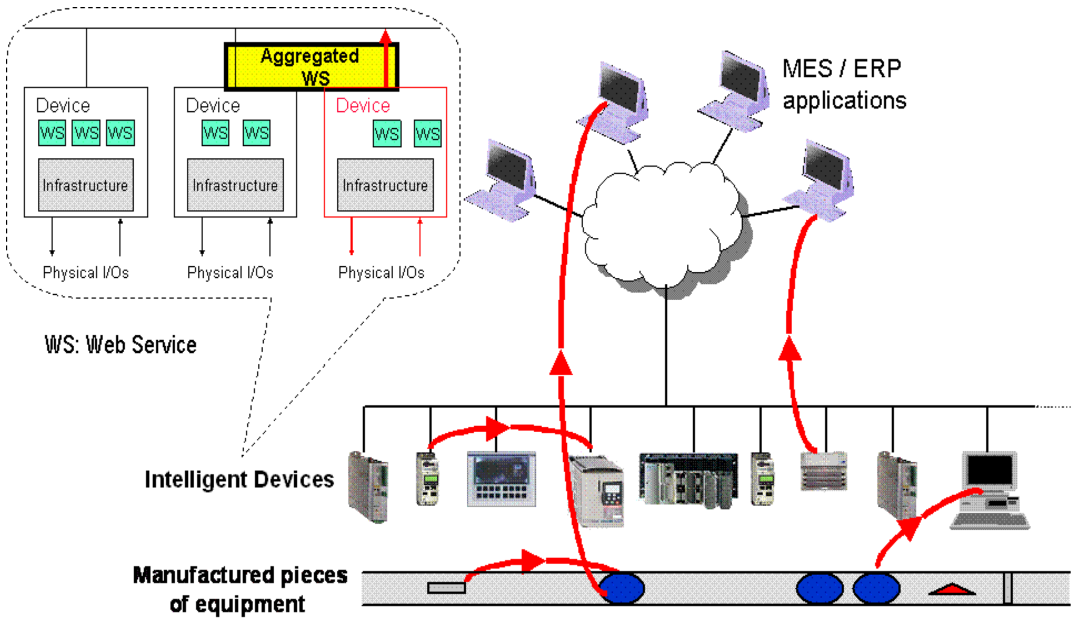

Figure 2. Integration of aggregated device-level services with higher-level web services

2.7. Work package 7: System engineering & management

It is vitally important to be able, reliably and repeatably, to construct and compose distributed embedded systems that can meet and adapt readily to ever changing user requirements. Such systems need to be generally applicable to a broad spectrum of application domains as described in section B1 and yet be capable of easy and precise tailoring to specific applications.

To address this need an engineering environment will be created for the lifecycle support of distributed embedded devices in both wired and wireless automation systems. This engineering system will be specified to meet the user applications requirements for the domains covered by the project.

The objective will be not only to support application design, simulation and monitoring of real-time distributed automation components from the control perspective (control dimension) but also to support the integration of these devices with higher-level business process systems (enterprise dimension), with supply chain partners (value/supply-chain dimension) and within a lifecycle engineering context (lifecycle dimension), i.e., adopting a four-dimensional approach inspired by ARC's CMM model. See Figure 3.

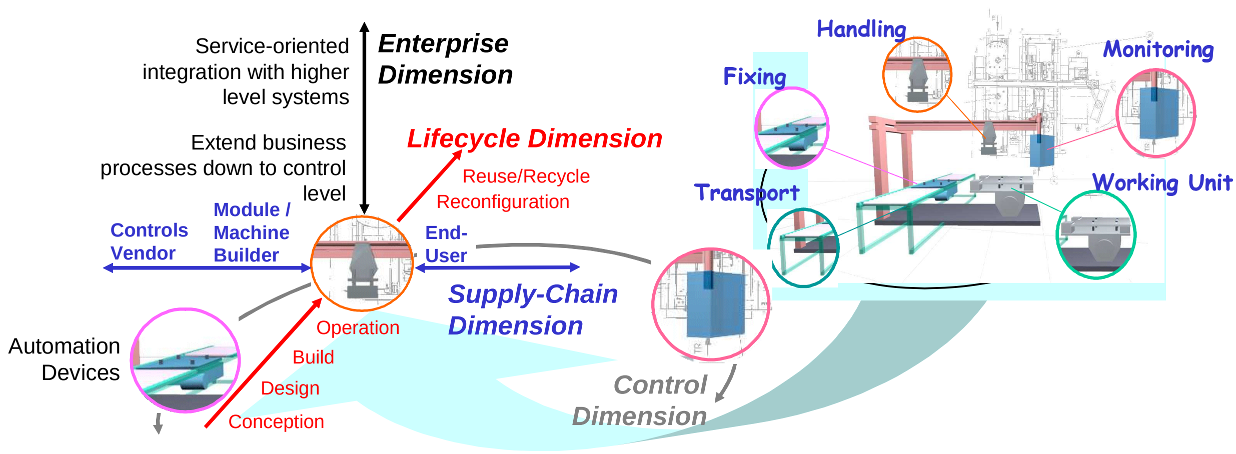

Figure 3. Dimensions of collaborative integration and support

The goal is to combine support for the configuration and optimisation of networked control capabilities with device management, configuration and lifecycle support services. End-users are needed to assist in exploring these new directions. In particular the aim is to create an effective tool-set whose benefit and value are clear within the user's business context. This tool-set should support a well-integrated modular approach to real-time control system design, deployment, maintenance, diagnostics and enterprise integration. For example, a machine builder may require support to:

1. Implement a machine control system.
2. Integrate this automation system seamlessly with the end-users business system functionality, e.g., MES, ERP, scheduling, data archiving.
3. Integrate and share component-specific and process-related information with supply-chain partners throughout the lifecycle, from initial simultaneous engineering through maintenance to reuse and decommissioning.

All the above need to be done in a manner that is amenable to unforeseen changes at any stage in the system's lifecycle, as business needs dictate.

2.8. Work package 8: Pilot applications

The main goals of WP 8 are:

- To set up application pilots for selected scenarios of the process industry as well as in the field of manufacturing automation.
- To run trials and to test real world situations like automatic set-up and system start; device or system failure; plug & play situations; control failure; hard real-time conditions, staff failure; change of production volume, product type, quality requirements and delivery times, impact of lead times; as well as process monitoring, diagnostic and prognostic capabilities, ad–hoc networking, or service-oriented cross layer communication.
- Comparison with the performance of traditional process automation and control technology provided by the end-users and refinement of the application and demonstrator prototypes.
- Evaluation and assessment of results.

2.9. Work package 9: Dissemination

This WP, led by Politecnico di Milano (POLIMI), is concerned with the dissemination and promotion of the project results. There will be three major strands to the activity in this WP, scientific dissemination, industrial promotion and dissemination via centres and networks of excellence. In addition an interactive Website will be developed to support both external dissemination and interaction between the project partners. This WP complements the key standardisation and roadmapping work to be carried out in WP10. International conference special sessions and workshops will be organised to promote SOCRADES with three major events of this type envisaged over the course of the project.

The device-centric and service-oriented technologies, methods and systems developed in this project are both highly innovative and culturally new approaches in the context of traditional centralised automation systems. An effective and well-managed dissemination plan is, therefore, vital to promote and explain this new paradigm to both the industrial and academic communities. The aim is to form a critical mass of key industrialists and academics to promote the SOCRADES concept. In particular, effective dissemination is important in order: 1) to make key individuals and groups aware of the work, 2) to enable them to understand the concepts and potential benefits and 3) to obtain critical feedback from them to assess the perceived value of the approach.

All the academic partners will take a leading role in disseminating the results of the research via publications in journals and conference proceedings and also via educational projects. These publications will be carefully planned as strategic collaborative research outputs within the dissemination plan involving all project partners.

The Tampere University of Technology, the Loughborough and Lulea Universities, and the Politecnico di Milano will contribute to the scientific dissemination of the results obtained by the SOCRADES through workshops and tutorials, e.g., under the IEEE Industrial Informatics Conference, where the main research issues will be presented and the solution compared with other solutions in an international scenario. The partners will also present the results of the research in the main conferences of the real-time systems and embedded systems domain. The University of Loughborough will also feature SOCRADES in a planned future presentation in the UK at the Royal Academy of Engineering on the topic of "Technologies and Methods for the Lifecycle Engineering of Modular Reconfigurable Manufacturing Automation".

Targeted conferences are expected to include:

- IEEE Real-Time and Embedded Technology and Applications Symposia and Conferences
- IEEE INDIN (Industrial Informatics) conference
- Euromicro Workshop on Parallel, Distributed, and Network-Based Processing
- IFAC Workshop on Programmable Devices and Embedded Systems
- IFAC World Congress
- WS-FM International Workshop on Web Services and Formal Methods
- ICSOC International Conference on Service-Oriented Computing
- RTAS IEEE Real-Time and Embedded Technology and Applications Symposium
- IFIP International Conference on Network and Parallel Computing
- IFIP International Conference on Embedded And Ubiquitous Computing
- IEEE ETFA (Emerging Technologies and Factory Automation) conference
- IEEE IECON (Industrial Electronics Conference)

Dissemination of SOCRADES results will be performed by the project partners through an active participation in fairs and conferences, e.g., IEEE INDIN (Industrial Informatics), IEEE ETFA, SPS IPC Drives, and IPROMS Network of Excellence. FlexLink will disseminate information via its network of sales units in 25 countries, by FlexLink News and by other publications, including professional journals. Jaguar Cars will include SOCRADES as a project of special interest in its Technology Cycle Plan (TCP), a five-year initiative beginning in 2005 to specify the requirements and identify future new control system technologies and methods.

2.10. Work package 10: Exploitation, standards and roadmapping

The main goals of WP10 are:

- To prepare a detailed exploitation plan of the results of the project with the purpose to prepare the appropriate actions for making the exploitation as successful as possible
- To derive from the SOCRADES technological innovation a set of specifications for an international standardisation bodies with the purpose to spread the results world-wide and facilitate the adoption of the service-oriented devices
- To write a roadmap that starting from the SOCRADES results could explore the gap between the currently available technologies and the new paradigm promoted by SOCRADES. The purpose of the roadmap is to help the supplier, vendors and system integrators and the users to easily adopt and implement the SOCRADES paradigm.

2.11. Work package 11: Project management

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.

- Performing a procedure for updating and revising the plans every 12 months due to changes and new knowledge.
- Successfully managing collaboration with external organizations to ensure results that are tested and validated by users.

The overall project management responsibility is endorsed by the co-ordinator.

3. Quality assessment criteria

Taking into account the above objectives and by synthesizing them, the following criteria have been defined in order to assess the quality of the deliverables of the first 18 months of the project:

1. Applicability (the deliverable is applicable at the device level, is usable, sufficient performance is achieved, the solution is scalable)
2. Scientific value (the deliverable uses state-of-the-art methodologies, tools and notations)
3. Compatibility with legacy solutions (the solution is interoperable with existing solutions, is leveraging existing standards, and relevant projects have been investigated)

3.1. Completeness

- All items described in the DoW are covered and have been traced.
- All responsible persons / organisations have agreed.

3.2. Clarity

- The deliverable is synthetic
- The deliverable objective is clearly stated
- Deliverable users have agreed and well understood the content
- References are defined. (i.e. other EU projects).
- Time schedule and action plan are well defined.
- The content is unambiguous.

3.3. Applicability

- The content is technically applicable.
- The content meets the project business goals.
- Performance aspects are according to the requirements.
- The compliance with standards of the proposed solutions is clearly stated
- Possible certification (from external certification bodies e.g. WC3, IEC …) if applicable and relevant has been studied.

3.4. Scientific value

- All necessary sciences are applied (state of the art, methodologies, tools, notations etc.), given the allocated resources and the scope of the project
- Situation in regarding of existing patents have been studied and gaps for new patents identified.

3.5. Compatibility

- The requirements are checked against usability with other projects/working groups.
- The solution is compatible with used standards on the market (e.g. DPWS, WS-*).
- The solution may be applied using legacy devices.

4. Quality assessment matrix

The following matrix is describing how, for each deliverable planned to be delivered in the first 18 months of the project, the above criteria will be applied.

Note that

- "+" in a cell means that the corresponding criterion is applicable;
- Wherever useful, footnotes provide the details of the applicability of the criteria concerned.

	Completeness	Clarity	Applic-ability	Scientific value	Compatibility
D1.1 State of the art	+	+[1]	-	+[2]	+[3]
D1.2 Requirements of end users and component vendors/system integrators	+	+[1]	-	+[4]	-
D1.3.1 Trend screening report 1	+	+[1]	-	+[5]	-
D1.3.2 Trend screening report 2	+	+[1]	-	+[5]	-
D2.1 Framework specification for device-level service platform	+	+	+	+	+
D2.2 Specification of service gateways for non-service enabled devices	+	+	+	-	+
D3.1 Report on trend analysis and requirements	+	+	-	+	-
D3.2 Architecture and functional specification of DPWS-oriented wireless sensor/actuator networks	+	+	+	+	+[6]
D4.1 Architecture for fault-tolerant application interaction	+	+	+	+	+[6]
D6.1 Service integration concept for field related data into business processes	+	+	+	+	+
D6.2 Integration concept of non Web Service enabled devices	+	+	+	+	+
D6.3 Early prototyping of integration	+	+	+	+	+
D7.1 User requirements report	+	+	+	+	+
D7.2 A catalogue of available methods and tools	+	+	-	+	-
D7.3 Report of the state of the art in device support and maintenance	+	+	-	+	-
D7.4 Early prototyping of application description and support methodology	+	+	+	+	+
D8.1 Demonstrators and application scenarios	+	+	-	+	+
D8.2 Specification of trials	+	+	-	+	+
D8.3 Evaluation report	+	+	-	+	+
D9.1 Dissemination plan	+	+	-	-	-
D9.2 Initial dissemination progress report	+	+	-	-	-
D10.1a Exploitation Plan, 1st release	+	+	-	-	-
D10.1b Exploitation Plan, 2nd release	+	+	-	-	-
D10.2 Specifications for standards	+	+	+	+	+
D10.3 Report on the activities with the international standard bodies	+	+	-	-	-
D10.4a Roadmap for the adoption of the SOCRADES paradigm, 1st release	+	+	+	+	+
D10.4b Roadmap for the adoption of the SOCRADES paradigm, 2nd release	+	+	+	+	+
D11.1 SOCRADES Goal Definitions	+[7]	+	-	-	-
D11.2a Project Reports, 1st release	+	+	-	-	-
D11.2b Project Reports, 2nd release	+	+	-	-	-
D11.2c Project Reports, 3rd release	+	+	-	-	-
D11.3a Year 1 cost statements	+	+	-	-	-

Table 1: Quality assessment matrix

1 - Are the general content and the structuring (table of content) of logical nature and in line with the DoW?
- Are responsibilities assigned for the individual paragraphs within the deliverables?
- Is the deliverable schedule in line with the overall project timing?

2 Does it represent the state-of-the-art?

3 Are the relevant projects and activities considered for the state-of-the-art investigation done for D1.1?

4 Are use cases and requirements specification (D1.2) done using best practice approaches?

5 Does it refer to the state-of-the-art?

6 Should not be applied to the full degree. Since we will specify a demonstrator rather than a product, we will have to make compromises concerning compatibility, as far as allowed by the demonstrator's functionality and environment.

7 Compared to KO meeting decision