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Contributors	
Partner	Contributors
TID	Carlos Bueno Royo, Juan Lambea Rueda, Alfonso Castro, Beatriz Fuentes, Sergio Garcia, Oscar Dueñas
ENG	Francesco Torelli, Matteo Melideo
TA	Mark Evenson
GPI	Annamaria Chiasera
SAP	Wolfgang Theilmann, Sylvia Scheu
INTEL	Michael Nolan

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Executive Summary

This deliverable aims at evaluating the readiness and applicability of the results of SLA@SOI project to the real needs of different industries. This analysis will help future adopters of the results of the project to assess the feasibility and expected benefits of the technology

The analysis presented in this document is based on the results of the evaluation of the SLA@SOI project against each of our industrial use cases that has been carried out by each of our use case and industrial partners. Several surveys and analysis have been carried out during the project to help in this analysis.

During the first part of the project, a technology and a market readiness survey were defined and filled in by the industrial partners of SLA@SOI. As a result of both surveys, it was observed that SLA@SOI technology is a core platform that would improve products and services that face large and growing markets and, therefore, it represents an important chance for early adopters.

During the final phase of the project, as it incorporates four distinct and complementary industrial Use Cases, a consistent approach to evaluation, is taken where possible to ensure that the evaluation is realistic and can be reasonably interpreted and easily adapted in domains not considered in the project. As detailed in the Use Case Specification and Lab Demonstrator Deliverables, and summarised in the Scientific Evaluation, the detailed assessments of SLA Framework features at low-level, they are explicitly set in the context of higher-level business objectives in each domain. This clarifies the relationship between the performance of a single or group of features, and business impact. In this final phase of the project, this detailed evaluation is integrated with the higher level assessment that is dealt with specifically in this document.

Finally, the analysis is complemented with a comprehensive survey to assess the readiness of the technology in order to use it in real industrial applications. The result of this analysis reflects that the results of the project are compatible with an advanced research project with a good demonstration of the technology.

As a result of the analysis, it has been proven by the analysis of the gathered data that the project outcomes present good technical maturity, while the final steps of adaptation, integration and marketing of solutions should be done on the specific exploitation scenarios. Given that the uses cases have reported great business value for each of the individual use cases, with several business benefits in common, it is reasonable to consider that SLA@SOI framework provides also a high potential for other new and future scenarios and applications.

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1 Introduction

1.1 Context and Scope

This deliverable describes to which extent the outcomes of the project are ready to be adopted by the project partners or even by external industrial stakeholders. This version of the deliverable has been refined and also includes an updated analysis so that external adopters can decide if the technology is suitable for their purposes.

This deliverable is related to D.B1a (Scientific Assessment) because the results of it are reflected in the maturity of the technology reflected in the surveys and analysis of this deliverable. It is also related to D.B8a (Exploitation plan), since the information gathered in this deliverable can be an input for the exploitation definition.

Main achievement

The main achievement of this deliverable has been to bring out a number of conclusions and analysis about the benefits of the technology of the project and applicability in other domains, and the readiness and maturity of the results. All of it will help internal and external stakeholders to evaluate and uptake the technology for their own applications.

1.2 Document Overview

The deliverable is structured as follows: in section 2, the objectives and methodology of the deliverable are presented; section 3 gathers a readiness analysis from the use cases and shows the results of two readiness surveys, and depicts a global overview of the situation of the technology in the market; it includes some graphs that shows different important points about the survey analysis. Finally, section 4 provides the main conclusions.
The following table lists all the changes and new elements of this deliverable compared to the previous deliverable version.

Section	Change overview
Section 1	Updated with the focus in a final document
Section 2.4	Section is split in two sections because a second survey has been added
Section 2.2.1	Minor update to adapt some words to a final document style
Section 2.4	Added TRL separation with 2 surveys
Section 3.1.3	Added B5 Network Negotiation new sub-scenario
Section 3.1.6	Added section with commonalities of the use case
Section 3.3	New section with TRL survey results summary
Section 4	Conclusions chapter rewritten
Appendixes A, B, C	Minor updates to final document style
Appendix D	New appendix with TRL survey results

Table 1: Document changes against previous version

2 Objectives and Evaluation Process

2.1 Objectives

The main objectives of this deliverable are to evaluate the industry impact of SLA@SOI results and to describe the industrial and technical conditions and scope under which the SLA management framework can be used. This deliverable intends to be a summary of the applicability of the project results for industry uptake.

Therefore, there are three clear steps in this analysis:

- *Ex-ante* analysis, already done in the Description of Work.
- *In-itinere* analysis, that corresponds to the previous version of the deliverable.
- *Ex-post* analysis that is shown in this version of the document. (M38).

For the *in-itinere* analysis, the focus was concentrated on how the results achieved by the project to date are ready to be industrialized, and what actions should be taken in order to improve it by the end of the project. Therefore, the main objectives of the first version of the Industrial Assessment were twofold:

1. Identify industrial and business benefits of SLA@SOI in the current status of the project.
2. Identify the level of maturity and readiness of the achievements and outcomes of SLA@SOI project during the first two years of execution.

This report was used to help to steer the project towards an effective exploitation of the results of the project in the third year.

In the *ex-post* analysis, at the end of the project, a new iteration of the analysis has been performed with more comprehensive data, and some conclusions are provided so that external industrial stakeholders can assess whether the project results are usable in their specific industrial context.

2.2 Evaluation Process

2.2.1 Industrial assessment process

In order to achieve these goals, a process to gather the needed information to evaluate the whole SLA@SOI results from industry point of view will be followed. This process includes the following activities:

1. Gather information from the use cases about different aspects of the applicability of the results:
    - Industrial and Business Context description. A short description of the business and technological context in which the SLA@SOI improvements are to be applied.
    - Business improvements on factors and use case specific metrics. Analysis of the technology readiness and industrialization of the technology from the point of view of each use case in the light of the following:

- Major industrial/business advantages of SLA@SOI. Taking into account the common metrics and factors described below, and also the specific value dials of the use case, identify and justify for each use case the most important factors and metrics.
- Technology Readiness. Analysis from the point of view of the use case, how innovative the technology provided by the project, in relation to the state of the art, patents, literature, etc. Detect those aspects of the project that are readier to be industrialized (SLA Model, Architecture, SW components, any specific features…) or that provide better breakthroughs.
- Market Readiness. Analysis from the point of view of the use case, which are the main aspects of the target market of the use case, and what advantages can the project innovation provide in that market.

  - Required improvements proposed during project year 2 have been done.

2. Provide a survey to the industrial partners of the project following the market and technology perspectives of the Clover Leaf Model.
3. Analyze the results of the information gathered from CL model and provide a common view of the status of the project in terms of industrial applicability.
4. Provide a survey to the industrial partners of the project following the market and technology perspectives of the TRL Model.
5. Analyze the results of the information gathered from TRL Model and provide a common view of the status of the project in terms of industrial applicability.

The described process can be assimilated as the cycle process recommended by ITIL in the ITIL Service Design recommendation. The next figure sums up the process:

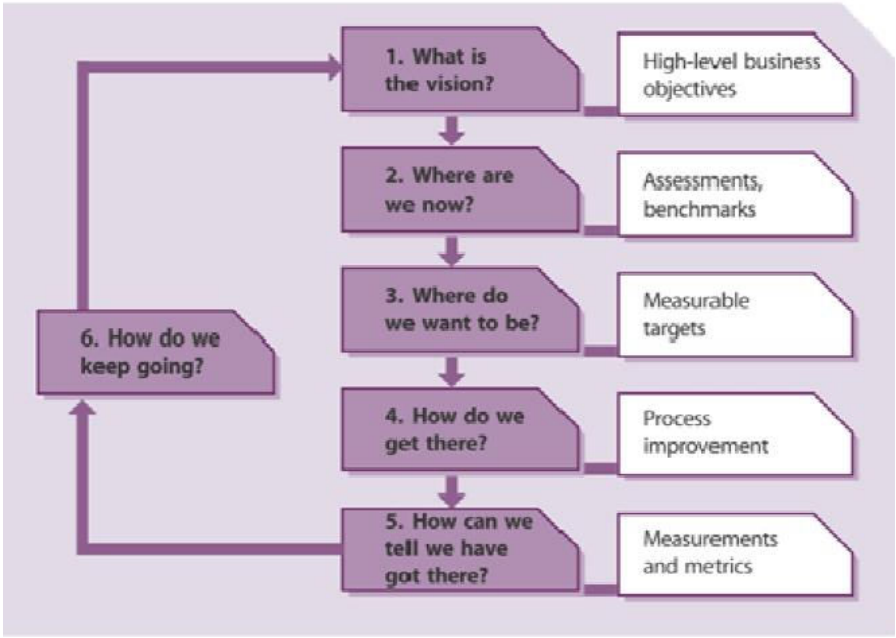

Figure 1: ITIL process

2.3 High level factors and metrics

The metrics needed for a proper industrial evaluation are related to industrial point of view. This means that evaluation has to take into account business details and industrial-specific issues (like customer-facing perspective) because industrial partners have to deal with their markets and customers.
From this point of view, it is essential to analyze the industrial impact of SLA@SOI result. In this way, the factors to be used are related to business metrics and the impact caused to customers.

Therefore, the metrics defined to analyze business impact are:

- Number of stakeholders needs met. Stakeholders might have own needs and might not fit perfectly with SLA@SOI features. With this metric, the mapping between features and industrial needs is measured. This information has been gathered with surveys.
- Industrial applicability. This means how the SLA@SOI result can be applied to the current industry in terms of products to be created, changes in the product chain-value, etc. to be measured. This metric ranks each SLA@SOI feature accordingly to industrial applicability in SLA@SOI partners.
- Time to market reduction for new products and services. One of the most important impacts in an IT company is the reduction of the time expended in the development of new products. This metric can be measured by ranking the expected reduction of the time to market if SLA@SOI features are adopted.
- Potential profits. The main objective of every company is just to increase its benefits. So, one of the most powerful tools to evaluate SLA@SOI result in the industry is by measuring the expected increase in the benefits.
- Expected increase on customer experience. Other important issue for IT companies is the experience of the customer. If customers perceive products as they expected, they will probably be loyal to the company. In order to measure the increase of this customer perception, it has been evaluated as a value dial.
- Cost impact. Another way to increase profits is to reduce costs changing the production line. As this project aims to change how operators provide services, it could impact in costs reducing them. In order to measure this metric, a survey where stakeholders rank the features according to their cost impact could be acceptable.
- Impact on corporative image. One of the most important IT assets is the corporative image that customers have. Adopting SLA@SOI features can impact on corporative image. This issue can be measured by a survey.
- Possibility of creating competitive advantages. Another important issue in nowadays industry is the possibility of owning a competitive advantage that allows the company to have an extra profit. In order to measure this metric, a survey where stakeholders rank the features according to their cost impact could be acceptable.

These factors, together with the value dials identified by the use cases and the market and technology perspectives of the CloverLeaf and Technology Readiness Levels Model has been used to make the industrial/business analysis of SLA@SOI outcomes from the perspective of each use case, as described in the first step of the above described process.

These are some of value dials identified by the different use cases that are of common applicability for most of them: Time to market reduction, Dependability, Flexibility, Scalability, Energy Efficiency, Technical Efficiency, Operational

Efficiency, Resource allocation efficiency, End2End manageability, Agility, Fast decision making, Customer satisfaction, SLA compliance and performance awareness, and Cost effectiveness.

2.4 Readiness Factors

It has been decided to evaluate the project outcomes from the point of view of the technology and the market using two models. Each model has his type of survey and these surveys have been completed by all the industrial partners of the project, for all the market segments and products in which they intend to apply the outcomes of the project. The results are presented in section 3.2.

2.4.1 Cloverleaf Model

In order to assess the readiness of the technology to be transferred or used by external industrial stakeholders, the Cloverleaf Model [1] has been selected, as a comprehensive methodology to determine when and which technologies are likely to be successful in the commercialization/industrialization process. This model proposes four different perspectives for the evaluation of a given technology: Market Readiness, Technology Readiness, Commercial Readiness and Management Readiness. This is the list of questions used to evaluate the different aspects:

- Market Readiness
  - The technology offers significant identifiable and quantifiable benefits
  - The product/process has distinct advantages over competing products
  - The technology has future uses
  - There is a definable marketable product
  - A defined market is accessible
  - The market is a large one
  - The market is a growing one
  - The technology has immediate market uses
  - The technology will be first-to-market
  - Manufacturing is determined to be feasible
- Technology Readiness
  - The technology is a new, non-obvious invention
  - The patent and literature search are complete and clear
  - There are no other dominant patents
  - The technology is state-of-the-art or major breakthrough
  - The technology is a core or platform technology
- Commercial Readiness
  - Prospective licensees are identified
  - Inventor has industry contacts
  - Licensee financial support is available for further development/patenting
  - There is access to venture capital
  - A positive return on investment is expected
  - Royalty/licensing income expected to provide positive net present value
  - Government support available for additional development
- Management Readiness
  - Inventor will champion as a team player
  - The inventor has realistic expectations for success
  - The inventor is recognized and established in the field
  - Commercialization skills are available
  - Management capabilities are available

For each of the criteria conditions, the reviewer has to enter a score for extent to which the condition is met (1=not met, 2=partially met, 3=fully met) and the level of confidence on the answer (from 1 to 3).

2.4.2 Technology Readiness Level Model

The Technology Readiness Level Model has been applied within the final year of the project. In this final stage of the project, the aim of the evaluation is to provide real information about the maturity and readiness of the technology to be transferred or used by external industrial stakeholders. While the Cloverleaf model presented above provided interesting inputs for the midterm of the project, a new and more complete proposal is presented here.
The Technology Readiness Level Model [4] has been selected, as a comprehensive methodology to determine when and which technologies are likely to be successful in the commercialization/industrialization process. This approach allows contrasting project outcomes using other perspective.
This model, proposed by several agencies from the US government, including the NASA, proposes different levels for the maturity of a given technology:

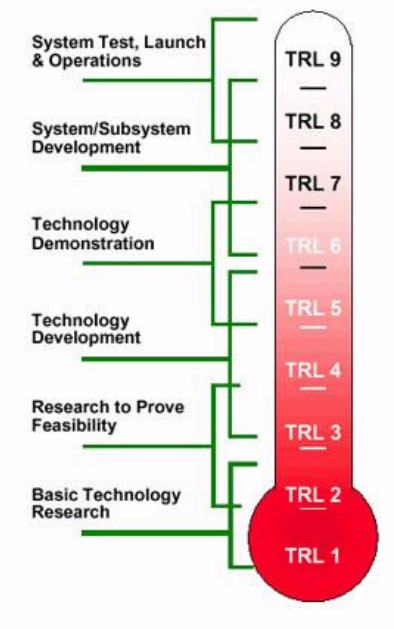

Figure 2: TRL Model

The model used in this analysis is a modification of the original TRL model, focused on software and IT innovation projects. In the following table there is a description of the levels considered in this analysis, and their meaning and fulfilment criteria.

TRL TRL	Definition	Software Description	Exit Criteria
1	Basic principles observed and reported.	Scientific knowledge generated underpinning basic properties of software architecture and mathematical formulation.	Peer reviewed publication of research underlying the proposed concept/application.
2	Technology concept and/or application formulated.	Practical application is identified but is speculative, no experimental proof or detailed analysis is available to support the conjecture. Basic properties of algorithms, representations and concepts defined. Basic principles coded. Experiments performed with synthetic data.	Documented description of the application/concept that addresses feasibility and benefit.
3	Analytical and experimental critical function and/or characteristic proof of concept.	Development of limited functionality to validate critical properties and predictions using non-integrated software components.	Documented analytical/ experimental results validating predictions of key parameters.
4	Component and/or breadboard validation in laboratory environment.	Key, functionally critical, software components are integrated, and functionally validated, to establish interoperability and begin architecture development. Relevant environments defined and performance in this environment predicted.	Documented test performance demonstrating agreement with analytical predictions. Documented definition of relevant environment.
5	Component and/or breadboard validation in relevant environment.	End-to-end software elements implemented and interfaced with existing systems/simulations conforming to target environment. End-to-end software system, tested in relevant environment, meeting predicted performance. Operational environment performance predicted. Prototype implementations developed.	Documented test performance demonstrating agreement with analytical predictions. Documented definition of scaling requirements.
6	System/subsystem model or prototype demonstration in an operation environment.	Prototype implementations of the software demonstrated on full-scale realistic problems. Partially integrate with existing hardware/software systems. Limited documentation available. Engineering feasibility fully demonstrated.	Documented test performance demonstrating agreement with analytical predictions.
7	System prototype demonstration in an operational environment.	Prototype software exists having all key functionality available for demonstration and test. Well integrated with operational hardware/software systems demonstrating operational feasibility. Most software bugs removed. Limited documentation available.	Documented test performance demonstrating agreement with analytical predictions.

8	Actual system completed and "flight qualified" through test and demonstration.	All software has been thoroughly debugged and fully integrated with all operational hardware and software systems. All user documentation, training documentation, and maintenance documentation completed. All functionality successfully demonstrated in simulated operational scenarios. Verification and Validation (V&V) completed.	Documented test performance verifying analytical predictions.
9	Actual system flight proven through successful mission operations.	All software has been thoroughly debugged and fully integrated with all operational hardware/software systems. All documentation has been completed. Sustaining software engineering support is in place. System has been successfully operated in the operational environment.	Documented mission operational results.

Table 2: Levels description of TRL Model

The Figure 3 shows how the program risk at technology transition (product launch in the commercial world) decreases as knowledge of the technology improves. Improved knowledge is shown by a higher TRL. The technology transition or product launch decision is the point where the technology moves from the laboratory to a system for Engineering and Manufacturing Development.
The diagram shows that risk is reduced if the technology transition decision is delayed until the technology has matured to one of the higher TRLs.

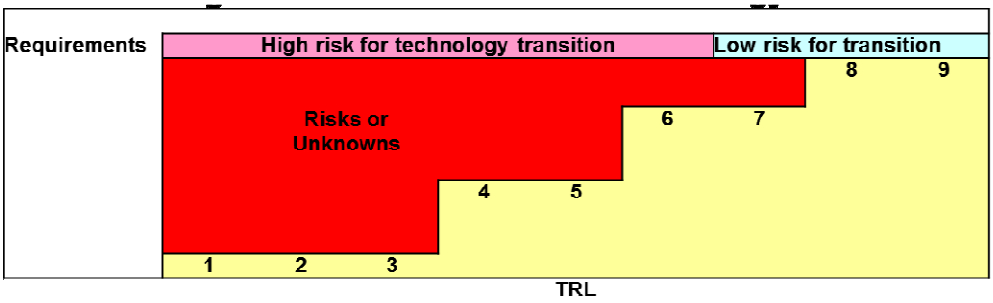

Figure 3 Using TRLs to Control Risk of Technology Transition

Finally, Figure 4 shows which the desired level of TRL of a project is, depending on its nature. An FP7 IP project like SLA@SOI should have levels 5 or 6 fulfilled.

	Basic Research	Applied Research	Advanced Research	Advanced Tech Demonstrator		
Actual system flight proven through successful mission operations	Too well known for Basic Research	Too well known for Applied Research	Too well known for Advanced Research	Too well known for Advanced Tech Demonstrator	TRL Increasing Maturity	9
Actual system completed and flight qualified through test and demonstration	Too well known for Basic Research	Too well known for Applied Research	Too well known for Advanced Research	Too well known for Advanced Tech Demonstrator		8
System/subsystem model or prototype demonstration in a relevant environment	Too well known for Basic Research	Too well known for Applied Research	Too Well Known for Advanced Research	Desirable		7
System/subsystem model or prototype demonstration in a relevant environment	Too well known for Basic Research	Too well known for Applied Research	Too Well Known for Advanced Research	Desirable		6
Component or breadboard validation in a relevant environment	Too well known for Basic Research	Acceptable	Desirable	Acceptable		5
Component or breadboard validation in laboratory	Acceptable	Desirable	Acceptable	Unacceptable -- Too Risky		4
Analytical and/ or experimental critical function or characteristic proof-of-	Acceptable	Desirable	Acceptable	Unacceptable -- Too Risky		3
Technology concept or application formulated	Desirable	Acceptable	Unacceptable -- Too Risky	Unacceptable -- Too Risky		2
Basic principles observed and reported	Desirable	Acceptable	Unacceptable -- Too Risky	Unacceptable -- Too Risky		1

FP7 IP Project

Figure 4 TRL desired level.

2.5 Measurable indicators vs. Impact

When specifying the four Industrial Use Cases, a consistent approach was taken in order to relate the performance of technical features of the SLA Management Framework to actual Business Process Performance. Each of the four domains has selected high level objectives that reflect objectives, tactics activities / business processes that would exist in real world instances of ERP Hosting, Enterprise IT, Service Aggregation and e-Government. These objectives are selected based on their centrality to the role or objectives of key stakeholders in these domains. Put simply, they are core to profitability, competitiveness, agility or customer satisfaction. A measurable improvement of systems or processes supporting these objectives, which can be realistically accredited to the contribution of SLA Management Features, will form part of the final Business Evaluation of the SLA Management Framework.

The following sections include tables which relate value dials (in turn aligned with measurable performance indicators which can be associated with individual or combined Framework features) with these high level objectives. A comprehensive hierarchy of High Level Objectives and Value Dials is included in the document, and they have been ground-up fine-grained assessed by each individual use case based on the performance of specific aspects of the SLA Management Framework.

3 Analysis

3.1 Use cases readiness assessment

3.1.1 Use Case: ERP Hosting

Industrial and Business Context description

Currently we face as a key trend in the software market there is a shift to on-demand business. Customers are increasingly buying software services instead of software installations. Doing so, they rely on the availability and quality of these services to operating their own business. Hence, they require strong guarantees on the quality of service. Dependable service levels will become a major differentiator in the market of on-demand software solutions and the Internet of Services. At the same time market analysis shows that current SaaS offers still come with extremely limited service level guarantees [1].

Looking at the current trend from service-enabled applications to Software-as-a-Service and Internet of Service scenarios we foresee an enormous pressure for service providers to professionalize and automate the offering and management of their services by introducing the notion of SLAs in order to be competitive in upcoming service markets. This competition mainly relates to the areas of dependability, costs and ease of consumption.

Dependability is of utmost importance for all kinds of customers of business solutions as non-operating solutions would seriously impact their ability to continue business.

Cost is becoming increasingly important as the market is commoditizing. For such markets cost is a major buying decision which in turn requires provides to create very cost effective platforms where cost for hosting an additional tenant is minimized.

Agility / ease of consumption becomes increasingly important as we see a global trend from hard-wired value chains to flexible business value networks fixed business network where connections are dynamically added, changed or stopped [3].

Business improvements on factors and use case specific metrics

Major industrial/business advantages of SLA@SOI

Three of the main business advantages of SLA@SOI have been already introduced above, namely the improvements on agility, dependability, and cost. A fourth aspect which is purely motivated from a service provider perspective is the aspect of transparency. The challenge here is that advanced business solutions have complex dependencies on various software, middleware, and infrastructure artefacts. The management of these dependencies is complex and can easily lead

to errors. Therefore, increased transparency is a major business benefit for service providers and will eventually also contribute to increased efficiency, dependability but also the ability to flexibly react on changed market conditions.
The following table provides an overview of these areas including the most relevant measurable KPIs for the B3 use case.

Value Dial	Measurable KPI
Agility	- time to quotation - time to provision - time to adjust (intentional change) - time to complete (BCM / BPM) analysis
Dependability	- number of SLA terms specified - number of SLA terms monitored - number of SLA terms empirically validated - time to react (on SLA violation)
Cost	- development costs, e.g. number of automatically generated SLA term specifications and time to create needed SLA specifications - environmental/energy efficiency, i.e. energy consumption per system, tenant and business transaction - technical efficiency, i.e. resource (e.g. CPU) usage per system, tenant and business transaction - process efficiency, i.e. number of working hours per service request
Transparency	- end2end manageability of a complete service hierarchy - number of tools/management consoles - customizable entries per product offer - compliance awareness

Table 3: Value Dials and KPIs for "ERP Hosting" use case

Agility, as perceived by customers, largely breaks down to the 3 processes of quotation, provisioning and adjustment and to the analysis of business continuity/performance scenarios. Dependability becomes evident by the detail of the specified SLA terms, their monitorability, their empirical validation, and the ability to react on violations. Cost breaks down into development, environmental and technical efficiency; the latter two are measured per system, per tenant, and eventually per business transaction. Furthermore, process efficiency relates to human resources and their involvement in service requests (quotation, provisioning, maintenance, change). Transparency breaks down to indicators about the feasibility of consistent End2End management, the number of required tools, the ability to customize management tasks and offerings across the stack, and the compliance awareness for customers.

Technology Readiness

Looking at the current market of hosted enterprise solutions [1], the technology of SLA@SOI is still highly innovative. Actually, very limited service level guarantees are typically offered, and if so they are poorly specified and tracked. The contributions of the framework (SLA/SCM models, architecture, prediction capabilities) are extremely useful and ready for actual industrial usage.
The developed measurement-based software performance analysis tools turned out to be very helpful in supporting the assessment of existing service stacks. They significantly reduce the effort to derive appropriate models about their non-functional behaviour (dependencies between components, performance, reliability, etc.) and also improve their quality.

Market Readiness

The target markets for the ERP Hosting use case are service providers for business applications. The results of SLA@SOI give them clear advantages in their competitive positioning, as they can save costs and increase agility, dependability, and transparency. Complementary services for business continuity and business performance management also receive high market interest.
Due to the complexity of the topic, market readiness seems best for dedicated SaaS offerings (e.g. on collaboration tools or business functions for lines of businesses). Market readiness is also good but a bit less obvious for complex application suites (such as a complete business application suite).

Conclusions

The business value of an SLA-driven management approach is indeed significant for the ERP hosting use case in general and multiple more specific sub-scenarios in particular. SLAs play an importance role in all these areas as they provide a business justification for all kinds of management and customer interaction activities. Therefore, the actual business value spans across multiple areas, including agility (through process automation), dependability (through formalization), cost efficiency (through a combination of both), and transparency (through the systematic foundation of decisions and actions on SLAs).
The technology readiness of SLA@SOI is very high and it can be well applied in this use case and its sub-scenarios. Obviously, concrete extensions required for the respective technical target environment need to be realized. Market demand for proper SLA support is very high and SLAs will most likely play an influential role throughout the next couple of years.

3.1.2 Use Case: Enterprise IT

Industrial and Business Context description

The cloud computing market is evolving rapidly, with a fast-growing number of external cloud services and enabling technologies. This creates a need for tools such as the SLA@SOI framework to better understand the market, define cloud computing strategy, and facilitate adoption of cloud computing services that meet the need of today but are also capable of evolving over time to meet those of the future.

Cloud computing is about delivering a highly available computing environments where secure services and data are delivered on-demand to authenticated devices and users over a shared, scalable infrastructure that supports multiple tenants. Clouds offer the potential for highly flexible computing and storage resources, provisioned on demand, at theoretically lower cost than buying, provisioning, and maintaining more fixed equivalent capacity.

The primary object of the Enterprise IT use case is to help move enterprise from the traditional statically enforced written SLA contract today, to one which is automatically derived and bound to the services being offered.

Business improvements on factors and use case specific metrics

Major industrial/business advantages of SLA@SOI

It is important to identify the business value of the SLA@SOI work in quantifiable terms. Many new technologies will claim to improve business factors such as reliability, sustainability, manageability or total cost of ownership of IT systems and the SLA@SOI project is tasked with measuring these. In that context, the business value to be realised by the B4 use case are in three main areas:

- IT enabling the enterprise
- IT efficiency
- IT investment and technology adoption.

The direct benefits of these three areas to IT services are agility, dependability and automated response. The derived benefits range from efficiency via reduced cost of ownership to governance of future investment decisions. B4 defines these areas as 'Value Dials'. For each value dial, the measurable Key Performance Indicators (KPI's) which support the value dial are also listed. The use case is working to establish baselines for current performance of enterprise IT hosted services and then compare these to an SLA@SOI enabled hosted service using the KPI's below. The complete mapping of value dials to KPIs for the use case is shown below in Table 4.Deliverable D.B4c presents a complete evaluation of the use case at the end of year 3.

Value Dial	Measurable KPI's
Agility	-Time to Provision -Number of Images -Number of Management tools -Streamlined communication (one stop shop)
Dependability	-Number of SLA Terms -Number of Monitored SLA terms Reporting
Automated Response	-Volume of Service requests -Number of working hours per service request
Energy Efficiency	-Energy Consumption kW/hr - Energy Savings
Utilisation Efficiency	-CPU Utilisation -Memory Utilisation -Number of VMs per physical host
Cost Effectiveness	-Number of VMs per physical host -Energy Consumption kW/hr - Vendor Support Contract costs
Operational Costs	-Energy Consumption kW/hr - Vendor Support Contract costs
Control of Resources	-Number of Management Tools. -Ability to Specify location by SLAT value -Availability of Product Catalogue -Resource Utilisation over time
Fine grained investment granularity Efficient use of resources	-CPU Utilisation -Running cost per service -Number of VMs per physical host -Energy Consumption kW/hr - Energy Savings
Optimal payback on investment	-Total running cost -Running cost per service

Table 4: Value Dials and KPIs for "Enterprise IT" use case

Technology Readiness

SLA management in IT is not new, however today's solutions are usually manual, they are simplistic or focus on macro agreement terms such as availability without providing any real assurance or measurable guarantee that the agreed terms can even be measured, not to mention guaranteed. Therefore, the automation of such services is at the core of the SLA@SOI project. The framework architecture developed in this project, is a significant improvement on current best practice in the enterprise environment. SLA management is a complex topic which presents many issues as the project defines a generic framework which needs to meet the diverse needs of the use cases which are driving its development. However, the process of defining these features, the obstacles it presents and the framework architecture and implementation are of immense interest in an area of growing importance in the IT world.

Market Readiness

The target market for the B4 use case is the corporate or enterprise IT environment. Areas such as automated SLA management have obvious benefits such as a value dials listed in this section for any business which has adopted or invested heavily in virtualisation technologies. The migration to these technologies has already yielded some initial benefits by either providing the same compute capacity with a much smaller hardware footprint or by providing much increased capacities with the same footprint. However, this use case is about taking the next step in this evolutionary road and realising those benefits fully through automation and manageability improvements to provide a true, guaranteed, utility computing service to the internal enterprise without having to outsource sensitive services to external cloud providers.

3.1.3 Use Case: Service Aggregator

Service Aggregator use case can be analysed as two different parts because it is composed in two different sub-scenarios: service aggregator and network negotiation.

Business Context for Service Aggregator

Currently, most Telecom Operators are deploying or planning to deploy solutions aligned with Web2.0 principles to enable user-generated services through the exposure and mash-up of network features and data. Value-added services like automated discovery, negotiation and service composition, favors the appearance of service aggregators. A service aggregator plays the role of a service provider that offers an aggregated business function view of discrete separate business functions. That is, it consumes multiple services from different providers and aggregates their results behind the facade of a service offering a single business function. Thus the service aggregator operates as a service provider to its customers and as a service requestor to its suppliers.
To achieve it, most Telco operators are deploying Service Delivery Platforms to expose their Telco capabilities to third parties and to provide an environment for creation and delivery of services. Adding SLA capabilities to the SDPs

environment is a major breakthrough and provides a number of benefits described in this section.

Business improvements on factors and Service Aggregator specific metrics

Major industrial/business advantages of SLA@SOI

From the application of the SLA@SOI framework and concepts to the service aggregation use case, and especially, to the baseline of Service Delivery Platforms, it comes out a number of conclusions on the benefits of the project outcomes in relation to some of the defined value dials. Since the SDP platforms deployed and being deployed currently do not support SLA management, the first benefit from using SLA@SOI in this use case is a better quality of experience of end users and therefore, and improved **customer satisfaction**, due to the fact that the platform will automatically react and adjust the service in case of SLA breaches, increasing the service **dependability**. Moreover, the service providers can offer prices in accordance with the real quality provided, since the SLA breaches will eventually result in penalties.

Another important benefit of using SLA@SOI framework together with SDPs is the ability to have an **end to end manageability** and visibility of the services in use; the platform is aware of the real quality provided by each service or third party and the SLA breaches, and it is easier for the platform managers to take **fast decisions** on the commercial offer, services configuration, resource reallocation, etc. These reconfigurations are carried out in an **agile** way because of the automatic adjustment and negotiation mechanisms provided by SLA@SOI, leading to a **higher operational efficiency**.

Value Dial	Measurable KPI's
Customer satisfaction	Rate of claims per customer % reduction (elimination to zero) of undetected SLA violations
Dependability	Availability (% of the time the service is available, ej. 99,99%) Mean time to recover from an SLA breach (in seconds)
End2End manageability	rate of monitored atomic services per total number of atomic services
Fast decision making	
Agility	average time to provision a service average time to modify a service
Operational Efficiency	Opex associated to platform management

Table 5: Value Dials and KPIs for "Service Aggregator" sub scenario

Business Context for Network Negotiation

Traditional businesses about network capabilities offers has been fixed because fixed networks deployment imply installation of physical resources to fulfil customer demands. However with the growing of communications technologies to provide new broadband services, this approach has changed. Today, in concrete areas in which is very high the number of customers, the operator deploys different technologies available for customers (DSL and fibre optic), and inside of each one is possible to have different static configurations and offers.

Current and future networks equipment allows flexible changes in terms of features and capabilities like bandwidth and latency independently of contracted broadband.

Telefónica is working to enhance his network to achieve more flexibility and this flexibility can be transferred to final customers in order they can take the advantage of it. It is not clear yet how is the best way to achieve it, but this use case shows one example in which final customers and the operator can trade and negotiate those capabilities. This is not negligible because the effort in terms of cost and time needed to support these new features is very high, and is fully dependent of equipment vendors and commercial offer complexity.

Final customer SLAs (or also called business SLAs) has to be wrapped in a manner in which customers can know the details of the offers or they are almost transparent for them.

Business improvements on factors and Network Negotiation specific metrics

Major industrial/business advantages of SLA@SOI

In the current product portfolio of the Telco operators there are a small group of services that follows SLAs. The major quantity of services that uses SLAs are related with services offered to big companies as was explained in service aggregator sub-scenario. However, customer services can be modelled using SLAs and there are some benefits of SLA@SOI application in those scenarios. The following information is an assessment about usability of the sub-scenario of the use case and how the relation to some of the defined value dials is.

The first benefit from using SLA@SOI in this use case is a better quality of experience of end users and therefore, an improved **customer satisfaction**, due to the fact that the customer is able to control the services he wants to consume by his own. A way to decrease calls to the CRM is to give the control to the customers in a quickly way. **Service consumption possibilities are enhanced and easy-to-use** is other value dial affected. The customer has almost a full control of his services and it opens a new way in the relationship operator-customer. Needed adaptation to the customer requirements is carried out in an **agile** way because of mechanisms provided by SLA@SOI. Finally, **resources allocation efficiency and optimization** is the outcome in terms of the increased adaptation of the different networks and services of the Telco operator to the customers that requires them.

Value Dial	Measurable KPI's
Customer satisfaction	Rate of claims per customer Rate of customers calls to CRM
Service consumption possibilities are enhanced and easy-to-use	Rate of services contracted/modified manually by customers
Agility	average time to provision/modify a service
Resources allocation efficiency and optimization	% of fixed network resources utilisation % of mobile network resources utilisation

Table 6: Value Dials and KPIs for "Network Negotiation" sub scenario

Technology Readiness

Although providing SLA management in SDPs is an obvious improvement of such platforms, current available SDPs do not provide a comprehensive SLA framework

that covers the overall architecture (business, services and infrastructure). However, at this stage it is critical to follow up the evolution of the state of the art and patents on the field to identify the potential opportunities of industrialization of the project outcomes. This last question affect also to network negotiation strategies and current relationships between customers and telco operators.

Market Readiness
Since most of the Telco operators are about to deploy SDPs, and most of telecommunications software and infrastructure providers already offer SDPs in their portfolio, it can be stated that it is a large and mature market to industrialize and deliver the outcomes of the project. SLA management can represent a clear added value to current SDP platforms and the comprehensive framework of SLA@SOI will keep the interest of Telco providers. Regarding network negotiation strategies, the trend to give the control to the customer is strong, and different alternatives will appear. The important point here is that in this case product/services features will be modeled using SLAs.

Conclusions

Service Aggregator and Network Negotiation prototypes have demonstrated a significant value for the telco Service Aggregator use case. The different uses of an SLA-driven management approach in the telco domain have added an important value to the project taking into account very different prototypes; first one focused in whole sale and the second in retail. The SLA management is the key piece to be applicable to different domains in the telco environment. The current implementation of the use cases, make use of concrete and specific SLAs, and therefore they do not exploit the complex, comprehensive and generic framework provided by SLA@SOI. The technology developed can be applicable to different components of the networks and systems in a telco operator. Further developments are needed to integrate and adapt those telco components and systems to convert them in SLA-enabled, but SLAs will be the key in the next couple of years.Use Case: E-Government

Industrial and Business Context description

In deliverable *D.B6a - Use Case Specification eGovernment,* a detailed description of the business and technological context motivating such use case has been provided. Anyway, for a matter of convenience, it will be proposed here again a brief summary pointing out the focal points with an invitation for the reader to refer to the just mentioned deliverable for additional information.

Many public administrations (PA) both local and central are moving toward a service based paradigm where the services are not all necessarily web- or e-services. On the other side, citizens are changing their life style adapting to this new trend due to new needs interacting remotely with the different PA and relying more and more on services outsourced by the PA to third party providers.

Given this situation it is quite important to provide a standardized and well recognized approach to manage the quality of these services and react in case of infringements of the SLAs. The PAs already define SLAs and do track these but when a service involves several related component services, it is quite difficult to monitor all related SLAs. This makes difficult to control the real service quality and to adjust it in a timely way, to provide to the citizens a transparent view on the quality of the delivered services and complicate the construction and adaptation of services to fulfil new citizens' needs.

At the right moment there are not standardized technologies to monitor the SLA and there are not at all the technological supports to offer these to the real final users in a user friendly manner. More in general there is low automatic support to SLA management and SLA related activities such as resource management or SLA negotiation.

In a society where everything is moving toward a service based business the simplification of the SLA management is an important requirement to its continuous improvement.

Despite the focus of the project is mainly on hardware and software services and enterprise business, part of the SLA@SOI results for SLA management are perfectly suitable with the public administration and citizens services context, that at the right moment is suffering a lack of technologies supporting the monitoring, reporting and semiautomatic negotiation of the SLA.

Business improvements on factors and use case specific metrics

Major industrial/business advantages of SLA@SOI

The main positive impact of the SLA@SOI Framework in the eGovernment domain is expected on Agility, Efficiency, SLA Compliance and Customer satisfaction.
A significant improvement of the PA agility is foreseen thanks to automatic management of monitoring and negotiation. Both this features will allow to reducing the time needed to adapt the services to different workload and to new needs formalized in SLAs.

An improvement in resource allocation is expected to reduce the number of SLA violations in a significant way. On turn the improvement of SLA Compliance will contribute to improve the citizens satisfaction. The citizens satisfaction can also been increased by the dynamic binding capabilities of the SLA@SOI Framework that can select and provide to the citizens more services suitable to their preferences. Another key contribution to citizens satisfaction will come from the augmented transparency of QoS thanks to the possibility to adopt the SLA approach in a systematic way for each PA service and to publish the data about the SLA fulfilment.

The SLA@SOI platform have the potential to have a high impact in any context where SLAs can be used, included the eGovernment domain, also due to the big dimension of the potential market and its growing trend. Anyway to achieve such benefits the SLA@SOI Framework needs first of all to reach a stable and mature state. The Table 7 specifies the Value Dials measured in Y3.

Value Dials	Measurable KPI's
User Preference Matching	- Number of mobility options - Percentage of late pickups - Percentage of late arrivals
Integrated offer of services	- Average time to book a Mobility & Health service
SLA compliance	- Number of SLA violations in the time interval T - Percentage of lost calls - Percentage of calls that find busy lines - Mean time to perform a health treatment booking

	- Mean time to perform a mobility booking - Penalty
Resource allocation efficiency	- Human resource cost

Table 7: Value Dials and KPIs for "eGovernment" use case

Technology Readiness

There is actually no integrated solution for monitoring SLAs of both IT services and human based services and to automate the related management operations such as resource adjustment and negotiation with third parties.

From an innovative point of view the project results are definitely meaningful because it offers a flexible, scalable and customizable approach to the SLA Management. In addition to this, one of the added value of the project for this specific use case, is that all the results will be open source and that the SLA model are general purpose and suitable of any kind of service and context.

Market Readiness

The market the following use cases are addressing is particularly sensitive to the topics related to the SLA. In fact in Europe most of the PAs are moving toward a service based business. It is obvious that nowadays not all the services can be provided as web- or e-services and for some of them it is still necessary the interaction with the human being. Despite all, whatever is the means the service is provided, the need to describe and manage the SLA is more and more important not only for the PAs themselves (that increasingly turn to third party providers the service delivery) but also for the citizens benefiting of these services. The citizens do not have any idea about the SLA underling most of the service they daily use without any means to formally protest and proceed for any SLA violations. The protests up to now are based on a subjective perception of the quality of the service while we have to turn toward an objective and clear one, to be more effective and transparent toward all the involved actors (consumer, provider and prosumer).

Thus, the trend in the next future is to have a SLA Knowledge and related Service Quality Transparency to make the PAs in the position to better monitor the service chain, to manage the costs in a more efficient way and allocate the resources promptly and effectively.

The outcome of this use case can be used as a proof of concept to convince the Governance to invest time and resources on SLA management and to test more easily the impact of new services or different service configurations.

From the citizens' point of view, the benefits are to be able to identify dependable services, be aware of the recognition of their feedbacks and requirements.

Conclusions

SLAs are important in eGovernment as a mean of control of outsourced services and to increase the transparency of services quality. The SLA@SOI Framework may significantly help in reaching these goals, obtaining an increased citizens' satisfaction with minor costs for the PAs.

It is important to note that in order to fully exploit the SLA@SOI framework in a real scenario, an initial effort is necessary to acquire the needed knowledge on the adopted integration technologies and to customize a suite of features that depends on the specific use case. After this initial phase, the IT systems already in use can be integrated with a minimal effort.

While the product is not completely mature with respect to the management of human based services, the possibility to have an integrated management of hardware, software and human services is very valuable and unique on the market.

3.1.4 Use Case Commonalities

For the previous analysis, all the KPIs and value dials proposed by the use cases have been aggregated into a set of common business objectives. Through the evaluation of the KPIs of each of the use cases, it is possible to have an estimation of the improvements and better scored business objectives of SLA@SOI applicability.

For scoring the different KPIs, the use cases have based on their own evaluation to assign one of the following values after the application of SLA@SOI technology:

1. much worse
2. worse
3. slightly worse
4. equals
5. slightly better
6. better
7. much better

These KPIs are mapped into Value Dials, and those into High Level Business Objectives. The average value of the scored parameters has been used to compute de next level in the hierarchy.

The results can be observed in **Table 8**. The top rated business objective is the business value for consumers and citizens. That means that one of the main values obtained from the project are those related to providing reliable services, in a fast manner, which fulfil what consumers and users expect from the service.

Another business objective relevant to all the use cases and with a high score is the efficiency and reduction of costs. This is remarkable in the case of technical and processes efficiency, while for resources allocation and energy savings the results only reflect a slight improvement.

Business Objectives	B.O. Score	Value Dials	V.D. Score	UC Involved	KPIs	B3	B4	B5	B6
Enhance transparency & Enabling the Enterprise	5,14	Agility	5,00	B3, B4, B5	Number of change procedures supported (B3)	5			
					Number of policy parameters supported (B3)	4			
					Dynamic Scalability (B4)		5		
					Scale up/Scale Out (B4)		5		
					Average time to provision a service (B4, B5)		5	5	
					Average time to modify a service (B5)			5	
					Time to agree a new contract (B6)				6
					Time to adjust resources/processes (B6)				5
		End2End manageability	4,67	B3, B5	number of tools/management consoles (B3)	5			
					rate of monitored atomic services per total number of	5		4	
		Ability to choose from different options	5,40	B3, B6	Availability of explicit product catalogue (B3)	4			
					Customizable entries per product offer (B3)	5			
					Number of mobility options (B6)				6
					PercentageLatePickups (B6)				6
					PercentageLateArrivals (B6)				6
		Dependability	5,50	B3, B4, B5	Number of SLA Terms (B4)		7		
					Number of empirically validated SLA terms (B3)	7			
					Number of Automatically Monitored SLA terms (B4)		7		
					Reporting: Service Availability, Period (B4)		6		
					Availability (% of the time the service is available, ej.			3	
					Mean time to recover from an SLA breach (in seconds) (B5)			3	
Increase efficiency and reduce costs	5,24	Energy Efficiency	4,50	B3, B4, B5	Energy Consumption kW/hr (B5) / energy consumption per 1000 SAPS (B3)	6		3	
					Energy Savings (B4, B5)		6	3	
		Technical Efficiency	6,00	B3	CPU capacity per requested SAPS (B3)	6			
		Process Efficiency	6,00	B3	number of working hours per service request (B3)	6			
		Operational Efficiency	5,00	B3, B5	Opex associated to platform management (B5)				
					Time to collect business information (B3)	5		5	
		Development Effectiveness	5,50	B3	Number of automatically generated SLA term specifications (B3)	6	5		
		Cost Effectiveness	5,00	B4	Vendor Support Contract Costs (B4)		5		
		Resources allocation efficiency and optimization	4,67	B6	% of fixed network resources utilisation (B5)			5	
					% of mobile network resources utilisation (B5)			5	
					Human resource cost (B6)				4

Business Objectives	B.O. Score	Value Dials	V.D. Score	UC Involved	KPIs	B3	B4	B5	B6
Investment & Technology Adoption	5,38	Control of Resources	5,75	B4	Automated Policy based Management (B4)		6		
					Number of management Tools (B4)		6		
					Location Specification (B4)		6		
					Resource Utilisation over time (B4)		5		
		Optimal payback on investment	5,00	B4	Total Cost of Ownership (B4)		5		
Business values for the Customer / Citizen & Citizen Service Center	5,81	Customer Satisfaction	6,33	B5	Rate of claims per customer (B5)			7	
					Rate of customers calls to CRM (B5)			6	
					% reduction (elimination to zero) of undetected SLA violations (B5)			6	
		Fast decision making	5,00	B5	% of automatic penalties adjusted (B5)			5	
		User Preference Matching	6,00	B6	Mean feedback satisfaction level (B6)				6
		Integrated offer of services	5,00	B6	Mean booking time (B6)				5
		Compliance awareness	7,00	B3	Fast decision making (B3)	7			
		Usability	5,00	B3	User experience and satisfaction index (B3)	5			
		Service consumption possibilities are enhanced and easy-to-use	6,33	B3	time to quotation (B3)	7			
					Rate of services contracted/modified manually by customers (B5)			6	
					time to provision (B3)	6			
Enable dynamic service provisioning	6,00	Services get dependable through SLAs	6,00	B3	number of SLA terms (B3)	6			
					number of SLA terms monitored (B3)	6			
Business values for the Governance & Citizen Service Center	5,50	compliance and performance awareness	5,50	B6	Number of violated guarantee Terms (B6)				6
					Percentage of not replied (B6)				6
					Percentage of calls that find busy lines (B6)				6
					Mean time to perform a health treatment booking (B6)				5
					Mean time to perform a mobility booking (B6)				5
					Penalty (B6)				5
						5,61	5,64	4,73	5,50

Table 8: Business Objectives linked with Value Dials among use cases

3.2 Cloverleaf Survey Results

In Appendix B: is shown the Survey of Industrial Partners from ENG&GPI, Intel, TA, SAP, TID, XLAB.
In the rest of the section the data collected from the different partners are compared to identify the mean score obtained in each parameter and the parameters that have higher or lower score.

3.2.1 Common Metrics survey

In this section the results of the analysis of the different surveys are provided. In the next section an interpretation of the results is provided.

Market Readiness and Technology Readiness

Table 9 shows the average market readiness and technology readiness for each analysed parameter. The green background is used to highlight the parameters that on average have the higher score. Instead, in yellow the parameters with the lower score on average are shown.

Market Readiness	Average
The technology offers significant identifiable and quantifiable benefits	4,88
The product/process has distinct advantages over competing products	6,25
The technology has future uses	5,75
There is a definable marketable product	4,88
A defined market is accessible	5,75
The market is a large one	7,00
The market is a growing one	7,00
The technology has immediate market uses	3,75
The technology will be first-to-market	3,13
Manufacturing is determined to be feasible	4,50

Table 9: Average Market Readiness

Technology Readiness	Average
The technology is a new, non-obvious invention	5,13
The patent and literature search are complete and clear	1,63
There are no other dominant patents	1,88
The technology is state-of-the-art or major breakthrough	4,00
The technology is a core or platform technology	6,00

Table 10: Average Technology Readiness

Top-rated Business metrics

Max Market Readiness		
Target Market	Business Software for Lines of Business (LoBs) of Large Enterprises (Les)	3rd party services
Target Product	OnDemand applications with special line of business scope	SDP with SLAs
MAX Market Readiness Score	71	

Max Technology Readiness	
Target Market	Business Software for LoBs of LEs
Target Product	OnDemand applications with special line of business scope
MAX Technology Readiness Score	23

Lowest-rated Business metrics

Min Market Readiness Score		
Target Market	Enterprise Collaboration Software	Telecommunication as a Service
Target Product	OnDemand product for semi-formal collaborations	Cloud-based teleco service platform
MIN Market Readiness Score	34	

Min Technolgy Readiness Score	
Target Market	Telecommunication as a Service
Target Product	Cloud-based teleco service platform
MIN Technology Readiness Score	12

3.2.2 Industrial Readiness survey

3.2.2.1.1 Average Market readiness parameters

From the average score of the parameters in Table 9 we can see an agreement among the partners that in general assigns the maximum score to the Market readiness parameters related to the characteristics of the market and like its size and evolution, in particular, the market is a large one and the market is a growing one.

Similarly, all the partners agrees on assigning a low score to the parameter "The technology will be first-to-market" meaning that the technology in use in the project will not be completely new solutions for the market.

3.2.2.1.2 Average Technology Readiness parameters

The average values of the evaluation shows how the technology is seen from the partners as a platform technology as it gets on average the higher score. Finally most of the partners perceive that the patent and literature search is not yet completed.

3.2.2.1.3 Top-rated Business metrics

Referring to the maximum score obtained in the market readiness evaluation we can see how in general SAP is more confident than the other partners for the "OnDemand application with special line of business scope". Similarly also TID assigns the same score to their "SDP with SLA" product.

For the technology readiness SAP assigns again the topmost values as above. From the market and from the technology point of view the product of SAP supporting specific business needs are more ready and consolidated from the market and technology point of view in contrast to more formal and theoretical work with more emphasis on research.

3.2.2.1.4 Lowest-rated Business metrics

If we look at the minimum scores in the evaluation we can see how the OnDemand product for semi-formal collaborations product of SAP is not mature neither from the technology point of view and the market. This, as said above, could be due to the fact that the market needs solutions that are more focused on specific business needs rather than general systems.

3.3 Technology Readiness Levels Model Survey Results

In Appendix D: is shown the TRL Survey of Industrial Partners from ENG, GPI, Intel, SAP, TID, and XLAB.

In the rest of the section the data collected from the different partners are compared to identify the mean score obtained in each level and the levels that have higher or lower score.

3.3.1 Common Data about survey

This section shows a summary of the average of the results of the analysis of the different surveys provided by the industrial stakeholders. In the next section an interpretation of the results is provided.

Figure 5 shows the average about the survey taking into account all industrial partner surveys. And the detailed survey from industrial partners compared with the overall average can be seen in Figure 6.

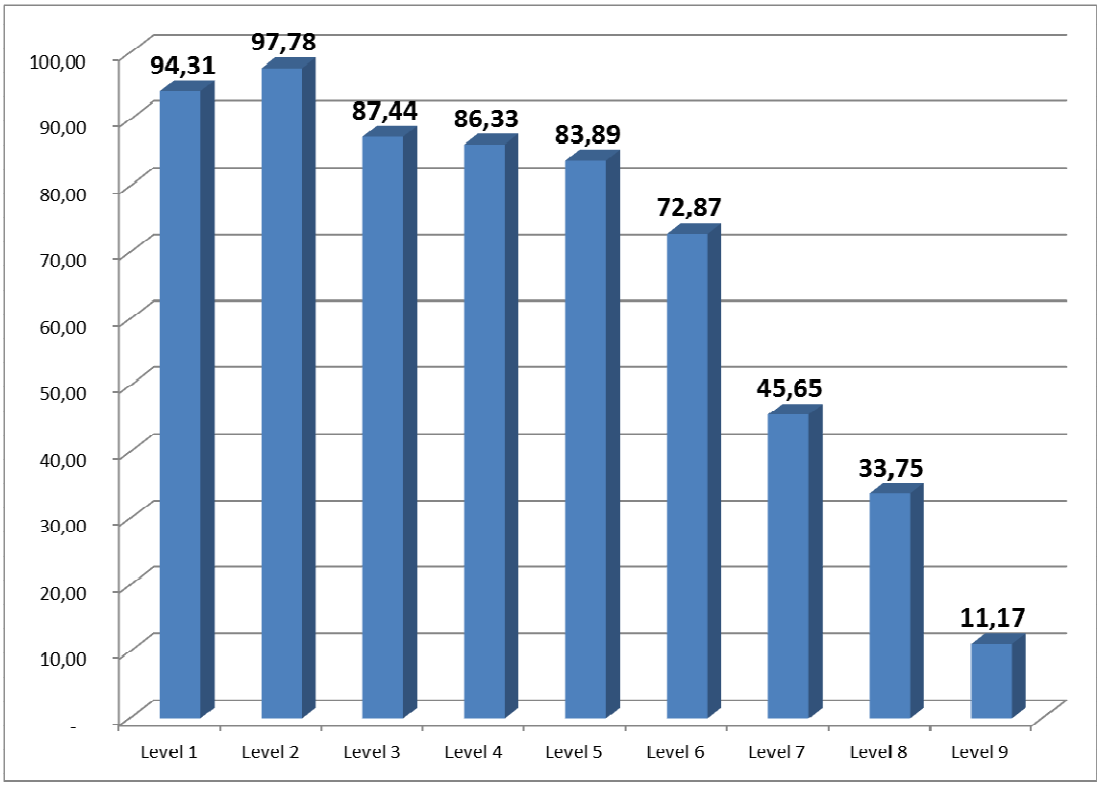

Figure 5: Technology Readiness Levels Average

Top-rated Levels

The highest rated levels		
Level 1	Basic principles observed and reported.	Basic Research finished
Level 2	Technology concept and/or application formulated.	Basic Research finished

High rated levels		
Level 3	Analytical and experimental critical function and/or characteristic proof of concept.	Applied Research finished
Level 4	Component and/or breadboard	Applied Research finished

	validation in laboratory environment.	
Level 5	Component and/or breadboard validation in relevant environment.	Advanced Research finished
Level 6	System/subsystem model or prototype demonstration in an operation environment.	Advanced Technology Demonstrator finished

Lowest-rated Levels

Low rated levels		
Level 7	System prototype demonstration in an operational environment.	Advanced Technology Demonstrator finished
Level 8	Actual system completed and "flight qualified" through test and demonstration.	Advanced Product finished

The worst rated level		
Level 9	Actual system flight proven through successful mission operations.	Commercialization and Advanced Product finished

3.3.2 Industrial Readiness survey analysis

It can be explained some conclusions about the average of the TRL survey.

Level 1 & Level 2
Very good score, although some partners state their doubts about deep enough state of the art and peer reviewed publications.

Level 3
Good score. Excellent identification of components and functions for the applications. The analytical and experimental proofs of concepts of the components is not enough documented.

Level 4
Good score. Excellent definition of the architecture. The evaluation metrics of the use cases should be revised.

Level 5
Acceptable score. Mapping of components to critical functions very well resolved. Use cases definitions are good. Analysis of test results vs. predictions should be improved. The facilities and test environments for the use cases should be reviewed and their availability guaranteed.

Level 6
Acceptable score. The system requirements are successfully finalized. The system has not been completely tested on a full scale realistic application.

Levels 7, 8 and 9
Lower scores, as expected in a research and innovation project.
For a real delivery and uptake of the software generated in the project, an important effort must be done to finalize, test and evaluate it.
It can be stated that the software is not ready for launch/operation yet.
However, the architecture (including component interfaces) and the use cases are in an advanced situation.

The following figure shows all the information of the industrial partners' surveys together. It can be seen that the pattern of fulfillment of all the levels is quite similar, while it is remarkable that there are important differences in the evaluation of different partners. This is due to different involvement of the same partners in the technological core of the project (the higher involvement, the higher score). Those partners that have a deeper knowledge and involvement have a more positive view of the maturity and readiness of the results.

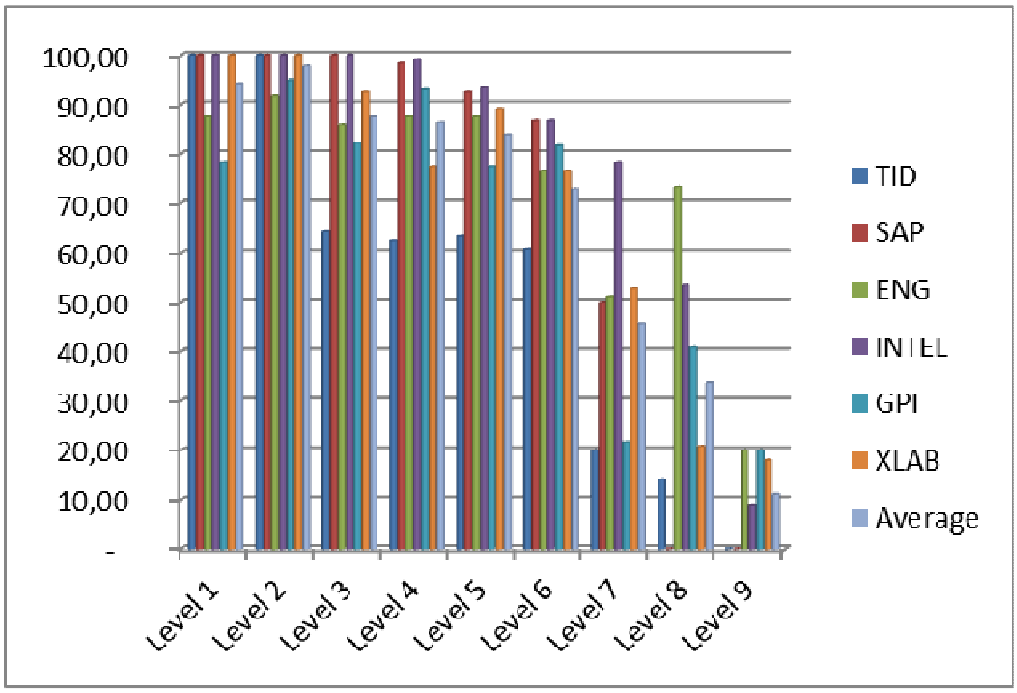

Figure 6: Summary of the survey Technology Readiness Levels

3.4 Industrial and Business Assessment Summary

3.4.1 Business Metrics Analysis

What comes out from the analysis of the industrial and business advantages reported in the SLA@SOI use cases is that SLA@SOI technology is very promising in terms of business improvements and benefits.

Despite the use cases are different among them, they have been identified value dials (or metrics) common to all them (ref. Section 2.3). Among these metrics **agility**, **dependability**, **efficiency** are those that all the Use Cases recognised important and strategic for their industrial and business improvement. The reason for this is that in all use cases it has been identified the need to have a solution, such as the one provided by SLA@SOI, able to react promptly and in an easy way to the market needs (agility) guaranteeing an higher and higher degree of dependability.

The other value dial that SLA@SOI results is expected to satisfy is a more effective efficiency management in terms of resources and operations efficiency that is reflected also in a minor impact in terms of costs to bear.

This is expected to be achieved thanks to well defined SLA customizable for different application domains and supporting tools enabling a SLA management more flexible with automatic adjustment and negotiation mechanisms.

What is derived from the analysis of the Business Metrics analysis is that, thanks to SLA@SOI what the final users expect to obtain is a greater customers' satisfaction thanks to a complete, automatic and flexible SLA Management set of tools.

3.4.2 Technology Readiness

In this section, the assessment results on the Technology Readiness collected from the different final users are summarized. To recall the reader about this assessment aspect, according to the methodology the project decided to follow[1], the Technological Readiness analyse the following aspects:

- The technology is a new, non-obvious invention
- The patent and literature search are complete and clear
- There are no other dominant patents
- The technology is state-of-the-art or major breakthrough
- The technology is a core or platform technology

(According to the methodology for each of the criteria conditions above, the user enters a score for two different aspects: (i) "extent to which condition is met" where 1=not met, 2=partially met, 3=fully met and (ii) "level of confidence" where 1=low confidence 2=moderate confidence and 3=high confidence.)

The tables below show the results obtained by the survey. For a matter of convenience and a more effective visualization aiming at grouping the opinion of the different users, the tables have been divided according to the two aspects and the weighted score:

Technology Readiness	Extent to which condition is met					
	Usr1	Usr2	Usr3	Usr4	Usr5	Average score
The technology is a new, non-obvious invention	1	2	2	2	2	2
The patent and literature search are complete and clear	1	1	2	1	1	1
There are no other dominant patents	1	2	2	2	2	2
The technology is state-of-the-art or major breakthrough	2	2	2	2	2	2
The technology is a core or platform technology	3	3	2	3	3	3

Technology Readiness	Level of confidence					
	Usr1	Usr2	Usr3	Usr4	Usr5	Average score
The technology is a new, non-obvious invention	3	2	3	2	2	2
The patent and literature search are complete and clear	1	1	1	2	2	1
There are no other dominant patents	2	1	1	1	1	1
The technology is state-of-the-art or major breakthrough	1	2	2	2	2	2
The technology is a core or platform technology	3	3	1	3	3	3

[1] "Development of a Technology Readiness Assessment Measure: The Cloverleaf Model of Technology Transfer" - Louise A. Heslop, Eileen McGregor and May Griffith "The Journal of Technology Transfer" Volume 26, Number 4 / October 2001

Technology Readiness	Weighted Score					
	Usr1	Usr2	Usr3	Usr4	Usr5	Average score
The technology is a new, non-obvious invention	3	4	6	4	4	4
The patent and literature search are complete and clear	1	1	2	2	2	2
There are no other dominant patents	2	2	2	2	2	2
The technology is state-of-the-art or major breakthrough	2	4	4	4	4	4
The technology is a core or platform technology	9	9	2	9	9	8

Looking at these tables, after the first round of the assessment and evaluation process, what comes out is that there is a general agreement about the Technology readiness aspect among all the users who filled the survey. In particular, reading at this report and analysing the results above what is clear is that after the second year of project there was a partial level of confidence on the novelty and breakthrough of the SLA@SOI Technologies. The same results are obtained for the extent to which the conditions\requirements are met. Anyway what balanced this feeling of pessimism was the fact that it was clearly recognized by all the involved parties in this survey that the technology developed in SLA@SOI will be a core one. The evidence of this is given by the weighted score[2] of this dimension ("The technology is a core or platform technology").

To summarize the general feeling of the final users on this specific assessment aspect, the sentence below is the one that better reflect the current status of the technology: "… it is a complex topic which presents many issues as the project defines a generic framework which needs to meet the diverse needs of the use cases which are driving its development. However, the process of defining these features, the obstacles it presents and the framework architecture and implementation are of immense interest in an area of growing importance in the IT world. …"

These specific survey results also reflected the status of the project after the second year and the complexities and obstacles met so far. In fact, most of the project results were still at an early prototype phase and not all the requirements had been still implemented. As a consequence, the integration of all the functionalities in the general SLA@SOI framework was partial and the training and confidence of the final users toward the adoption of the SLA@SOI tools was still weak and rough.

On the other hand, the TRL survey implemented during the final phase of the project provides a more concise and comprehensive view of the project maturity and readiness. The overall view of the technological readiness shows that the results are aligned to what is expected in a project of this nature. That is, according to Figure 4, for a FP7 Integrated Project, the main objective is to carry out a successful research and innovation project in which the technology created is properly demonstrated. This means, according to the TRL definition, to achieve a good score in the first 6 levels. The survey results show that the levels 1 to 5 have a good achievement, and only level 6 is slightly lower. Therefore, it can be stated that the technology has been successfully demonstrated and ready for a real industrialization process. The weaker issue in the results shows that the evaluation metrics, infrastructure and testing in real environments should be improved, which is consistent with the conclusions arisen from the Cloverleaf survey.

[2] Obtained by multiplying the "extent to which the condition is met" and "level of confidence (ref. methodology at note 1)

3.4.3 Market Readiness

We now provide a short summary of the observations on market readiness as provided by the use cases in sections 3.1.1 through 3.1.5, and then some brief remarks on the common trends.

For ERP hosting, market readiness was felt to reside more in discrete service offerings rather than in complete application suites due the simpler nature of such deployments. For enterprise IT, the market is judged to be ready for the much more fully automated manageability improvements that our project is investigating, feeling that providing such capabilities has the potential to be a solid evolutionary step over current offerings. For service aggregation of telecommunications services the ability to "bake-in" SLA management offers the business layer a key unique selling point over current offerings. The ability to translate these business concepts to technical aspects of manageability on the basis of a common model provides a key component of this differentiation. For the eGovernment market the ability of this common model to provide a reference point for evaluation and disputes about service quality for services definitions based on both human and electronic resources provides a transparency not matched by current offerings.

We can then summarize the market readiness appraisals as each arguing that SLA@SOI does indeed potentially provide a useful **novelty** in all of the proposed application domains, indicating that each use case should be able to provide a further assessment on the relative impact and relevance of this innovation when the individual scenarios are more mature. For all applications, one of the key aspects of this innovation was felt to be the applicability of a **common model** over existing offerings. And finally in all of these markets, the potential of our approach to increase the **agility** by which business processes may be enacted, modified and monitored was judged to be a prime potential advantage over existing solutions.

3.4.4 Overall readiness and recommendations

As a result of the previous analysis it can be summarized that:

- SLA@SOI technology can significantly improve the results of different types of products, services and systems in terms of agility (better processes, reaction time, time to market, etc.), dependability (better reaction to customer's demands, more reliable systems) and efficiency (especially in terms of processes and operations).
- The integrated approach of SLA management proposed by the project is a key value, beyond the innovation level of many features of the project. This is reflected in the architecture and SLA model as key assets.
- The technology (software) produced has significantly improve its quality, reliability and reusability. It can be used in many different industrial applications.
- The tests performed and the evaluation metrics have been designed for the objectives of the project. Any new possible application of the results should define appropriate and realistic evaluation metrics, arrange the proper testing infrastructure, and carry out real operational tests.

3.4.5 Use Cases Evaluation

ERP Hosting use case

The introduction of an SLA-driven management approach for hosted enterprise applications is not a trivial endeavor.

First of all, it requires a systematic approach in analyzing the envisaged service offering and comparing it with the underling system at hand. The intended SLA features must be carefully mapped to the capabilities of the underlying system in order to understand, which features can be implemented with which effort. The systematic approach introduced in the adoption guide turned out to be a very helpful instrument in this regard.

Second, SLA management needs to be integrated into the broader IT management environment. The latter one is typically rather large already for enterprise applications. Such environments often already come with some kind of KPI-driven system management approach. While those KPIs reflect provider-driven goals and indirectly may also reflect customer requirements, SLAs make the latter very explicit. Therefore, the introduction of an SLA-driven management approach must be carefully aligned with the existing KPI-management system in order to achieve a consistent and harmonized overall picture.

The SLA@SOI reference architecture turned out to be very helpful in developing a sound approach for the actual SLA management system. The concepts sketched there have been very well applicable to the domain of enterprise applications.
The SLA@SOI reference framework turned out to provide a solid core of basic functions for SLA management which were successfully used in our demonstrators. The extension of this core with domain specific elements is however unavoidable and requires still a reasonable effort.

The potential business value generated through SLA management cannot be underestimated. It offers a major step in improving the quality of service offers to customers but also in the efficiency at which these offers can be maintained by the service provider. We expect these improvements to become a major competitive advantage in future service offerings.

Enterprise IT use case

At the end of the SLA@SOI project, the key messages that the Enterprise IT Use case have proven are:

(a) SLA-aware frameworks have strong business value – barriers to cloud can be overcome to realise productivity and efficiency gains.
(b) SLA-aware framework concepts can be implemented – proven by lab and field scale demos.
(c) SLA@SOI can go beyond the strict confines of QoS term management and use service and infrastructure metadata to make run-time optimisation decisions – as shown in the run-time scenario.

The use case took a structured approach to requirements gathering in its early phases in order to solve real issues faced by the providers of hosted IT services in

an enterprise setting. Namely, these revolve around agility, total cost of ownership, security, scalability, productivity and capacity planning.

The provisioning scenario addressed issues around agility, productivity, security and dependability. The run-time scenario dealt with efficiency and scalability, while the investment governance scenario total cost of ownership and capacity planning. KPIs for each of the value dials which are used to measure the success of these are listed in chapter 5 of the field demonstrator deliverable (D.B4c). The lab demonstrator KPIs showed large improvements over industry, but in the last 12 months industry has integrated cloud systems and some of the key items such as agility and time to provision have become a reality. However, the work of SLA@SOI in the enterprise use case goes beyond those areas. Currently industry is in an early adoption phase for cloud. They need tools to deploy and manage clouds, to deploy virtual machine templates, to automate provisioning, to perform security and data backup services. Early versions of these tools exist and they will continue to develop. The objective of research activities today should be to anticipate the future needs of industry in this area. In the 3-5 year timescale, security, dependability, efficient & reliable operations and scalability will be key elements of the cloud migration which will need to be addressed in a comprehensive way. The core elements of the enterprise IT use case are still state of the art and aimed directly at those areas. The work we have done is helping to determine the future tools and product feature sets which industry will need to continue its cloud journey.

Using the IT Compatibility Maturity Framework (IT-CMF) as its basis, the field demonstrator deliverable performed an assessment of the workpackage which showed that across the 11 most critical processes (CPs) to an IT service business, the SLA@SOI framework would score at a very impressive level 4 if it were fully implemented on an industrial scale. Typical industry values seen in industry for these CPs would be 3 or less. This assessment shows how adopting an SLA-aware framework in the way that B4 has done can help move IT service delivery up the value chain of the organisation and help IT transition from being a cost centre (ie: an inefficient, but necessary expense) to being a true enabler of the core business functions and a distinguisher for that organisation in the industry,

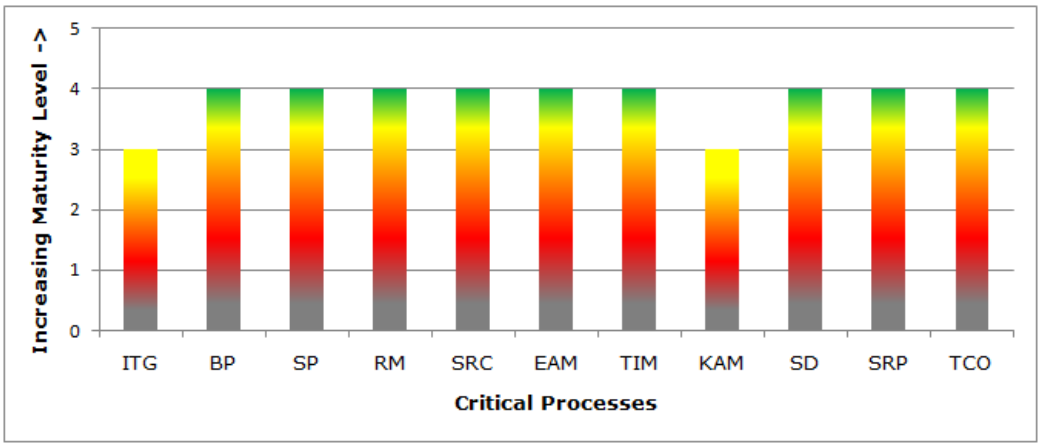

Figure 5: Summary IT-CMF Evaluation of Cloud CPs

Service Aggregator use case

SLA@SOI framework and its technology is fully applicable to the telco domain. Both sub-scenarios implemented in the use case are a nice proof of concepts in

which different approaches has been used. Architecture, SLA model, business SLA management and the rest of important assets of the project are a good basis and pieces of technology and software that can be used to build new components, products and/or services in the telco domain. It is important to highlight that it will require some adaptations and extensions, but the novel research level reached is very high and industrialization in different facets are realistic.

The different proof of concepts that have been built in simulated environments that works relatively near the real prototypes and networks, allow a level of maturity of the solution that was not yet sufficient. A full integration in telco systems has not been reached but it is not necessary for the aim of the prototypes and the use cases. As was explained in exploitation section of B5 use case deliverable [6], real end customers are testing the prototypes. Some possible final products can reach the market in following months and the technological value of this project to obtain it was worthy.

Telco real systems are more complex and time is needed in order companies can starts to depend on legal contracts automatically managed by SLAs. But we are confident; SLA@SOI project was one of the pieces of the board that facilitated a new automatic econtracting era.

eGoverment use case

The application of the SLA@SOI framework to the eGovernment use case tested the potentials of SLA based service management in a rather complex scenario in which human based services co-exist with classical IT services. The adoption of the SLA features is not immediate but it requires some adaptation and most importantly an accurate modeling of the SLA. The correlation of some of these SLA is not always so easy to capture especially when it depends on the user behavior and citizen perception (e.g. the citizen satisfaction). This means that some features of the framework can be tested quite easily in a simulated environment (e.g. service efficiency in terms of time and resource consumption). Instead, the nature of the services in the eGovernment use case is such that it is required a particularly careful analysis of the environment in which the services are deployed to capture the expectations of the users and to model them in a set of business indicators and later on formalized into a set of SLA and KPI.

From the industrial point of view this analysis time is unavoidable but it makes a solution innovative and capable to reach the market. Definitely the time devoted to this analysis and adaptation phase in order to adopt the SLA@SOi features is not cost zero but the advantages obtained by the framework adoptions are worth the effort. Particularly, the monitoring capability of the SLA@SOI framework helps to identify process weaknesses and the reason of user un-satisfaction. And most importantly the reports generated can be used to interact with the Governance to propose changes or to test new services or service provisioning configuration schema that with a pure manual monitoring of the services is not easy to see.

Another big inefficient in many PAs is the way contracts are managed. This process is typically very long as it may take also months to complete. We are conscious that a complete automation of this process is not possible as a supervision by physical person acting as guarantor is unavoidable but it possible to simplify some of the steps of such process (e.g. the exchange and preparation of the offers among the different parties of a contract). Also in this case the added value of the SLA@SOI features is not only in merely reducing the time taken by these operations with the introduction of IT systems to manage the negotiation of contract automatically but even more importantly is the capability

to give evidence to the users (Governance, service providers and citizens) of the inefficiencies in these manual processes and their causes.

The evaluation has been performed in a simulated environment as the maturity of the solution was not yet sufficient for an on-field evaluation. Specifically the integration and testing process could be further simplified before it can be used in a real marketable product.

However, the results are promising and they will be shared with the local Governance to get commitment to start experimentation with real citizens.

This will require coping with more complex situations and legal contracts that are more "distant" from automatically managed SLAs.

4 Conclusions

4.1 Summary

This deliverable has summarized the point of view of industrial stakeholders of the SLA@SOI project.

First, two surveys have been defined from two different models; the Cloverleaf model proposal and Technology Readiness Levels. They are focused on those aspects that are relevant for the project in this stage (technology and market). These surveys have been completed by all the industrial partners, and the results are analysed in the document. The used approach allows contrasting two different points of view to evaluate the industrial applicability of the project. Besides, a readiness analysis has been carried out by all the use cases of the project, focusing on their own metrics and value dials, and the business and technology readiness of the project.

4.2 Lessons learned

Because of the different nature and business of the industrial stakeholders of the project, it is important to have a common understanding and a way to unify and align the different points of views. Each industrial partner and use case has his requirements and the domain can be determinant in the way of understand the business.

After this evaluation, it can be stated that SLA@SOI was well balanced in terms of maturity. The focus was in the research and development, near the reality and the business of the industrial partners. We have validated the project outcomes using different industrial domains, demonstrating that the project provides a great business value for individual use cases, which in turn, may be extrapolated to many other future business scenarios and applications. The technology outcomes have been proven to as mature as expected for an innovation project, according to the TRL survey, although the final step of adaptation, integration and market delivery has not been tackled.

4.3 Final Recommendations for Industrialization

Each industrial partner of the SLA@SOI project is going to exploit their demonstrators in his own business and domains. Exploitation deliverable [5] is a complementary document that can offer a common understanding about the evolution of the demonstrators by the different industrial partners of the project.
However, both for the project partners and for external adopters of the technology, some recommendations have to be raised.

First of all, it is a core technology to be applied to different environments, most of them unforeseen. Though the results of the project are complex they are well applicable in a large variety of scenarios.. Also, we gained good confidence that

the main tenets of the project are very well defined, and that the model and architecture of the system is sound and reusable.

An important aspect to be considered by any industrial adopter is the careful analysis of the actual business objectives that shall be pursued via SLA management. It is recommended to do a proper and specific selection of metrics to evaluate, and to do application specific assessment of the benefits of the technology, assuring that the testing environments are as close to reality as possible.

5 References

[1] Heslop, L.A., McGregor E., Griffith, M. "Development of a Technology Readiness Assessment Measure: the Cloverleaf Model of Technology Transfer". In *The Journal of Technology Transfer*, Issue 26, pp. 369—384, 2001.

[2] SLA@SOI: Deliverable D.B8a Exploitation Plan. July 2010

[3] Kagermann H, Österle H 2006, Geschäftsmodelle 2010 - Wie CEOs Unternehmen transformieren. Frankfurter Allgemeine Buch, Frankfurt (in German)

[4] Sauser, B., Verma, D., Ramirez-Marquez, J. and Gove, R. From TRL to SRL: The concept of systems readiness levels. Conference on Systems Engineering Research, Los Angeles, CA, 2006.

[5] SLA@SOI: Deliverable D.B8a Exploitation Plan. July 2011

[6] SLA@SOI: Deliverable D.B5c Service Aggregator. July 2011

Appendix A: Glossary

The following list shows the most important entries of the SLA@SOI glossary. Note that terms that are specific for the current document and not part of the overall project wide glossary are marked with an asterix *.

Agreement Initiator	An agreement initiator is a party to a *service level agreement*. The initiator creates and manages an agreement on the availability of a service on behalf of either the service customer or service provider, depending on the domain-specific signalling requirements.
Agreement Offer	An offer is the description of the agreement relationship that is sent from *agreement initiator* to *agreement responder* during agreement creation, indicating the relationship which the initiator would like to form.
Agreement Responder	The agreement responder is a party to a *service level agreement*. The responder implements and exposes an agreement on behalf of either the service provider or service customer, depending on the domain-specific signalling requirements.
Agreement Template	An agreement template is an XML document used by the *agreement responder* to advertise the types of offers it is willing to accept.
Agreement Term	Agreement terms define the content of a *service level agreement*.
Business Service	A business service is exposed/invoked via at least some non IT elements.
Business Manager	A specialization of *service provider*: person that defines the SLATs of products and joins available services in a product.
External Service	External services are exposed across the boundaries of an organization, i.e. across at least two administrative domains.
Framework Administrator	A specialization of *service provider*: person that configures/adapts the SLA@SOI framework for a specific application.
Guarantee Term	Guarantee terms define the assurance on service quality associated with the service described by the service definition terms. They refer to the service description that is the subject of the agreement and define service level objectives, qualifying conditions and business value expressing the importance of the service level objectives.
Hybrid Service	A hybrid service is a set or bundle of other services where all these services are exposed to the customer but have different service interface types (e.g. an IT service and a business service).
Infrastructure Manager	A specialization of *infrastructure provider*: person/system that is interested to measure and control infrastructure properties.
Infrastructure Provider	A specific kind of service provider that focuses on the provisioning of *infrastructure services*.

Infrastructure Service	An infrastructure service is a specific *IT service* which exposes resource/hardware-centric capabilities.
Internal Service	Internal services are exposed within the boundaries of an organization, i.e. within one administrative domain.
IT Service	An IT service is exposed/invoked by means of information technology. Specific classes of IT services may be software services, infrastructure services or media services.
Offered Service	An abstract service (more precisely: service type) which is offered by a specific *Service Provider* to its *Service Customers*.
Operation Level Agreements	A specification of the conditions under which an *internal service* or a component is to be used by its "customer".
Service	A means of delivering value to customers by facilitating outcomes customers want to achieve without the ownership of specific costs and risks. See also *service interface type*, *service concreteness*, *service exposure*
Service Concreteness	The stage a service reaches over time from a fully abstract type to actually instantiated. See also *service type*, offered *service*, *service implementation*, *service instance*
Service Consumer	Person(s) who actually consume/use the provided services. Typically they belong to the *service customer*.
Service Customer	Someone (person or group) who orders/buys services and defines and agrees the service level targets.
Service Description Term	Service Description Terms describe the functionality that will be delivered under the *service level agreement*. The agreement description may include also other non-functional items referring to the service description terms.
Service Exposure	Services can be exposed either internally (within the same administrative domain) or externally. See also *internal service*, *external service*
Service Implementation	A service implementation is a possible concrete realization of a given *service type*.
Service Instance	A concrete realization of an *offered service* which is ready for consumption by service users. It relies on the instantiations of all the resources required for a given *service implementation*.
Service Interface Type	Describes the nature of an actually exposed service, i.e. about the nature of his invocation interface. See also *business service, IT service*, *hybrid service*
Service Level Consequence	An action that takes place in the event that a service level objective is not met.
Service Level Agreement	An agreement defines a dynamically-established and dynamically managed relationship between parties. The object of this relationship is the delivery of a service by one of the parties within the context of the agreement. The management of this delivery is achieved by agreeing on the respective roles, rights and obligations of the parties. The agreement may specify not only functional properties for identification or creation of the service, but also non-functional properties of the service such as performance or

	availability. Entities can dynamically establish and manage agreements via Web service interfaces.
Service Level Objective	Service Level Objective represents the quality of service aspect of the *agreement*. Syntactically, it is an assertion over the agreement *terms* of the agreement as well as such qualities as date and time.
Service Provider	An organization supplying services to one or more internal customers or external customers.
SLA Manager	A specialization of *service provider*: person/system that is responsible for managing SLATs and SLA relationships.
Software Designer	A specialization of *software provider*: person that designs/develops the architecture and components of a specific SLA based application.
Software Manager	A specialization of *service provider*: person that defines software-based services, takes care of their management and supports the SLA manager in creating appropriate SLA templates.
Software Provider	An organization producing *software components* which might be used by a *service provider* to assemble actual *services*.
Software Service	A software service is a specific *IT service* which is exposed/invoked by means of software entities such as Web services, user interfaces, or software-based business processes.
Software Component	Software components are the entities produced at design-time by a *software provider*.
Service Type	A service type (or abstract service) specifies the external interface of a service possibly including non-functional aspects. It does not specify any means (components, resources) which are needed for the actual provisioning of that service.

Appendix B: Abbreviations

CL	Clover Leaf Model
CRM	Customer Relationship Management
ERP	Enterprise Resource Planning
IT	Information Technology
ITIL	Information Technology Infrastructure Library
KPI	Key Performance Indicator
PA	Public Administration
SaaS	Software as a Service
SCM	Supply chain management
SDP	Service Delivery Platform
SLA	Service Level Agreement
TaaS	Telco as a Service
TID	Telefónica Investigación y Desarrollo
TRL	Technology Readiness Levels
VM	Virtual Machine

Appendix C: Cloverleaf Model Survey of Industrial Partners

Cloverleaf Model of Technology Transfer	ENG&GPI			Intel			TID_SDP		
Target Market	**Contact centers services**			**Internal Intel IT Organisation**			**3rd party services**		
Target Product	**Booking services for healthcare**			**iCloud Managability**			**SDP with SLAs**		
	Extent to which condition is met	**Level of confidence**	**Score**	**Extent to wich condition is met**	**Level of conficence**	**Score**	**Extent to which condition is met**	**Level of confidence**	**Score**
Market Readiness									
The technology offers significant identifiable and quantifiable benefits	1	3	3	2	2	4	3	3	9
The product/process has distinct advantages over competign products	1	3	3	3	3	9	3	3	9
The technology has future uses	1	3	3	3	3	9	3	2	6
There is a definable marketable product	1	2	2	1	1	1	3	3	9
A defnied market is accessible	1	2	2	3	2	6	3	3	9
The market is a large one	3	3	9	3	3	9	3	2	6
The market is a growing one	3	3	9	2	3	6	3	2	6
The technology has immediate market uses	1	2	2	2	2	4	2	2	4
The technology will be first-to-market	1	2	2	2	2	4	2	2	4
Manufacturing is determined to be feasible	1	3	3	2	2	4	3	3	9
Market Readiness Score (Max 90)			**38**			**56**			**71**
Technology Readiness									
The technology is a new, non-obvious invention	1	3	3	2	2	4	2	2	4
The patent and literature search are complete and clear	1	1	1	1	1	1	1	2	2
There are no other dominant patents	1	2	2	2	1	2	2	1	2
The technology is state-of-the-art or major breakthrough	2	1	2	2	2	4	2	2	4

The technology is a core or platform technology	3	3	9	3	3	9	3	3	9
Technolgy Readiness Score (Max 45)			**17**			**20**			**21**
		TOTAL SCORE	**55**		**TOTAL SCORE**	**76**		**TOTAL SCORE**	**92**

Cloverleaf Model of Technology Transfer

	SAP - SME Suite			**SAP - ECS**			**SAP - LoBs of Les**		
Target Market	**Business Software (ERP, CRM, ...) for SMEs**			**Enterprise Collaboration Software**			**Business Software for LoBs of LEs**		
Target Product	**OnDemand product for complete business software suite**			**OnDemand product for semi-formal collaborations**			**OnDemand applications with special line of business scope**		
	Extent to which condition is met	**Extent to which condition is met**	**Level of confidence**	**Extent to which condition is met**	**Level of confidence**	**Extent to which condition is met**	**Level of confidence**	**Level of conficence**	**Score**
Market Readiness									
The technology offers significant identifiable and quantifiable benefits	2	2	4	1	2	2	3	3	9
The product/process has distinct advantages over competign products	2	2	4	2	2	4	3	2	6
The technology has future uses	3	2	6	2	1	2	3	3	9
There is a definable marketable product	2	2	4	1	2	2	3	2	6
A defnied market is accessible	3	3	9	2	3	6	3	3	9
The market is a large one	3	3	9	2	2	4	3	3	9
The market is a growing one	3	3	9	2	2	4	3	3	9

The technology has immediate market uses	2	2	4	1	2	2	3	2	6
The technology will be first-to-market	1	2	2	2	2	4	2	2	4
Manufacturing is determined to be feasible	2	2	4	2	2	4	2	2	4
Market Readiness Score (Max 90)			**55**			**34**			**71**
Technology Readiness									
The technology is a new, non-obvious invention	2	3	6	3	3	9	3	3	9
The patent and literature search are complete and clear	2	1	2	2	1	2	2	1	2
There are no other dominant patents	2	1	2	2	1	2	2	1	2
The technology is state-of-the-art or major breakthrough	2	2	4	2	2	4	2	3	6
The technology is a core or platform technology	2	1	2	2	1	2	2	2	4
Technolgy Readiness Score (Max 45)			**16**			**19**			**23**
		TOTAL SCORE	**71**		**TOTAL SCORE**	**53**		**TOTAL SCORE**	**94**

Cloverleaf Model of Technology Transfer

	XLAB_ISL			TA		
Target Market	**SMEs using remote support and remote collaboration**			**Telecommunication as a Service**		
Target Product	**ISL Online**			**Cloud-based teleco service plaform**		
	Extent to wich condition is met	**Level of conficence**	**Score**	**Extent to wich condition is met**	**Level of conficence**	**Score**
Market Readiness						
The technology offers significant identifiable and quantifiable benefits	2	2	4	2	2	4
The product/process has distinct advantages over competign products	3	3	9	3	2	6
The technology has future uses	3	3	9	1	2	2

There is a definable marketable product	3	2	6	3	3	9
A defnied market is accessible	2	2	4	1	1	1
The market is a large one	3	3	9	1	1	1
The market is a growing one	3	3	9	2	2	4
The technology has immediate market uses	2	3	6	2	1	2
The technology will be first-to-market	2	2	4	1	1	1
Manufacturing is determined to be feasible	2	2	4	2	2	4
Market Readiness Score (Max 90)			**64**			**34**
Technology Readiness						
The technology is a new, non-obvious invention	2	2	4	1	2	2
The patent and literature search are complete and clear	1	2	2	1	1	1
There are no other dominant patents	2	1	2	1	1	1
The technology is state-of-the-art or major breakthrough	2	2	4	2	2	4
The technology is a core or platform technology	3	3	9	2	2	4
Technolgy Readiness Score (Max 45)			**21**			**12**
		TOTAL SCORE	**85**		**TOTAL SCORE**	**46**

Appendix D: Technology Readiness Levels Model Survey of Industrial Partners

	TID	SAP	ENG	INTEL	GPI	XLAB	
Level 1	100,00	100,00	87,50	100,00	78,33	100,00	94,31
Research hypothesis formulated?	100	100	100	100	80	100	96,67
Basic scientific principles observed?	100	100	80	100	60	100	90,00
Industry needs analyzed?	100	100	75	100	100	100	95,83
State of the art analysis done?	100	100	90	100	70	100	93,33
Scientific knowledge generated underpinning hypotheses?	100	100	80	100	60	100	90,00
Peer reviewed publication of studies confirming basic principles?	100	100	100	100	100	100	100,00

Industrial Partners Comments:
SAP: Complete analysis done and published in paper "Quality Considerations in SAP Architectures".
Intel: - A1 & B1 deliverables document these
GPI: The analysis of the state of the art and the research hypothesis and the scientific principles observed will be included in scientific publications.

	TID	SAP	ENG	INTEL	GPI	XLAB	
Level 2	100,00	100,00	91,67	100,00	95,00	100,00	97,78
Project objectives formulated?	100	100	100	100	100	100	100,00
Basic scientific principles underpinning concept identified?	100	100	100	100	100	100	100,00
Basic properties of algorithms, representations & concepts defined?	100	100	70	100	70	100	90,00
Preliminary analytical studies confirm basic concept?	100	100	80	100	100	100	96,67
Ptential applications identified?	100	100	100	100	100	100	100,00
Preliminary design solution identified?	100	100	100	100	100	100	100,00
Preliminary system studies show application to be feasible?	100	100	70	100	100	100	95,00
Basic principles coded?	100	100	100	100	70	100	95,00
Benefits formulated and indicators defined ?	100	100	100	100	100	100	100,00
Research & development approach formulated?	100	100	100	100	100	100	100,00
Preliminary definition of Laboratory tests and test environments established?	100	100	100	100	100	100	100,00
Concept/application feasibility & benefits reported in scientific journals/conference proceedings/technical reports?	100	100	100	100	15	100	85,83

Industrial Partners Comments:
SAP: Objectives for SLA management at SAP discussed and agreed with internal stakeholders from development groups.
Intel: - A4 and B4 deliverable specifications document these.
GPI: The scenario is based on a deep analysis of the systems currently in use in the healthcare. Based on that and on historic information a laboratory tests and test environment have been defined.
XLAB: Objectives for SLA management integration in XLAB commercial projects agreed.

	TID	SAP	ENG	INTEL	GPI	XLAB	
Level 3	64,17	100,00	85,83	100,00	82,17	92,50	87,44
Critical functions/components of the concept/application identified?	100	100	90	100	100	100	98,33
Preliminary evaluation metrics established?	25	100	100	100	100	100	87,50
Laboratory tests and test environments established?	75	100	100	100	81	80	89,33
Laboratory test support equipment and computing environment completed for component/proof-of-concept testing?	45	100	75	100	100	90	85,00
Component acquisition/coding completed?	80	100	75	100	52	85	82,00
Components verification and validation completed?	60	100	75	100	60	100	82,50
Analytical verification of critical functions from the proof-of-concept of components?	70	100	75	100	30	100	79,17
Analytical and experimental proofs-of-concept for components documented?	60	100	75	80	38	85	73,00

Industrial Partners Comments:
SAP: "Critical aspects researched; results published (as far as confidentiality allowed) e.g.
* On Cost Modeling of Hosted OLTP Application
* SLA-driven Planning and Optimization of Enterprise Applications
* Black-Box Performance Models: Prediction based on Observation
* A Model-Driven Framework for Process-centric Business Continuity Management"
Intel: "Analytical & experimental PoC documentation should be on track for completion by the end of year 3, but it is not complete yet. See B4 Year 1 & 2 deliverables and flyers for baseline KPI evaluation"
GPI: A simulation environment is set up to validate critical properties of the system and its capability to reach the expected results.
XLAB: Critical functionality for integration of the SLA management in the commercial products identified. Still some proof-of-concept testing needed.

	TID	SAP	ENG	INTEL	GPI	XLAB	
Level 4	62,50	98,33	87,50	99,17	93,00	77,50	86,33
Concept/application translated into detailed system/subsystem/component level software architecture design?	100	100	100	100	100	100	100,00
Preliminary definition of operational environment completed?	80	100	100	100	100	100	96,67
Laboratory tests and test environments defined for integrated component testing (ORC)?	75	100	75	100	80	100	88,33
Key parameter evaluation metrics established for use case tests?	25	100	100	100	100	0	70,83
Laboratory test support equipment and computing environment completed for integrated component testing?	25	100	75	100	100	80	80,00
System/subsystem/component level coding completed?	70	90	75	95	78	85	82,17
Integrated component tests completed?	60	90	75	90	60	80	75,83
Preliminary system requirements defined for final application?	70	100	100	100	84	100	92,33
Relevant test environment defined in use cases?	45	100	100	100	84	85	85,67
Integrated component performance results verifying analytical predictions and definition of relevant operational environment documented?	50	90	75	65	100	75	75,83

Industrial Partners Comments:

SAP: "End2end evaluation in lab environment conducted and published:
* Managing on-demand business applications with hierarchical service level agreements
* Business Continuity Management and SLA Translation"

Intel: "- There is still work remaining to complete component level coding.
- For integrated component tests, this is ongoing and not yet complete.
- The use cases have base lines For KPI performance. Essentially, these are our analytical predictions. But integrated component testing is not complete and therefore verifying performance results against these baselines is not documented yet."

GPI: Integration of the different components to test their capability to work smoothly together.

XLAB: Components development in the final phase, therefore also integration tests not fully completed. Integrated component performance still to be evaluated and documented.

	TID	SAP	ENG	INTEL	GPI	XLAB	
Level 5	63,33	92,50	87,50	93,33	77,50	89,17	83,89
Critical functions and associated subsystems and components identified?	90	85	100	100	100	95	95,00
Use case environments finalized?	80	100	100	95	100	95	95,00
Baseline of key evaluation metrics defined?	25	100	100	95	75	95	81,67
designed?	70	90	90	100	70	100	86,67
Subsystem/component integrations and implementations completed?	80	80	85	85	70	80	80,00
Facilities and testing environment available to support testing in use cases?	35	100	50	85	50	70	65,00
Analysis of test results completed verifying performance relative to predictions?	0	90	85	70	80	50	62,50
Subsystems/integrated components successfully demonstrated in the use cases?	80	80	100	70	80	60	78,33
Successful demonstration documented along with scaling requirements?	50	80	85	60	70	60	67,50

Industrial Partners Comments:
SAP: Technology transfer projects with development groups showcased specific functions (e.g. on SLA-aware workload management, business process simulation, business continuity management) in the respective relevant target environments.
Intel: "- Integration of components is not complete, but is (hopefully) nearly there.
- Analysis of test results against predictions is not complete but a lot of work is done on this so far.
- A lot of work is also complete on integrating components into the use cases, but again, this is not complete.
- How do we define 'scaling' in this context? We have performed successful demos in year 2. Not sure if scaling is comprehended everywhere, but should be addressed better by the end of year 3 with our 'field-scale' demos
- Use Case test bed documented in B4 year 2 deliverable & baseline metrics also in that. "
GPI: The critical functions and associated subsystems and components have been identified and the environment of the use case has been finalized. The baseline of key evaluation metrics has been defined.

XLAB: Subsystems identified and designed, coding and integration in the final phase, analysis to be done, some subsystems demonstrated, some still to be integrated and demonstrated. The ongoing integration and demonstration includes only a subset of a commercial product component for now.

	TID	SAP	ENG	INTEL	GPI	XLAB	
Level 6	60,83	86,67	76,67	86,67	81,67	76,67	72,87
System requirements finalized?	85	90	100	100	100	90	94,17
Operating environments definition finalized?	75	90	80	100	80	90	85,83
Subset of relevant environments identified that address key aspects of the final operating environment?	75	95	50	100	100	80	83,33
Hardware/software interfaces baselined (defined and under version control)?	100	85	100	100	75	90	91,67
Facilities, computing environment available to support software model testing in the use cases environments?	30	90	60	100	60	60	66,67
Prototype implementation of the software demonstrated on full-scale realistic application?	0	70	70	20	75	50	47,50
Analysis of test results verify expected benefits in evaluation metrics?	50	75	70	100	80	60	59,17
Initial draft of required software documentation completed?	100	50	70	100	45	60	70,83
Engineering feasibility fully demonstrated and documented?	70	70	60	80	60	60	56,67

Industrial Partners Comments:
SAP: Technology transfer projects with development groups partially demonstrated engineering feasibility on full-scale realistic problems.
"- **Intel**: Scored prototype implementation low at only 20% as this is not demonstrated on a full-scale realistic application. But it may depend on your interpretation of what a realistic application is?
GPI: The prototype implementation of the software demonstrated in a reference scenario.
XLAB: Prototype implementation demonstrated on a realistic application, but not all application (commercial product) components were included. To be done soon.

	TID	SAP	ENG	INTEL	GPI	XLAB	
Level 7	20,00	50,00	51,11	78,33	21,67	52,78	45,65
All critical scaling requirements defined and addressed by design?	0	80	50	85	50	70	55,83
Facilities, computing environment available to support prototype and qualification testing of operational software?	0	75	80	95	50	70	61,67
Fully integrated software model or scaled prototype system coded that adequately addresses all critical scaling issues and component and hardware interfaces?	0	75	50	70	30	40	44,17
All software testing/V&V specified in software development plan completed and results documented?	0	20	40	75	50	50	39,17
All performance specifications defined and verified by test or analysis?	0	50	40	75	30	40	39,17
Fully integrated prototype software successfully demonstrated in operational environment?	80	60	50	60	30	55	55,83
All final acceptance testing plans/procedures/criteria have been baselined?	0	20	40	80	50	40	38,33
Intermediate draft of required software documentation completed?	0	20	50	80	45	50	40,83
Successful operational demonstration documented?	100	50	60	85	50	60	67,50

Industrial Partners Comments:
SAP: Technology transfer projects currently ongoing... Aiming at completing TRL 7 with full handover to development groups.
Intel: "- The architecture does allow for some scaling by design, for example the messaging bus, outsourcing to another SLA@SOI enabled cloud, etc but probably not all are
- We don't have a fully scaled prototype system to adequately address ALL possible scaling issues, but we can address a lot of them.
- Not all SW testing and validation is completed and documented.
- Depends on what you mean by 'operational environment'. If our test beds qualify as operational environments, then we are probably 90% there.
- Operational demonstrations documented should be complete by the end of year 3. "

GPI: The final testing of the system has been defined with a set of scenarios to verify the more critical functionalities.

	TID	SAP	ENG	INTEL	GPI	XLAB	
Level 8	14,17	-	73,33	53,33	40,83	20,83	33,75
All software components and hardware interfaces defined and design complete?	85	0	100	90	80	25	63,33
Software operations, maintenance and retirement baselined and draft documentation prepared?	0	0	60	50	45	25	30,00
All software testing/V&V completed as specified in project plans and results documented, reviewed and approved by approriate authorities?	0	0	100	50	20	15	30,83
All defects and software issues, including impacts on requirements either fixed or resolved, and results documented?	0	0	60	50	60	25	32,50
All component/subsystem/ hardware interface system acceptance testing completed?	0	0	100	50	20	15	30,83
Software readiness for launch/operation documented?	0	0	20	30	20	20	15,00
All required software user documentation, version description, and maintenance documentation completed?	0	0	50	35	50	20	25,83

Industrial Partners Comments:
Intel: - A lot of the work on these is done, but probably not documented and reviewed sufficiently to 'production quality'
GPI: The simulation strategy and scenarios have been documented in the project deliverable.

	TID	SAP	ENG	INTEL	GPI	XLAB	
Level 9	0	0	20	9	20	18	11,17
Software fully integrated and operated in the operational environment?	0	0	20	10	20	25	12,50
Software performance analyzed, verified and documented as meeting operational requirements?	0	0	20	15	20	20	12,50
All required software documentation completed?	0	0	20	20	20	15	12,50
Sustaining software engineering support in place?	0	0	20	0	20	15	9,17
Software operations, maintenance and retirement procedures finalized and documented?	0	0	20	0	20	15	9,17

Industrial Partners Comments:
Intel:- Some scores are quite low here due to integration issues and lack of documentation being in place due to time being spent fixing integration issues. Focus at present is on prototyping rather than production quality output. However, that focus still takes us some of the way on levels 8 and 9 so hence we don't think these scores should be 0 either.
GPI: Final development is in progress and progressing according the plan.