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Authors: *FBK*

Editor: *Annapaola Marconi (FBK)*

Reviewers: *Harald Psaier (TUW)*

Osama Sammodi (UniDue)

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Management Summary

In this deliverable we describe the final version of the S-Cube Integrated Research Framework (IRF). More precisely, the research work-packages have been asked to report any update to the research challenges and questions collected during the previous years of the project and reported in deliverables CD-IA-3.1.3 for year 2 and CD-IA-3.1.5 for year 3. Furthermore, the research work-packages have been asked to update the relationships between the research challenges and questions in the IRF and the Future of Internet vision, which have been defined in CD-IA-3.1.5. Only minor updates have been reported with respect to the challenges, questions, and relations with the Future of Internet, which confirms the good level of consolidation of the IRF already reached at the end of the 3rd project year.

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Members of the S-Cube consortium:

University of Duisburg-Essen (Coordinator)	Germany
Tilburg University	Netherlands
City University London	U.K.
Consiglio Nazionale delle Ricerche	Italy
Center for Scientific and Technological Research	Italy
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http://www.s-cube-network.eu/results/deliverables/

The S-Cube Deliverable Series

Vision and Objectives of S-Cube

The Software Services and Systems Network (S-Cube) will establish a unified, multidisciplinary, vibrant research community which will enable Europe to lead the software-services revolution, helping shape the software-service based Internet which is the backbone of our future interactive society.

By integrating diverse research communities, S-Cube intends to achieve world-wide scientific excellence in a field that is critical for European competitiveness. S-Cube will accomplish its aims by meeting the following objectives:

- Re-aligning, re-shaping and integrating research agendas of key European players from diverse research areas and by synthesizing and integrating diversified knowledge, thereby establishing a long-lasting foundation for steering research and for achieving innovation at the highest level.
- Inaugurating a Europe-wide common program of education and training for researchers and industry thereby creating a common culture that will have a profound impact on the future of the field.
- Establishing a pro-active mobility plan to enable cross-fertilisation and thereby fostering the integration of research communities and the establishment of a common software services research culture.
- Establishing trust relationships with industry via European Technology Platforms (specifically NESSI) to achieve a catalytic effect in shaping European research, strengthening industrial competitiveness and addressing main societal challenges.
- Defining a broader research vision and perspective that will shape the software-service based Internet of the future and will accelerate economic growth and improve the living conditions of European citizens.

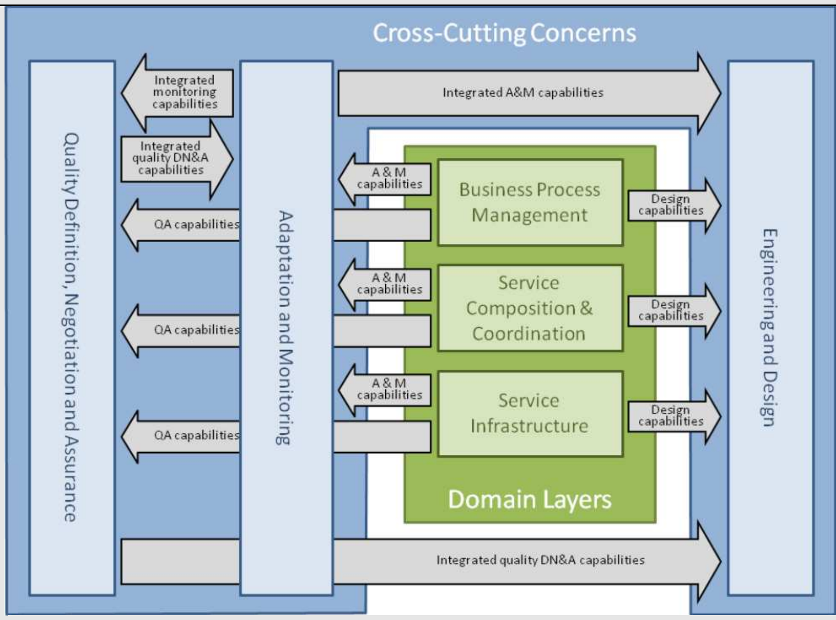
S-Cube will produce an integrated research community of international reputation and acclaim that will help define the future shape of the field of software services which is of critical for European competitiveness. S-Cube will provide service engineering methodologies which facilitate the development, deployment and adjustment of sophisticated hybrid service-based systems that cannot be addressed with today's limited software engineering approaches. S-Cube will further introduce an advanced training program for researchers and practitioners. Finally, S-Cube intends to bring strategic added value to European industry by using industry best-practice models and by implementing research results into pilot business cases and prototype systems.

S-Cube materials are available from URL: http://www.s-cube-network.eu/

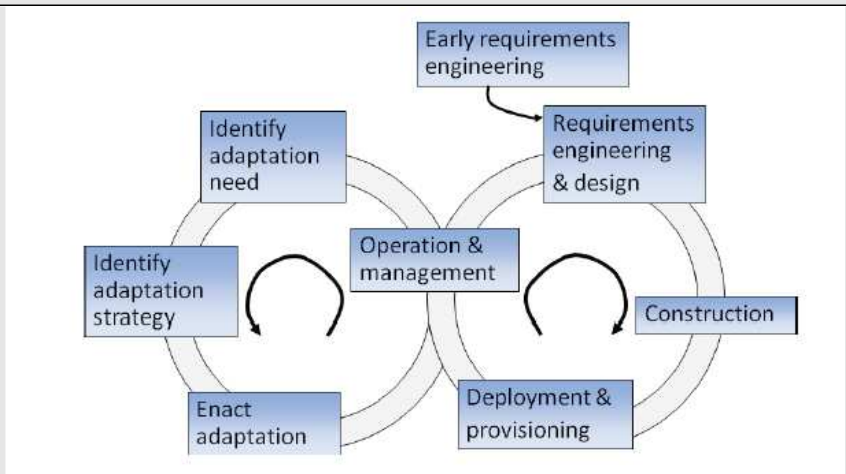
Contents

1 Views

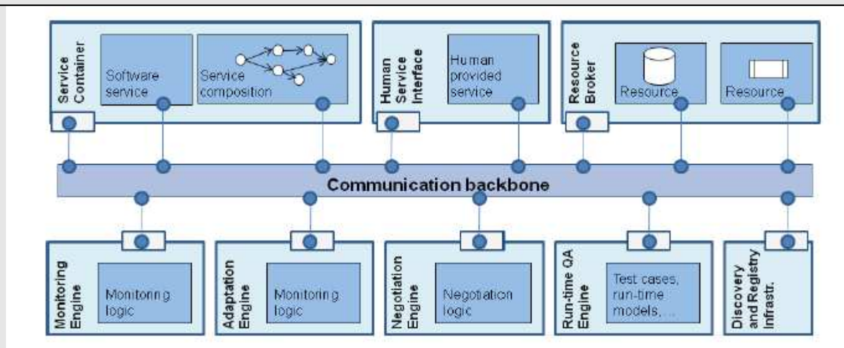
1.1. Views

Name	Conceptual Research Framework
Synopsis	The conceptual research framework provides a high-level conceptual view of the S-Cube research activities.
Authors	-
Description	 The conceptual research framework is the core element in the definition of the IRF. Its aim is to organise the joint research activities within S-Cube by providing a high-level conceptual architecture for the principles and methods for engineering service-based applications, as well as for the technologies and mechanisms which are used to realize those applications. The framework consists of six components, which are in 1-to-1 relation with the six research work-packages of the network. Moreover, the framework distinguishes between the horizontal components corresponding to the “traditional” domain layers of a SBA, i.e., “Service Infrastructure”, “Service Composition and Coordination”, and “Business Process Management”, and the vertical components, which correspond to the cross-cutting issues addressed by the project, namely “Engineering and Design”, “Adaptation and Monitoring”, and “Quality Definition, Negotiation and Assurance”. We note that the distinction between the two kinds of components is one of the core elements of the S-Cube approach. Indeed, an element that makes the S-Cube framework unique when compared to the traditional “layered” approach is that the framework systematically addresses cross-cutting issues. The framework sets out to make explicit the knowledge of the horizontal layers that is relevant for these cross-cutting issues, and that currently is mostly hidden in languages, standards,

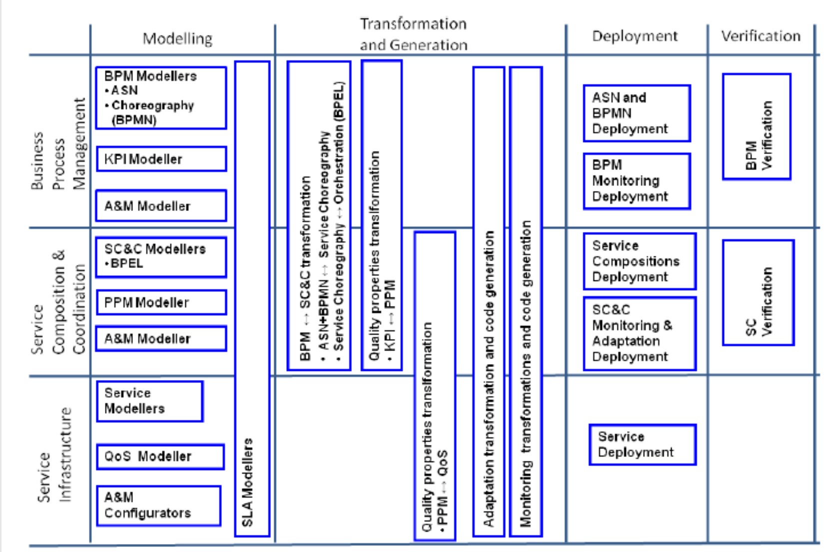
	mechanisms, and so on that are defined and investigated in isolation at the different layers. More precisely, the approach underlying the framework is that the domain layers offer (design, monitoring, adaptation, verification) capabilities that are relevant for the cross-cutting issues. The research efforts in the vertical components are responsible of defining over-arching principles and methodologies for addressing cross-cutting issues by exploiting in suitable ways the capabilities exposed by the horizontal components.
References	M. Pistore, R. Kazhamiakin, A. Bucchiarone (Eds.). *Integration Framework Baseline*, S-Cube Deliverable CD-IA-3.1.1
Glossary	SBA, Service Infrastructure, Service Composition and Coordination, Business Process Management, Adaptation, Monitoring, Design for Adaptation, Quality Attributes, Quality of Service Negotiation, Quality of Service-based Adaptation.
Keywords	-
	-

Name	Reference life-cycle
Synopsis	The reference life-cycle shows how the different research activities contribute to support a coherent design and run-time life-cycle of an SBA
Authors	-
Description	 The key purpose of this view is to complement the static view provided by the conceptual research framework and to relate the research efforts undertaken by the network to the different phases of the life of the SBAs. It is composed of two main cycles: the one on the right hand side corresponds to the *classical application design*, deployment and provisioning; the one on the left hand side corresponds to the *adaptation perspectives.* By adopting this two-cycle approach, not only must applications undergo the transition between the runtime operation and the analysis and the design phases in order to be continuously improved and updated (i.e., evolution), but they must provide mechanisms that, during runtime, continuously and automatically a) detect new problems, changes, and needs for adaptation, b) identify possible adaptation

	strategies, and c) enact them. These three steps (on the left hand side) lead to deployment and provisioning of the modified application. The identification of the changes in the environment and of the problems in the execution of the SBA (e.g., failures) is obtained through monitoring and run-time quality assurance. The monitoring activity triggers the iteration of the adaptation cycle, whose effects is to inject changes directly into the application being operated and managed.
References	M. Pistore, R. Kazhamiakin, A. Bucchiarone (Eds.). Integration Framework Baseline, S-Cube Deliverable CD-IA-3.1.1
Glossary	Life cycle model, Requirements Engineering, Design Principles, Adaptation, Evolution, Adaptation Strategy, Adaptation Requirements, Monitoring, Monitoring Requirements, Software Quality Assurance
Keywords	

Name	Logical Run-Time Architecture
Synopsis	The logical run-time architecture, shows how joint research activities undertaken by S-Cube are aligned
Authors	-
Description	 The key purpose of this view is to guarantee a coherent picture for all run-time mechanisms studied by S-Cube, that is, for all mechanisms that are adopted in the operation and management phases and in all the left hand side of the reference life-cycle. The proposed run-time architecture is *service-oriented*, that is, it assumes that all the run-time mechanisms and components are realized as services and are exposed on the same *communication backbone*. We can have two kinds of services called core and application-specific services. The *core services* are middleware services that the run-time architecture provides to all SBA in order to support the different aspects of the SBA execution. Examples of such core services are a discovery service, an engine for executing service compositions, or an engine for monitoring the behaviour of a SBA or the performance of a business network. These core services may belong to the "Adaptation and Monitoring" and "Quality Definition, Negotiation and Assurance" components. Some of these core services act as containers for *application-specific services,* i.e., services that are specific of the SBA in execution, and that encapsulate part of the application-

	specific logic. This is the case of the engine for executing service compositions. Other core services contain other parts of the application-specific logics, which are however not exposed as services. This is the case, for instance, of monitoring engine, which will contain the application-specific properties to be monitored.
References	M. Pistore, R. Kazhamiakin, A. Bucchiarone (Eds.). *Integration Framework Baseline*, S-Cube Deliverable CD-IA-3.1.1
Glossary	Service Runtime, Service Registry, Service Discovery, Autonomy, Self-*, Dynamic Binding, Quality of Service-based Adaptation, Adaptation, Monitoring. Service Composition, Monitoring Infrastructure.
Keywords	-

Name	Logical Design Environment
Synopsis	The logical design environment aims at providing a logical description of the foreseen design environment for SBAs.
Authors	-
Description	 This view is complementary to the run-time architecture and its purpose is to provide a context where to place the envisioned techniques and mechanisms that support the analyst and designer in the design of a SBA. The design environment covers phases corresponding to the right hand side of the life-cycle view, from early requirements engineering to deployment and provisioning. By adopting this logical design environment, the efforts undertaken by the different research work-packages define a coherent picture that supports the different aspects of the SBA design and engineering. The design environment should provide different functionalities (i.e. Modelling, Transformation and Generation, Deployment and Verification) at different application layers (i.e., Business Process Management, Service Composition and Coordination, and Service Infrastructure). Moreover we should have also cross-layer techniques that span over more application layers.

References	M. Pistore, R. Kazhamiakin, A. Bucchiarone (Eds.). *Integration Framework Baseline,* S-Cube Deliverable CD-IA-3.1.1
Glossary	Business Process Modeling, Service Composition, Service Deployment, Verification, Service Level Agreement, Adaptation, Monitoring, Key Performance Indicator.
Keywords	-

1.2. Elements

1.2.1 Elements of the Conceptual Research Framework

Name	Service Adaptation and Monitoring	
Synopsis	This element comprises research on languages and methods for monitoring and managing the adaptation of a SBA.	
View	Conceptual Research Framework	
Authors	-	
Description	This element covers the issues related to the adaptation of a SBA. Specifically, this comprises languages and methods for defining adaptation goals and different adaptation strategies, which are triggered by monitoring events. An example for an adaptation technique that falls into the responsibility of this aspect is a strategy that correlates the monitoring events across the functional layers, thereby avoiding conflicting adaptations, or the one that aims to predict the potential SBA problems and perform adaptation activities pro-actively.	
Related elements	***Element***	Integrated A&M capabilities
	Relation	Provides
	Element	A&M capabilities
	Relation	Uses
	Element	Integrated quality DN&A capabilities
	Relation	Uses
References	J. Hielscher, A. Metzger, R. Kazhamiakin (Eds.), *Taxonomy of Adaptation Principles and Mechanisms*, S-Cube Deliverable CD-JRA-1.2.2.	
Glossary	Service adaptation, service monitoring	
Keywords	Service-based Applications, Adaptation, Monitoring	

Name	Service Engineering and Design
Synopsis	This element comprises research on principles and methods for engineering and design of a SBA as well as its adaptation and monitoring tools.
View	Conceptual Research Framework
Authors	-
Description	This element covers the issues related to the life-cycle of services and SBAs. This includes principles and methods for identifying, designing, developing, deploying, finding, applying, provisioning, evolving, and maintaining services, while exploiting novel technologies from the functional layers. In particular, this aspect focuses on the quality of the SBA development process, on the roles and placement of the contextual properties of SBAs and

	human involvement, and on exploiting future service search engines for bottom-up SBA design.	
Related elements	***Element***	Design capabilities
	Relation	Uses
	Element	Integrated quality DN&A capabilities
	Relation	Uses
	Element	Integrated A&M capabilities
	Relation	Uses
References	Vasilios Andrikopoulos (Ed.), *Separate design knowledge models for software engineering and service based computing*, S-Cube Deliverable CD-JRA-1.1.2.	
Glossary	Service Engineering, Service Design, SBA Engineering, SBA Design	
Keywords	Service Engineering, Design	

Name	Service Quality Definition, Negotiation and Assurance	
Synopsis	This element comprises research on principles and methods for quality attributes and SLAs of SBA.	
View	Conceptual Research Framework	
Authors	-	
Description	This element involves principles and methods for defining, negotiating and ensuring quality attributes and Service Level Agreements (SLAs). Negotiating quality attributes requires understanding and aggregating quality attributes across the functional layers as well as agreeing on provided levels of quality. To ensure agreed quality attributes, techniques which are based on monitoring, testing or static analysis (e.g., model checking) are employed and extended by novel techniques exploiting future technologies (e.g., Web 2.0).	
Related elements	***Element***	Integrated quality DN&A capabilities
	Relation	Provides
	Element	QA capabilities
	Relation	Uses
	Element	Integrated A&M capabilities
	Relation	Uses
References	A. Gehlert, A. Metzger (Eds.), *Quality Reference Model for SBA*, S-Cube Deliverable CD-JRA-1.3.2.	
Glossary	Quality Attributes, Service Level Agreement, Negotiation	
Keywords	Quality Assurance, SLA	

Name	Business Process Management
Synopsis	This element comprises research on the “Business Process Management” functional layer of SBA.
View	Conceptual Research Framework
Authors	-
Description	This element addresses the aspects related to the modeling, designing, deploying, monitoring and managing of service networks, business processes and Key Performance Indicators (KPIs).

Related elements	***Element***	A&M Capabilities
	Relation	Provides
	Element	Design Capabilities
	Relation	Provides
	Element	QA Capabilities
	Relation	Provides
References	Branimir Wetzstein (Ed.), *Initial models and mechanisms for quantitative analysis of correlationsbetween KPIs, SLAs and underlying business processes,* S-Cube Deliverable CD-JRA-2.1.2	
Glossary	Key Performance Indicator, Agile Service Network, Business Activity, Business Process	
Keywords	-Business Process Management	

Name	Service Composition and Coordination	
Synopsis	This element comprises research on the “Service Composition and Coordination” functional layer of SBA.	
View	Conceptual Research Framework	
Authors	-	
Description	This element focuses on novel service composition languages and techniques. In particular, it provides mechanisms to adapt and monitor service compositions.	
Related elements	***Element***	A&M Capabilities
	Relation	Provides
	Element	Design Capabilities
	Relation	Provides
	Element	QA Capabilities
	Relation	Provides
References	Martin Treiber (Ed.), *Models and Mechanisms for Coordinated Service Compositions*, S-Cube Deliverable CD-JRA-2.2.2	
Glossary	Service, Service Composition, Process Performance Metrics	
Keywords	-Service Composition and Coordination	

Name	Service Infrastructure	
Synopsis	This element comprises research on the “Service Infrastructure” functional layer of SBA.	
View	Conceptual Research Framework	
Authors	-	
Description	This element studies a high-performance execution platform supporting adaptation and monitoring of SBAs (e.g., self-* mechanisms). The platform provides a set of core services, like service registries, discovery capabilities, and virtualization services to the other layers.	
Related elements	***Element***	A&M Capabilities
	Relation	Provides
	Element	Design Capabilities
	Relation	Provides
	Element	QA Capabilities
	Relation	Provides
References	Jean-Louis Pazat (Ed.), *Basic Requirements for self-healing*	

	services and decision support for local adaptation, S-Cube Deliverable CD-JRA-2.3.2
Glossary	Service Realization, Resources, Service Discovery and Selection, Service Registry, Service Metrics
Keywords	Execution Platform

Name	Integrated A&M capabilities	
Synopsis	This element comprises research on defining overall, cross-layer monitoring and adaptation strategies.	
View	Conceptual Research Framework	
Authors	-	
Description	This element is responsible of defining overall, cross-layer monitoring and adaptation strategies that are then realized by exploiting the capabilities offered by the domain layers. These overall monitoring and adaptation strategies are in turn capabilities that the “Adaptation and Monitoring” component offers to the “Engineering and Design” component. Indeed, the knowledge of the capabilities and mechanisms for monitoring and adaptation, which will be available at run time, is crucial at design time in order to design and construct a SBA that is able to exploit those capabilities. Indeed, by “design for monitoring” and “design for adaptation” we refer to the possibility of designing SBAs whose behavior relies on a full exploitation of the monitoring and adaptation capabilities offered by the framework.	
Related elements	***Element***	Service Adaptation and Monitoring
	Relation	Uses
	Element	Service Engineering and Design
	Relation	Provides
References	-	
Glossary	Cross-layer Adaptation, Cross-layer Monitoring	
Keywords	Adaptation, Monitoring	

Name	A&M capabilities	
Synopsis	This element comprises research on defining local monitoring and adaptation capabilities of the different layers.	
View	Conceptual Research Framework	
Authors	-	
Description	This element is responsible of defining monitoring and adaptation capabilities offered by the domain layers.	
Related elements	***Element***	Business Process Management
	Relation	Uses
	Element	Service Composition and Coordination
	Relation	Uses
	Element	Service Infrastructure
	Relation	Uses
	Element	Service Adaptation and Monitoring
	Relation	Provides
References	-	
Glossary	Cross-layer Adaptation, Cross-layer Monitoring	

Keywords	Adaptation, Monitoring

Name	Design Capabilities	
Synopsis	This element comprises research on languages and mechanisms for designing SBA layers.	
View	Conceptual Research Framework	
Authors	-	
Description	Each functional layer provides capabilities to the “Engineering and Design” of SBAs; these capabilities correspond to languages and mechanisms for modeling and specifying those aspects of a SBA that are specific to a domain layer. For example, the “Business Process Management” layer offers capabilities for modeling business processes (e.g., BPMN, or UML Activity Diagrams), as well as for specifying aspects related to the integration and execution of these business processes. The “Service Composition and Coordination” layer provides capabilities for modeling the single services, as well as service compositions (e.g., WSDL, BPEL). Finally, the “Service Infrastructure” layer provides capabilities for service discovery, for accessing service registries, and for managing service execution.	
Related elements	***Element***	Business Process Management
	Relation	Uses
	Element	Service Composition and Coordination
	Relation	Uses
	Element	Service Infrastructure
	Relation	Uses
	Element	Service Engineering and Design
	Relation	Provides
References	Vasilios Andrikopoulos (Ed.), *Separate design knowledge models for software engineering and service based computing*, S-Cube Deliverable CD-JRA-1.1.2.	
Glossary	Business Process Design, Service Composition Design, Service Design	
Keywords	-Design	

Name	QA Capabilities
Synopsis	This element comprises research on quality assurance capabilities.
View	Conceptual Research Framework
Authors	-
Description	Each domain layer provides capabilities that are exploited to achieve an end-to-end, cross-layer quality definition and assurance for the SBA. At the “Business Process Management” layer, these capabilities correspond to understanding how to express the relevant quality at tributes (e.g., KPIs) and the possibility of doing a static verification of the business process models, as well as of running simulations in order to predict and analyze the expected behavior of these models. At the “Service Composition and Coordination” layer, the capabilities cover

	understanding the relevant quality attributes and how to do both static verification and simulation of single services and of service compositions. At this layer, capabilities may also concern the possibility of testing the service composition. The "Service Infrastructure" layer, finally, provides capabilities for expressing relevant infrastructural quality attributes, and capabilities for exploiting the infrastructures for running simulations or to test cases on SBAs.	
Related elements	***Element***	Business Process Management
	Relation	Uses
	Element	Service Composition and Coordination
	Relation	Uses
	Element	Service Infrastructure
	Relation	Uses
	Element	Service Quality Definition, Negotiation and Assurance
	Relation	Provides
References	A. Gehlert, A. Metzger (Eds.), *Quality Reference Model for SBA*, S-Cube Deliverable CD-JRA-1.3.2.	
Glossary	Quality Attributes, Testing	
Keywords	-Quality Analysis	

Name	Integrated quality DN&A capabilities	
Synopsis	This element comprises research on integrated quality definition, assurance and negotiation capabilities.	
View	Conceptual Research Framework	
Authors	-	
Description	These capabilities of the "Quality Definition, Negotiation and Assurance" component are offered to the "Engineering and Design" component, so that they can be exploited during the design and construction of a SBA. More precisely, these capabilities concern languages that can be exploited for defining the expected quality of a SBA; they concern mechanisms for negotiating quality attributes between service consumers and providers; and mechanisms for static analysis, simulation and testing of SBAs. These capabilities are also offered to the "Adaptation and Monitoring" component, for the purpose of enabling pro-active adaptation on the basis of the analysis of the past, current and future quality of the SBA. Indeed, pro-active adaptation will exploit the testing, simulation and quality prediction mechanisms studied by the "Quality Definition, Negotiation and Assurance" component.	
Related elements	***Element***	Service Quality Definition, Negotiation and Assurance
	Relation	Uses
	Element	Service Engineering and Design
	Relation	Provides
References	-	
Glossary	Quality Attributes, Negotiation, Quality Assurance	
Keywords	-Quality Assurance, Negotiation	

1.2.2 Elements of the Reference life-cycle

Name	Early Requirements Engineering	
Synopsis	This element comprises research on requirements engineering with the objective to analyze and understand the problem by studying existing organizational and business setting.	
View	Reference Life-cycle	
Authors	-	
Description	This element related to the requirements expression in terms of high-level concepts that correspond to the actors that are relevant in the setting, and to their goals, needs, and mutual dependencies, without any reference to the system-to-be. This element studies requirements that exist *a priori* in the organizational and business setting, and that are hence largely independent from the solution. They are collected from the stakeholders and cover not only the functional aspects; they should cover also quality expectations, adaptation requirements and expectations of the actors.	
Related elements	***Element***	Requirements Engineering & Design
	Relation	Beforehand
References	-	
Glossary	Requirement, Requirements Engineering, Adaptation Requirements, Monitoring Requirements	
Keywords	Requirement Engineering	

Name	Requirements Engineering and Design	
Synopsis	This element comprises research on usual requirements engineering and design taking into account both functional and quality aspect of the SBA.	
View	Reference Life-cycle	
Authors	-	
Description	The main objectives of this element are similar to the ones of any classical software development, there are some peculiarities that make development of SBAs different from others. The first difference is that the availability of services drives the requirement engineering (RE) as well as the design phase in such a way that the usage of these services is possible. The second difference is that RE and design of a SBA have to be performed taking into account the three domain layers that define such an application. A third difference in that the SBA has to be built to be able to react to new and/or critical conditions by triggering proper adaptation actions. It means that new classes of requirements have to be elicited and understood. These include adaptation and monitoring requirements. At the level of design this means that proper adaptation strategies have to be designed together with monitoring mechanisms that allow the adaptation needs to be identified.	
Related elements	***Element***	Construction
	Relation	Beforehand
	Element	Early Requirements Engineering

	Relation	Next
References	-	
Glossary	Requirements Engineering, Service-Oriented Requirements Engineering, Adaptation Requirement and Objectives, Monitoring Requirements, Business Process Modelling, Service-based Applications.	
Keywords	-Requirement Engineering, Design	

Name	Construction	
Synopsis	This element comprises research on the SBA construction integrating different services.	
View	Reference Life-cycle	
Authors	-	
Description	This element of the reference life-cycle covers the issues related to the integration of different services. This means that for that for establishing the desired end-to-end quality of those SBAs, contracts between the service providers and the service requestors on quality aspects of services have to be established. Typically this requires some form of SLA negotiation and agreement. the service composition construction should cover not only the functional requirements, but also the QoS aspects and the adaptability requirements for the SBA. In addition to the service composition, the construction phase will also realize all those mechanisms that are necessary for supporting the monitoring, adaptation, and quality assurance of the SBA.	
Related elements	***Element***	Requirements Engineering and Design
	Relation	Beforehand
	Element	Deployment and Provisioning
	Relation	Next
References	-	
Glossary	Service Composition, Service Coordination, Service Orchestration, Service Choreography, Quality of Service Negotiation, Service Level Agreement, Quality of Service-based Application, Adaptation Mechanisms, Monitoring Mechanisms.	
Keywords	-Construction	

Name	Deployment and Provisioning
Synopsis	This element comprises all the activities needed to make the SBA available to its users.
View	Reference Life-cycle
Authors	-
Description	This element covers the issues related to the publishing of the SBA. It can be itself a service: in this case, a proper description of its interface should be provided and published on some registry. Moreover semantic service descriptions of various kind should be proposed. These include the description of the QoS characteristics of a service and enable for the definition of SLAs. In the case of

	adaptable SBAs, we could imagine that QoS and SLA information includes data on the adaptation characteristics of the SBA.	
Related elements	***Element***	Construction
	Relation	Beforehand
	Element	Operation and Management
	Relation	Next
References	-	
Glossary	Service, Service-based Application, Automatic Service Deployment, Semantic Web Services, Service Level Agreement, Quality of Service-Based Adaptation.	
Keywords	-Deployment	

Name	Operation & Management	
Synopsis	This element is used to specify all the activities needed for operating and managing a SBA	
View	Reference Life-cycle	
Authors	-	
Description	This element covers the issues related to the activities that govern the correct execution of SBAs and related services by ensuring that they respect the expected QoS level during execution. In this context, the identification of problems in the SBA (e.g., failures) plays a fundamental role. This identification is obtained by means of monitoring mechanism and, more in general, of mechanisms for run-time quality assurance. These mechanisms are able to detect failures, or critical conditions requiring the triggering of an adaptation mechanism needed to adapt SBAs.	
Related elements	***Element***	Deployment and Provisioning
	Relation	Beforehand
	Element	Identify Adaptation Need
	Relation	Next
	Element	Requirements Engineering and Design
	Relation	Next
References	-	
Glossary	Service Governance, Service runtime, Service-based application, Service runtime management process, Service Analysis, Monitoring mechanisms, Failure, Error.	
Keywords	-Management, Failures, Execution, Monitoring	

Name	Identify Adaptation Need
Synopsis	This element comprises the decision on the needs for the SBA to adapt.
View	Reference Life-cycle
Authors	-
Description	This element provides way to use information gathered during execution, the observation of the properties of the application, and the context of SBA constitute the elements on which the decision on the need for the SBA to adapt is based. Such decision may be automatically taken on the basis of monitoring requirements derived from adaptation requirements, or it may require human

	intervention (end user, system integrator, application manager). Moreover, such decision may be taken in a reactive way, when the problem has already occurred, or in a pro-active way, where the need is to prevent a potential problem.	
Related elements	***Element***	Operation and Management
	Relation	Beforehand
	Element	Identify Adaptation Strategy
	Relation	Next
References	-	
Glossary	Adaptation, Self-adaptation, Human Computer Interaction, Monitoring Requirements, Adaptation Requirements, Reactive Adaptation, Proactive Adaptation.	
Keywords	-Adaptation	

Name	Identify Adaptation Strategy	
Synopsis	This element covers the issues to define a set of possible adaptation strategies and related them with the adaptation needs.	
View	Reference Life-cycle	
Authors	-	
Description	This element covers the issues related to the identification and selection of adaptation strategy and their relation with adaptation needs. The decision on what strategy use at run-time may be may be automatic if either the SBA or the execution platform decide the action to perform, or it can be done by a human user. Among the possible adaptation strategies we mention service substitution, SLA re-negotiation, SBA re-configuration or service re-composition.	
Related elements	***Element***	Identify Adaptation Need
	Relation	Beforehand
	Element	Enact Adaptation
	Relation	Next
References	-	
Glossary	Adaptation Strategy, Self-Adaptation, Human Computer Interaction	
Keywords	-Adaptation	

Name	Enact Adaptation
Synopsis	This element covers the issues to define a set of adaptation mechanisms that implement adaptation strategy and its run-time activation.
View	Reference Life-cycle
Authors	-
Description	This element of the reference life-cycle covers the issues related to the implementation of adaptation mechanisms that realize adaptation strategies. For example service substitution, re-configuration, re-composition may be obtained using automated service discovery and dynamic binding mechanisms, while re-composition may be achieved using existing automated service composition techniques. As these examples show, the enactment of an adaptation strategy usually requires the exploitation of

	mechanisms provided by different layers, in particular by the "Service Composition and Coordination" and by the "Service Infrastructure" layers.	
Related elements	***Element***	Identify Adaptation Strategy
	Relation	Beforehand
	Element	Operation and Management
	Relation	Next
References	-	
Glossary	Adaptation Mechanism, Service Discovery, Dynamic Binding, Service composition.	
Keywords	Adaptation, Run-Time	

1.2.3 Elements of the Logical Run-Time Architecture

Name	Service Container	
Synopsis	In the run-time architecture of S-Cube services are deployed in containers called "Service Containers".	
View	Logical Run-Time Architecture	
Authors	-	
Description	The run-time architecture is service-oriented, it means that all the run-time mechanisms and components are realized as services and are exposed on the same communication backbone. We distinguish between *core* and *application-specific* services. The core services are middleware that the run-time architecture provides to all SBA in order to support the different aspects of the SBA execution (i.e., discovery service, an engine for monitoring the behaviour of a SBA, etc..). Application-specific services are specific service of the SBA in execution, and that encapsulate part of the application-specific logic. All these kind of services are deployed onto a container and the communication backbone allows accessing both services deployed within the containers.	
Related elements	***Element***	Communication Backbone
	Relation	Is exposed to
References	-	
Glossary	Service	
Keywords	Service	

Name	Human Service Interface
Synopsis	This element provides the fact that we can have also human-services that can be integrated in the SBAs.
View	Logical Run-Time Architecture
Authors	-
Description	Human Computer Interaction is the study of the interaction between humans and computers (in their broadest sense, including computerized devices and large scale computer systems as well as stand-alone computers). It is concerned with the design, evaluation and implementation of interactive computing systems which it aims to make more usable and useful for human use. With this element we should be able to provide interfaces among Humans that provide services and the SBA.

Related elements	**Element**	Communication Backbone
	Relation	Communicates with
References	-	
Glossary	Human Computer Interaction	
Keywords	HCI	

Name	Resource Broker	
Synopsis	This element provides the way to select resources in automatic way during the SBA execution.	
View	Logical Run-Time Architecture	
Authors	-	
Description	Brokering is used to automate resource selection. For example the role of grid brokers is to provide an interface for the users to access grids, accept and understand user jobs, discover resources, find a suitable resource for a job with scheduling, submit jobs to resources and provide the output of the jobs to the user. The S-Cube run-time architecture have to provide	
Related elements	**Element**	Communication Backbone
	Relation	Communicates with
References	-	
Glossary	Grid Brokering	
Keywords	Resource Management	

Name	Monitoring Engine	
Synopsis	To execute monitoring the run-time architecture must provide a monitoring engine.	
View	Logical Run-Time Architecture	
Authors	-	
Description	With monitoring we mean a process of collecting and reporting relevant information about the execution and evolution of SBA. Such information, namely monitoring events, represents evolution of SBA and changes in the environment. Run-time monitoring has to be supported by monitoring engines that should be included in the infrastructure. Moreover a precise monitoring logic have to be provided to specify monitoring properties.	
Related elements	**Element**	Communication Backbone
	Relation	Communicates with
References	-	
Glossary	Monitoring	
Keywords	Monitoring	

Name	Adaptation Engine
Synopsis	This element provides the way to execute different types of adaptation during the SBA execution
View	Logical Run-Time Architecture
Authors	-
Description	Adaptation is the process of modifying an SBA in order to satisfy

	new requirements and to fit new situations dictated by the environment on the basis of adaptation strategies designed by the system integrator. The run-time architecture must provide an adaptation engine that realizes the different adaptation strategies.	
Related elements	***Element***	Communication Backbone
	Relation	Communicates with
References	-	
Glossary	Adaptation, Adaptation Strategy	
Keywords	Adaptation	

Name	Negotiation Engine	
Synopsis	This element provides the way to execute negotiation among parties that are involved in a SBA	
View	Logical Run-Time Architecture	
Authors	-	
Description	Negotiation is a process carried out between Service Providers and Requesters by formulating, exchanging and evaluating a number of Agreement proposals that may end with the stipulation of a contract in the form of an Service Level Agreement. The S-Cube run-time architecture have to deploy a Negotiation Engine able to execute this process using a precise Negotiation Logic.	
Related elements	***Element***	Communication Backbone
	Relation	Communicates with
References	-	
Glossary	Negotiation, Quality of Service Negotiation	
Keywords	Negotiation	

Name	Run-time QA Engine	
Synopsis	This element provides the way to execute quality analysis techniques on the SBA.	
View	Logical Run-Time Architecture	
Authors	-	
Description	To assure the desired quality of a service-based application, two complementary strategies can be employed: constructive and analytical quality assurance. Where the goal of constructive quality assurance is to prevent the introduction of faults (or defects) while the artifacts are created (in the sense of 'correctness by construction'), the goal of analytical quality assurance is to uncover faults in the artifacts after they have been created. The run-time architecture should provide an engine able to verify the quality of SBAs using different techniques like Testing, Statical Analysis, Monitoring, etc..	
Related elements	***Element***	Communication Backbone
	Relation	Communicates with
References	-	
Glossary	Quality of Service-based Application	
Keywords	Quality	

Name	Discovery and Registry Infrastructure	
Synopsis	This element provides the way to discover and add services in the S-Cube platform.	
View	Logical Run-Time Architecture	
Authors	-	
Description	A Service Registry is a repository that contains service related meta information (e.g. Web service descriptions). The S-Cube run-time architecture has to provide mechanisms to find new services and add them in the deployed registry. The purpose of this element is to capture the basic requirements for decision support in service execution, deployment and runtime management for services including core services such as discovery and registries.	
Related elements	***Element***	Communication Backbone
	Relation	Communicates with
References	Jean-Louis Pazat (Ed.), *Basic Requirements for self-healing services and decision support for local adaptation*, S-Cube Deliverable CD-JRA-2.3.2	
Glossary	Service Registry	
Keywords	Service Discovery, Servie Registry	

Name	Communication Backbone	
Synopsis	This element has the objective to support the communication among any kind of services.	
View	Logical Run-Time Architecture	
Authors	-	
Description	This element supports the communication among any kind of services, regardless of whether they are core services or application-specific services.	
Related elements	***Element***	Service Container
	Relation	Communicates with
	Element	Human Service Interface
	Relation	Communicates with
	Element	Resource Broker
	Relation	Communicates with
	Element	Monitoring Engine
	Relation	Communicates with
	Element	Adaptation Engine
	Relation	Communicates with
	Element	Run-time QA Engine
	Relation	Communicates with
	Element	Negotiation Engine
	Relation	Communicates with
References	-	
Glossary	Service adaptation, service monitoring	
Keywords	Communication	

1.2.4 Elements of the Logical Design Environment

Name	Modelling Techniques
Synopsis	The element covers the issues to define a set of possible techniques for modelling a SBA.
View	Logical Design Environment
Authors	-
Description	The objective of this element is to provide a set of techniques for modelling a SBA at the different domain layers (i.e., Business Process Management, Service Composition and Coordination and Service Infrastructure), as well as for modelling the cross-cutting aspects of a SBA. More precisely, for each layer we must be able to provide techniques for modelling our SBA, for modelling the indicators that are used to evaluate the quality of the SBA, and for modelling the monitoring and adaptation aspects that are used to control and adapt the application at run-time.
Related elements	- -
References	-
Glossary	Business Process Modelling, Service Design, Design for Adaptation, Design for Monitoring, Design Principles,
Keywords	Modelling

Name	Transformation and Generation Techniques
Synopsis	This element has the objective to provide techniques to realize model-to-model transformations.
View	Logical Design Environment
Authors	-
Description	This element has the objective to provide techniques that allow for transforming high-level models of the behaviour of a SBA into lower-level executable models, and vice-versa. They include for instance transformation techniques that generate BPEL code from BPMN, or that transform choreographies into orchestrations, and vice-versa. Moreover, they contain techniques to transform high-level specifications of quality properties into lower-level specifications of the same properties and vice-versa, e.g. KPI to/from PPM models. Finally, they include techniques for generating code in automatic way from the design models, as well as mechanisms to transform adaptation and monitoring specifications from one layer to another one. An example are mechanisms for transforming the monitoring and adaptation strategies specified by the designer into engine mechanisms that the service infrastructure will provide.
Related elements	- -
References	-
Glossary	-
Keywords	-Model Tranformation, Code Generation

Name	Deployment Techniques
Synopsis	The element comprises techniques for deploying artifacts of a SBA specification.
View	Logical Design Environment

Authors	-	
Description	This element provides a set of techniques for deploying the artifacts corresponding to a SBA specification at the different layers. This corresponds to deploying service networks, as well as the real/physical deployment of services on a service infrastructure. This functionality also covers deployment techniques for the adaptation and monitoring mechanisms and specifications.	
Related elements	-	-
References	-	
Glossary	Automatic Service Deployment, Manual Service Deployment, Automated Service Composition.	
Keywords	Deployment	

Name	Verification Techniques	
Synopsis	This element provides ways to verify and validate different SBA models.	
View	Logical Design Environment	
Authors	-	
Description	This element provides validation techniques to validate different models with respect to functional to functional and non functional properties. The design environment must provide techniques to verify their correctness and completeness. Such verification techniques are available both at the Business Process Management and at the Service Composition and Coordination layers.	
Related elements	-	-
References	-	
Glossary	Validation, Verification, Completeness	
Keywords	-Verification and Validation	

2 Research

2.1. Research Challenges

2.1.1. Challenges from JRA-1.1

Name	Definition of a coherent life cycle for adaptable and evolvable SBA
Synopsis	A software life cyle is the total set of software engineering activities necessary to develop and maintain software products. Adaptable Service Based applications need a life cycle taking adaptation into account in a holistic way.
Authors	Elisabetta Di Nitto, Valentina Mazza
Description	The life cycle for the development of adaptable service based applications should include the ability to compose services in complex applications and to adapt and evolve applications. In fact, the service-oriented paradigm enables a high degree of flexibility of SBAs. This means that the SBA can be more easily

	adapted to new requirements than traditional software systems. The life cycles for SBAs that are currently presented in the literature are mainly focused on the phases that precede the release of software and, even in the cases in which they focus on the operation phases, they do not consider the possibility for SBAs to adapt dynamically to new situations, contexts, requirement needs, service faults, and the like. When dealing with adaptation, on the one side, the requirements engineering phase can be shortened to enhance the time-to-market of the SBA as the missing or misunderstood requirements can later be implemented through adaptation of the running SBA. On the other side, the application has to be designed and developed in such a way that it is able to recognize an adaptation need and to act accordingly. Indeed, not only the application-specific requirements have to be elicited and addressed in the resulting implementation, but also the requirements for adaptation needs to be identified and have to result in a corresponding implementation.
IRF elements	**Life cycle** **Framework:** SED
Related challenges	Run-time Quality Assurance Techniques Proactive SLA negotiation and agreement Multi-level and self-adaptation
References	CD-JRA-1.1.2 “Separate design knowledge models for software engineering and service based computing.” CD-JRA-1.1.4 “Coordinated design knowledge models for software engineering and service-based computing.”
Glossary	Life cycle model, Requirements Engineering, Design for Adaptation, Service Based Application Construction, Service Deployment, Adaptation Strategy, Adaptation Mechanism, Service Composition, Adaptation Requirements and Objectives
Keywords	Life cycle

Name	Measuring, controlling, evaluating and improving the life cycle and the related processes.
Synopsis	Adapting service based application in order to react to changes or to deviations from the desired behavior requires the need to continuously monitor the processes and the life cycles. So, there is the need to identify proper approaches for process measurement, control, evaluation and improvement.
Authors	Ita Richardson and Stephen Lane
Description	The definition of approaches for providing the necessary guidelines, procedures and processes to measure, control, evaluate and improve the engineering of SOA is a challenging task primarily due to variations in the existing service-engineering principles, techniques, methodologies and mechanisms both used in the industry and recommended by the research community. In addition, the practices in SOA have been found to be still immature. The problem gets further complex due to the growing requirement of integration of self-* properties such as self-

	adaptation and self-evolution in the service-based applications as the incorporation of self-* properties need capturing and handling dynamic operational requirements by the system. Therefore, the guidelines, procedures and processes for efficiently and effectively measuring, controlling, evaluating and improving the engineering of SOA, their self-adaptation and self-evolution could be only defined by considering the dynamic operational environment of a service-based application apart from considering the engineering process itself. Although different industry leaders and researchers are conducting the research in the SOA domain yet the definitions of standard guidelines, procedures and processes to measure, control, evaluate and improve the engineering of SOA are still missing.
IRF elements	**Life cycle:** Requirements Engineering and Design; Construction; Deployment and Provisioning; Operation and Management; Identify Adaptation Need **Framework**: SAM; SED; **Infrastructure:** Adaptation Engine; Monitoring Engine
Related challenges	-Definition of a coherent life cycle for adaptable and evolvable SBA -Quality Prediction Techniques to Support Proactive Adaptation -Multi-level and self-adaptation
References	CD-JRA-1.1.2 "Separate design knowledge models for software engineering and service based computing."
Glossary	Self-Adaptation, Adaptable Service Based Application, Adaptation, Business Process Measurement, Monitor, Monitoring in Service Composition, Monitoring Requirements, Monitored Property
Keywords	Adaptation, Monitoring

Name	HCI and context aspects in the development of service based applications
Synopsis	The emergence of some requirements for adaptation/evolution implies the triggering of some adaptation and/or evolution actions. service-based application development. The human beings involved in the execution of SBA could raise such requirements. In order to identify the requirements for adaptation/evolution is needed to understand how to characterize the context of the SBA and codify the human-computer interaction knowledge (user task knowledge, user task knowledge, accessibility knowledge).
Authors	Angela Kounkou, Neil Maiden
Description	Humans are involved in service-oriented computing as end users and consumers, but also as service designers and providers (e.g. Human-Provided Services). A foreseen change in the use and distribution of services, as exemplified in the vision of an upcoming Internet of Services, is expected to further draw humans within the "service loop" and to promote human-to-application interaction as well as application to-application interaction. However, to this day, there has been little intersection

	between research in service-centric systems and Human-Computer Interaction. Human specificities, diversity and tasks characteristics are currently not taken into account in SBA design and delivery - despite being properties that could be powerful drivers for SBAs configuration and personalization. Thus, an integration of HCI knowledge in the engineering of SBAs is necessary to address the need for SBAs to be designed and delivered in ways fitting to human use wherever appropriate. Such integration is also required for the exploration of new opportunities afforded by the exploitation of HCI knowledge - for the enhancement of SBAs' existing capabilities, and for the delivery of new capabilities. It's needed the identification of HCI knowledge that delivers enhanced or new capabilities for SBAs; moreover the codification of this knowledge for its application to the development and use of SBAs it's required. Moreover, another important issue is represented by the characterization of the context of SBA in order to enable the identification of the adaptation requirements; the observation of the context could guide the adaptation process.
IRF elements	**Life cycle:** • Early Requirements Engineering • Requirements Engineering and Design • Construction • Deployment and Provisioning • Identify Adaptation Need **Framework:** • SAM; • SED
Related challenges	Context and HCI -aware SBA monitoring and adaptation
References	PO-JRA-1.1.3 Codified Human-Computer Interaction (HCI) Knowledge and Context Factors
Glossary	Human Computer Interaction, Context, Adaptable Service Based Application
Keywords	Self-adaptation, self-evolution, HCI, Context

Name	Understand when an adaptation requirement should be selected
Synopsis	In the context of an Adaptable SBA we need to identify the requirements for adaptation and the objectives of the adaptation on the basis of the context and execution information.
Authors	Elisabetta Di Nitto, Valentina Mazza
Description	Observing the context and the properties of the application during execution by means of the monitors, critical events are detected triggering the adaptation. The process could be automatic or requiring human involvement: in this case, the user, on the basis of monitored information, decides to trigger the adaptation. When the process is automatic without human involvement, the system is considered self-adaptable. There is the need to identify proper modeling means to enable the automatic identification and analysis of adaptation requirements. These issues require a

	suitable design for adaptation phase for the identification of the requirements for adaptation, the strategies and the related mechanisms.
IRF elements	**Framework:** SED SAM **Life Cycle:** Requirements Engineering and Design; Identify Adaptation Need; Identify Adaptation Strategy; Enact adaptation. **Infrastructure:** Adaptation Engine; Monitoring Engine
Related challenges	Definition of a coherent life cycle for adaptable and evolvable SBA Measuring, controlling, evaluating and improving the life cycle and the related processes.
References	CD-JRA-1.1.2 "Separate design knowledge models for software engineering and service based computing."
Glossary	Adaptation Requirements and Objective, Adaptation Strategy. Adaptation Mechanism, Design for Adaptation
Keywords	Self-adaptation, self-evolution, Adaptation Requirements

Name	Identify best practices for SOA migration
Synopsis	Migration from legacy software to SOA is nowadays an important topic. Industry, in fact, has a large quantity of software to be modernized and made available as added-value services. Therefore, the identification of best practices and migration strategies for service engineering is critical for both SOA adoption in industrial setting, successful migration of legacies, and ROI.
Authors	Patricia Lago, Maryam Razavian
Description	Migration from legacy software to SOA is nowadays an important topic. Industry, in fact, has a large quantity of software to be modernized and made available as added-value services. Migration approaches from legacy systems to SOA mainly differ in the way they provide solutions for two challenging problems of what can be migrated (i.e. the legacy elements) and how the migration is performed (i.e. the migration process). Furthermore, there are many differences between academic and industrial approaches. For example, while scientific approaches mainly take a reverse engineering perspective, industrial practitioners developed best practices in forward engineering from requirements to SOA technologies, where legacy code is not transformed but used as a reference. Therefore, the identification of best practices and migration strategies for service engineering is critical for both SOA adoption in industrial setting, successful migration of legacies, and ROI.
IRF elements	Reference lifecycle: all elements
Related challenges	Evolution of Services Lifecycle of service compositions The identification of process-oriented SOA viewpoints
References	• Razavian, M. & Lago, P., A Frame of Reference for SOA Migration, In: Di Nitto, E. & Yahyapour, R. (eds.) Towards a

	Service-Based Internet, Springer Berlin / Heidelberg, 2010, 6481, 150-162. • Razavian, M.; Nguyen, D. K.; Lago, P. & van den Heuvel, W.-J. The SAPIENSA Approach for Service-enabling Pre-existing Enterprise Assets International Workshop on SOA Migration and Evolution (SOAME), OFFIS, 2010, 10. • Razavian, M. & Lago, P. Towards a Conceptual Framework for Legacy to SOA Migration 5th International Workshop on Engineering Service Oriented Applications (WESOA) at ICSOC, Springer, 2009, 6275, 445-455
Glossary	S-Cube lifecycle, Migration
Keywords	Software evolution, migration of legacy systems

Name	Support Agile Service Networks with context modelling
Synopsis	An emerging paradigm in service engineering is associated with Agile Service Networks (ASNs) that link together services collaborating to provide some added value. ASNs can be applied to various types of situations involving modern organizations and organizational social structures (OSSs), a.o. social networks like communities of practice and working groups; partnerships dynamically managed as collaborating services; global or distributed teams of developers within and across organizations. Such situations can be modeled as specific contexts. Hence, by using context modeling techniques we can reason about the requirements for supporting them with ASNs, and hence identify the mechanisms that ASNs should offer to be applied in practice.
Authors	Patricia Lago, Damian A. Tamburri
Description	Analysis and Identification of how social networks in organizations can be supported by service networks. Types of social networks will be identified from both research and industrial case studies. Their characteristics will be mapped on service networks. Scenarios about each typology will be defined to show how service oriented techniques like adaptation and composition can support this paradigm.
IRF elements	Reference lifecycle: all elements
Related challenges	Lifecycle of service compositions
References	S-Cube Deliverables: CD-JRA-2.1.3, PO-JRA-2.1.1, CD-JRA-2.1.2
Glossary	S-Cube lifecycle, Adaptable Service-Based Applications, Context
Keywords	Context modelling, Agile Services Networks, Context Adaptation

2.1.2. Challenges from JRA-1.2

Name	Comprehensive and integrated adaptation and monitoring principles, techniques, and methodologies
Synopsis	Current solutions for SBA adaptation and monitoring are highly fragmented and isolated; they address specific domains or aspects, specific functional layers or a particular phase of the SBA life-cycle. A holistic framework is needed that provides a

	comprehensive and integrated vision of the adaptation and monitoring problem.
Authors	Raman Kazhamiakin, WP-JRA-1.2
Description	To overcome the isolation and fragmentation of existing A&M solutions, the target holistic integrated A&M framework will aim to provide a uniform model of adaptation and monitoring that covers different domains, disciplines, and SBA elements. This framework will accommodate the integration of the existing solutions in different directions: - Cross-layer adaptation and monitoring, where the problem is addressed for SBA as a whole propagating and exploiting specific actions, mechanisms, and tools at different functional SBA layers. - Cross-boundary adaptation and monitoring, where the problem is considered across the boundaries of SBAs, addressing the issue of distribution of information, control, and effects to other applications, external systems, and services. - Cross life-cycle adaptation and monitoring, where the knowledge and models available at different phases of SBA life-cycle (e.g., design-time or post-operational data) is exploited in order to devise new monitoring approaches (e.g., post-mortem analysis for prediction) and adaptation decisions (e.g., to learn from previous decisions and adaptations)
IRF elements	**Framework:** - SAM - Integrated A&M capabilities - BPM - SCC - SI **Life Cycle:** - Operation and management - Identify adaptation need - Identify adaptation strategy - Enact adaptation **Infrastructure:** - Monitoring engine - Adaptation engine **Logical design environment:** - modelling techniques - transformation and generation techniques
Related challenges	Understand when an adaptation requirement should be selected
References	- CD-JRA-1.2.2 Taxonomy of Adaptation Principles and Mechanisms - PO-JRA-1.2.3 Baseline of Adaptation and Monitoring PTMs across Functional SBA Layers CD-JRA-1.2.4 Integrated adaptation and monitoring PTMs across functional SBA layer
Glossary	Adaptable Service-based application, Adaptation, Adaptation Strategy, Adaptation Requirements and Objectives, Adaptation Mechanism, Monitoring, Monitoring Event, Monitoring Mechanism, Business Process, Service Composition, Monitoring in Grid, Self-*

Keywords	- Cross-layer SBA monitoring and adaptation, adaptation and monitoring framework

Name	Proactive Adaptation and Predictive Monitoring
Synopsis	To anticipate the needs for critical changes and to prevent problems in SBA functioning, proactive adaptation aims to exploit predictive monitoring capabilities. In this way, potential problems will be identified before they may happen, and the necessary adaptation actions are driven by the predicted quality deviations or functional problems.
Authors	Raman Kazhamiakin, Barbara Pernici, WP-JRA-1.2
Description	In existing SBA approaches the adaptation aims to react to events that have already happened in the SBA execution or context. However, if the identified event is generated because of a very critical problem the change should be prevented. There is a need for solutions that do not define reactions to the critical changes and problems, but try to avoid them; the shift in SBA adaptation should be directed towards proactive management of undesirable situations. A key element for proactive SBA adaptation is the possibility of predicting future problems or undesirable situations, i.e., to understand what the symptoms representing future problems are, how to represent and detect them. It may be necessary to consider the solutions and mechanisms that traditionally are not applied to the monitoring problem (e.g., run-time testing and validation post-mortem analysis and data mining to predict certain trends. It is also important to identify the minimum set of observables that allow the diagnosis or the prediction of faults in the SBA.
IRF elements	**Framework:** - SAM - SQDNA **Life Cycle:** - Operation and management - Identify adaptation need - Identify adaptation strategy **Infrastructure:** - Monitoring engine - Adaptation engine
Related challenges	- Quality Prediction Techniques to Support Proactive Adaptation - Comprehensive and integrated adaptation and monitoring principles, techniques, and methodologies
References	- CD-JRA-1.2.2 Taxonomy of Adaptation Principles and Mechanisms - CD-JRA-1.2.4 Integrated adaptation and monitoring PTMs across functional SBA layer
Glossary	Adaptable Service-based application, Monitoring, Adaptation, Proactive Adaptation, Adaptation Requirements and objectives, Reactive Adaptation
Keywords	Proactive adaptation, predictive monitoring

Name	Context- and HCI-aware SBA monitoring and adaptation
Synopsis	Changes in the context must be reflected in the SBA and managed

	in appropriate ways; otherwise the system falls out of use. SBAs should be equipped with the required mechanisms to adapt quickly to changes in the system's context, particularly at run-time.
Authors	Andreas Gehlert
Description	The context, e.g., everything, which is outside the boundaries of the software system including stakeholders, other IT systems, rules and regulations as well as business objects, end-user settings and even physical environment, plays an important role for developing and maintaining SBAs. SBAs should be equipped with the mechanisms to model and represent critical context factors, to recognize relevant changes in those factors, and to transform them into the adaptation strategy at run-time. This amounts to modelling and capturing various context aspects, such as business context, user context, human-computer interactions, or execution context; to the development of novel monitoring techniques specifically focusing on the those aspects; and to the definition of new adaptation mechanisms that devise and realize appropriate adaptation strategies for those situations.
IRF elements	**Framework:** - SAM - SED -**Life Cycle:** - Requirements engineering and design - Deployment and provisioning - Operation & management - Identify adaptation need **Infrastructure:** - Monitoring engine - Adaptation engine **Logical design environment:** - modelling techniques
Related challenges	- HCI and context aspects in the development of service based applications - Understand when an adaptation requirement should be selected
References	- CD-JRA-1.2.2 Taxonomy of Adaptation Principles and Mechanisms - PO-JRA-1.2.3 Baseline of Adaptation and Monitoring PTMs across Functional SBA Layers
Glossary	Adaptation, Monitoring, Adaptation requirements and objectives, Context, Human-Computer Interaction, Personalization, User modelling
Keywords	-

Name	Mixed initiative SBA adaptation
Synopsis	While most of the approaches aim to provide solutions for self-adaptation, in many applications the user has to control the way the system operates and is adapted. The adaptation process should consider and support human roles and activities from the very beginning interacting with them and realizing their decisions.
Authors	Raman Kazhamiakin, JRA-1.2

Description	Most of the existing approaches aim to develop self-adapting systems, i.e., the SBAs that identify and react to changes autonomously. While this approach suites very well in the level of service infrastructure, this is often not the case for the systems oriented towards end users (user-centric systems, B2C applications). The end user has to control the system works (make appropriate decisions or intercept adaptation activities), or drives the way the system is adapted (i.e., system is personalized to fit a particular user through preferences, HCI aspects). To achieve this, it is necessary to consider the human roles in the adaptation process from the very beginning, properly designing the adaptation infrastructure, the models and interfaces to express the adaptation needs, to interact with the user, and to reflect his decisions. The research objectives are to come up with (i) new models that are able to adequately capture the adaptation problem solutions at run-time, are easily understood by humans, and able to capture their intentions and requirements; (ii) novel adaptation infrastructures that specifically target the human actions and decisions and transfer them into the internal system actions; (iii) new interfaces that enable interaction with the adaptation infrastructure based on the corresponding models.
IRF elements	**Framework:** - SAM - SED -**Life Cycle:** - Requirements engineering and design - Deployment and provisioning - Operation & management - Identify adaptation need - Identify adaptation strategy **Infrastructure:** - Monitoring engine - Adaptation engine **Logical design environment:** - Modelling techniques
Related challenges	- HCI and context aspects in the development of service based applications - Multi-level and self-adaptation
References	- CD-JRA-1.2.2 Taxonomy of Adaptation Principles and Mechanisms
Glossary	Adaptation, Monitoring, Adaptation requirements and objectives, User modelling
Keywords	-

2.1.3. Challenges from JRA-1.3

Name	End-to-End Quality Reference Model
Synopsis	To support end-to-end quality provision, the dependencies between different kinds of quality attributes need to be made explicit. In addition, the dependencies between quality attributes at the same and different functional levels of an SBA need to be understood. To achieve a shared understanding of quality attributes between the S-Cube layers and disciplines, a common S-Cube Quality Reference Model will be defined.
Authors	Andreas Metzger, WP-JRA-1.3
Description	**Motivation:** Different kinds of quality attributes are important in

	an SBA. There is thus a strong need for methods that address quality attributes in a comprehensive and cross-cutting fashion across all layers of a service-based application. Due to the dynamism of the world in which service-based applications operate, techniques are needed to aggregate individual quality levels of the services involved in a service composition in order to determine and thus check the end-to-end quality during run-time. This aggregation will typically span different layers of a service-based application and thus a common understanding of what the different quality attributes mean within and across these layers is needed. **Challenge:** To support end-to-end quality provision, S-Cube will aim at making the dependencies between different kinds of quality attributes explicit. For instance, the interrelation between the fulfilment of different QoS attributes across the various layers will be modelled. In addition, S-Cube aims at understanding the dependencies between QoI attributes on the infrastructure layer, the satisfaction of QoE on the service composition layer and the achievement of QoBiz (business value or business KPIs). One key means to achieve the above objective is to achieve a shared understanding of quality attributes between the S-Cube layers and disciplines by defining the S-Cube Quality Reference Model. Based on the S-Cube Quality Reference Model and the quality definition language (see Challenge "Rich and Extensible Quality Definition Language"), foundations for techniques will devised, which allow aggregating individual quality levels of the services involved in a service composition in order to determine and thus ultimately check end-to-end quality.
IRF elements	**Framework:** - SQDNA - BPM - SCC - SI **Life Cycle:** - early requirements engineering **Infrastructure:** - N/A
Related challenges	- Rich and Extensible Quality Definition Language
References	- PO-JRA-1.3.1 Survey of quality related aspects relevant for SBAs - CD-JRA-1.3.2 Quality Reference Model for SBA - CD-JRA-1.3.3 Initial Concepts for Specifying End-to-End Quality Characteristics
Glossary	Quality Attribute, Quality of Service Characteristic, Quality of Service Constraint, Quality of Service Dimension, Quality of Service Level, Quality of Service-Based Adaptation, Service Level Agreement, Level of Service
Keywords	-

Name	Rich and Extensible Quality Definition Language
Synopsis	To describe every relevant aspect of quality for services and SBAs, including metrics, units, measurement functions and directives, constraints, value types, etc, a quality definition language is required. This quality definition language will also encompass a rich set of domain-dependent and global quality attributes (i.e., the ones referenced in the S-Cube Quality Reference Model; see Challenge "End-to-End Quality Reference Model") and will be extensible so as to allow the addition of new quality dimensions when needed. Further, this quality definition language will be semantically enriched – where feasible – to be machine-processable or machine-interpretable. Finally, this language must be applicable in complex SBAs, in which services can be invoked and composed with variable quality profiles.
Authors	Andreas Metzger, WP-JRA-1.3
Description	**Motivation:** For what concerns quality modelling and definition, a lack of a well established, rich, extensible, and semantically enriched quality definition language has been observed. As a result, quality capabilities and requirements, as well as service SLAs are described by many different formalisms and languages. **Challenge:** S-Cube strives to develop a quality definition language, which allows describing every relevant aspect of quality for services and SBAs, including metrics, units, measurement functions and directives, constraints, value types, etc. In addition, this quality definition language will encompass a rich set of domain-dependent and global quality attributes and will be extensible so as to allow the addition of new quality dimensions when it is needed (e.g., for a application domain which has currently not been considered). As a starting point, the set of quality attributes as defined in the S-Cube Quality Reference Model (see Challenge "End-to-End Quality Reference Model") will be exploited. Further, this standard quality definition language will be semantically enriched – where feasible – to be machine-processable or machine-interpretable. This quality definition language will be created to be applicable in complex service-based applications, in which services can be invoked and composed with variable quality profiles. Such a quality definition language should thus be capable of expressing quality capabilities and SLAs by using functions, operators and comparison predicates on quality metrics. It should also allow the description of composition rules for possible combinations of composition constructs and quality metrics.
IRF elements	**Framework:** - SQDNA - BPM - SCC - SI **Life Cycle:** - early requirements engineering - construction

	- deployment & provisioning - identify adaptation need **Infrastructure:** - Monitoring engine - Run-time QA engine - Discovery and registry infrastructure - Negotiation engine - Adaptation engine
Related challenges	- End-to-End Quality Reference Model
References	- PO-JRA-1.3.1 Survey of quality related aspects relevant for SBAs - CD-JRA-1.3.2 Quality Reference Model for SBA - CD-JRA-1.3.3 Initial Concepts for Specifying End-to-End Quality Characteristics
Glossary	Quality Attribute, Quality of Service Characteristic, Quality of Service Constraint, Quality of Service Dimension, Quality of Service Level, Quality of Service-Based Adaptation, Reactive Adaptation, Service Level Agreement, Level of Service
Keywords	-

Name	Exploiting user and task models for automatic quality contract establishment
Synopsis	To devise advanced automated negotiation techniques and protocols (thereby enabling automatic quality contract establishment), one key challenge is how to exploit user and task models, which codify user preferences and characteristics. Those advanced techniques could lead to service negotiators (e.g., autonomous components provided as core services) that perform the negotiation process on behalf of the service consumers (requestors) and providers.
Authors	Andreas Metzger, WP-JRA-1.3
Description	**Motivation:** Service negotiation and agreement involves selecting one out of many service providers based on his quality offer so as to agree on and thus establish the contracts for the delivered service. To address dynamic adaptations of service-based applications, a growing need for automating the negotiation and agreement of quality attributes (e.g., as stipulated by SLAs) can be observed. However, this issue requires considering user interaction and experience (e.g., QoE) issues that may impact on the negotiation itself. This aspect requires a multi-disciplinary effort in which technology researchers will have to interact with researchers addressing user interaction issues. **Challenge:** One key research objective regarding quality contract establishment is to exploit user and task models, which codify user preferences and characteristics (see Challenge “HCI and context aspects in the development of service based applications”), in order to devise advanced automated negotiation techniques and protocols. Those advanced techniques could lead to service negotiators (e.g., autonomous components provided as

	core services) that perform the negotiation process on behalf of the service consumers (requestors) and providers.
IRF elements	**Framework:** - SQDNA - SED - SCC **Life Cycle:** - deployment and provisioning - operation & management - enact adaptation **Infrastructure:** - Negotiation engine
Related challenges	- Proactive SLA negotiation and agreement - HCI and context aspects in the development of service based applications
References	- PO-JRA-1.3.1 Survey of quality related aspects relevant for SBAs - CD-JRA-1.3.2 Quality Reference Model for SBA - CD-JRA-1.3.3 Initial Concepts for Specifying End-to-End Quality Characteristics
Glossary	Quality Attribute, Quality of Service Characteristic, Quality of Service Constraint, Quality of Service Dimension, Quality of Service Level, Quality of Service-Based Adaptation, Service Level Agreement, Quality of Service Negotiation, Service Level Agreement Negotiation, Level of Service
Keywords	-

Name	Proactive SLA negotiation and agreement
Synopsis	Based on the envisioned advances in automated negotiation, S-Cube aims to address the current state-of-the-art limitations by starting negotiation when there is evidence that the need for deploying a new service and/or change the conditions of deploying a current service is likely to arise but has not arisen yet. Thus, the challenge is to forecast at run-time a number of factors related to the deployment of services, as the availability of accurate forecasts can lead to effective proactive run-time negotiation strategies for service clients.
Authors	Andreas Metzger, WP-JRA-1.3
Description	**Motivation:** Similar to proactive adaptation (see Challenge “Quality Prediction Techniques to Support Proactive Adaptation”), proactive SLA negotiation and agreement is a key prerequisite for effective run-time SLA negotiation since negotiation does not have a negligible computational cost and, therefore, undertaking it when there is an immediate need to use a new service can be unlikely or unfeasible at run-time. **Challenge:** The challenge for quality contract negotiation and agreement is how to negotiate the terms and conditions under which a service can be offered before the need for deploying or

	invoking these services arises. Based on the envisioned advances in automated negotiation, we aim to address the limitations introduced above by starting negotiation when there is evidence that the need for deploying a new service and/or change the conditions of deploying a current service is likely to arise but has not arisen yet. Thus, our proactive negotiation approach is based on forecasting at run-time a number of factors related to the deployment of services. Those include, for example, the expected demand for a service, the expected levels of service provision, and the expected service terms and conditions that a service negotiator is likely to agree. The availability of accurate forecasts can lead to effective proactive run-time negotiation strategies for service clients. Prediction also plays a role in quality prediction for proactive adaptation (see Challenge "Quality Prediction Techniques to Support Proactive Adaptation"). Although the factors which are relevant differ in both situations, we expect to be able to exploit synergies between the principles and techniques that are developed.
IRF elements	**Framework:** - SQDNA - SCC **Life Cycle:** - deployment and provisioning - operation & management - enact adaptation **Infrastructure:** - Monitoring engine - Discovery and registry infrastructure - Negotiation engine - Adaptation engine
Related challenges	- Exploiting user and task models for automatic quality contract establishment - Quality Prediction Techniques to Support Proactive Adaptation
References	- PO-JRA-1.3.1 Survey of quality related aspects relevant for SBAs - CD-JRA-1.3.2 Quality Reference Model for SBA - CD-JRA-1.3.3 Initial Concepts for Specifying End-to-End Quality Characteristics
Glossary	Proactive Adaptation, Quality Attribute, Quality of Service Characteristic, Quality of Service Constraint, Quality of Service Dimension, Quality of Service Level, Quality of Service-Based Adaptation, Reactive Adaptation, Service Level Agreement, Software Quality Assurance, Quality of Service Negotiation, Service Level Agreement Negotiation, Level of Service
Keywords	-

Name	Run-time Quality Assurance Techniques
Synopsis	S-Cube will investigate how standard and consolidated offline software quality assurance techniques can be extended to be applicable while the application operates. In addition to extending

	the quality assurance techniques to the operation phase, synergies between the different classes of analytical quality assurance techniques will be exploited.
Authors	Andreas Metzger, WP-JRA-1.3
Description	**Motivation:** Given the need for adapting service-based applications at run-time, quality assurance techniques that can be applied at run-time are essential. The major type of run-time quality assurance techniques used today is monitoring. Monitoring observes the service-based application (or its constituent services) during their current execution, i.e. during their actual use or operation. However, monitoring only allows the assessment of the quality of ’representative’ applications (in fact the application in operation) and thus key problems might only be discovered by coincidence. In contrast, standard and consolidated software quality assurance techniques employed during design time, can uncover problems that might only occur after many invocations of the SBA. As an example model analysis can examine classes of executions, thereby leading to more universal statements about the properties of the artefacts. **Challenge:** S-Cube will investigate in how standard and consolidated offline software quality assurance techniques can be extended to be applicable while the application operates. For instance, we will investigate into run-time model analysis techniques and other online techniques such as online testing. In addition to extending the quality assurance techniques to the operation phase, synergies between the different classes of analytical quality assurance techniques will be exploited. As an example, we will investigate how testing can be combined with monitoring in such a way that when a deviation is observed during monitoring, dedicated test cases are executed in order to determine – with high confidence – the cause for the deviation. In order to achieve feasible results from run-time quality assurance, it is essential that the artefacts exploited for run-time analysis or testing are a consistent and up-to-date representation (abstraction) of the running service-based application. For example, this leads to the challenge on how to “synchronize” the model with the SBA in operation in order to achieve valid analysis results. Existing quality assurance techniques appear to be not yet fully incorporated into a comprehensive life-cycle. These aspects are particularly critical as the designers find that understanding what will happen as a result of some self-adaptation design choice quite difficult. Research, jointly with WP-JRA-1.1, will thus address the consistent and comprehensive integration of quality assurance into the service life-cycle (see Challenge “Definition of a coherent life cycle for adaptable and evolvable SBA”).
IRF elements	**Framework:** - SQDNA - SED **Life Cycle:** - deployment & provisioning

	- operation & management - identify adaptation need - identify adaptation strategy **Infrastructure:** - Monitoring engine - Run-time QA engine - Adaptation engine
Related challenges	- Quality Prediction Techniques to Support Proactive Adaptation - Definition of a coherent life cycle for adaptable and evolvable SBA
References	- PO-JRA-1.3.1 Survey of quality related aspects relevant for SBAs - CD-JRA-1.3.2 Quality Reference Model for SBA - CD-JRA-1.3.3 Initial Concepts for Specifying End-to-End Quality Characteristics
Glossary	Analytical Quality Assurance, Failure, Failure Semantics, Fault, Monitoring, Quality Attribute, Quality of Service Characteristic, Quality of Service Constraint, Quality of Service Dimension, Quality of Service Level, Quality of Service-Based Adaptation, Service Fault, Service Level Agreement, Software Quality Assurance, Static Analysis, Testing, User Error, Validation, Verification, Quality of Service Negotiation, Service Level Agreement Negotiation, Level of Service
Keywords	-

Name	Quality Prediction Techniques to Support Proactive Adaptation
Synopsis	To support the vision of proactive adaptation, novel quality prediction techniques need to be devised. Depending on the kind of quality attribute to be predicted, these can range from ones that built on traditional techniques to ones that exploit modern technologies of the Future Internet.
Authors	Andreas Metzger, WP-JRA-1.3
Description	**Motivation:** To respond in a timely fashion to changes implied by the highly dynamic and flexible contexts of future SBAs and to promptly compensate for deviations in functionality or quality, SBAs have to be able to self-adapt. In current implementations of service-based applications, monitoring events trigger the adaptation of an application. Thus self-adaptation often happens after a change or a deviation has occurred. Yet, such reactive adaptations have several drawbacks, such as: (1) Executing faulty services can lead to unsatisfied users and typically requires the execution of additional activities (e.g., compensation or roll-back); (2) Execution of adaptation activities takes time and thereby can reduce the system performance; (3) It can take time before problems in the system lead to monitoring events (e.g., time needed for the propagation of events from the infrastructure to the business process level), thus events might arrive so late that an adaptation of the system is not possible anymore (e.g., because the system is in a deadlock situation). Proactive adaptation presents a solution to address these

	drawbacks, because – ideally – the system will detect the need for adaptation and will self-adapt before a deviation will occur during the actual operation of the service-based application and before such a deviation can lead to the above problems. Key to proactive adaptation is to predict the future quality (and functionality) of a SBA and to proactively respond if the prediction uncovers deviations from expected quality (or functionality). **Challenge:** To support the vision of proactive adaptation, S-Cube will work on devising novel quality prediction techniques need. Depending on the kind of quality attribute to be predicted, these can range from ones that built on traditional techniques (see Challenge "Run-time Quality Assurance Techniques") to ones that exploit modern technologies of the Future Internet. As an example for the first case, correctness or performance (QoS) could be predicted by building on techniques similar to online testing or run-time model analysis. As an example for the latter case, usability of services (QoE) could be predicted by extending existing principles of reputation systems. In this context, one of the possible dimensions to explore is to analyze and predict the properties of networks arising from the interactions between various services. For instance if service A invokes service B, a link between these two services is established. The set of all services and their interactions constitutes a network, which can be represented as a graph structure that can be analyzed by means of traditional link analysis techniques. However, novel and more targeted analysis approaches are needed to support quality prediction.
IRF elements	**Framework:** - SQDNA - BPM - SCC - SI **Life Cycle:** - early requirements engineering - construction - deployment & provisioning - operation & management - identify adaptation need - identify adaptation strategy **Infrastructure:** - Monitoring engine - Run-time QA engine - Negotiation engine - Adaptation engine
Related challenges	- Run-time Quality Assurance Techniques
References	- PO-JRA-1.3.1 Survey of quality related aspects relevant for SBAs - CD-JRA-1.3.2 Quality Reference Model for SBA - CD-JRA-1.3.3 Initial Concepts for Specifying End-to-End Quality Characteristics

Glossary	Analytical Quality Assurance, Failure, Failure Semantics, Fault, Monitoring, Proactive Adaptation, Quality Attribute, Quality of Service Characteristic, Quality of Service Constraint, Quality of Service Dimension, Quality of Service Level, Quality of Service-Based Adaptation, Reactive Adaptation, Service Fault, Service Level Agreement, Software Quality Assurance, Static Analysis, Testing, User Error, Validation, Verification, Quality of Service Negotiation, Service Level Agreement Negotiation, Level of Service
Keywords	-

2.1.4. Challenges from JRA-2.1

Name	End-to-end processes in Service Networks
Synopsis	How to develop and validate design-time concepts, mechanisms and languages for specifying, analyzing, and simulating end-to-end processes in agile service networks?
Authors	JRA-2.1
Description	**Motivation:** Design time concepts, mechansisms and languages for specifying, analyzing and simulation of end-to-end processes – including the protocols that govern them- are still ill understood. **Challenge:** In particular, this challenge involves at least overcoming the following three impediments: • Exploring, developing and validating effective techniques, concepts, languages and mechanisms for analyzing, modelling and simulating end-to-end business processes in ASNs. In particular, deeper understanding of existing service engineering methodologies is needed in collaboration with SED. • Developing and validating approaches exist for analysis and formal verification of business protocols involving bi-lateral and multi-lateral agreements between network nodes. Solutions will be grounded on existing approaches and techniques in protocol engineering in connection with SED, as well as devising Quality of Service for SBAs and Service Level Agreements in SQDN. • Developing and validating analysis and design of business-aware transaction concepts and mechanisms to support business protocols in ASNs are typically very traditional in nature addressing traditional, short-running database transactions ignoring important business semantics including multi-party agreements on QoS. In particular, this sub-challenge is also related to the SQDNA and SED.
IRF elements	**Framework:** - BPM - SCC - SED - SQDN **Life Cycle:** - **Infrastructure:** - N/A

Related challenges	- Business transactions in service networks
References	- PO-JRA-2.1.1/2.1.2/2.1.3 -
Glossary	- business process management, optimization, end-to-end processes, protocols, simulation, analysis, choreography, conversations, QoS, composition
Keywords	-

Name	Business Transactions in Service Networks
Synopsis	How to develop and validate concepts, mechanism and languages for run-time monitoring of business transactions?
Authors	
Description	*Motivation*: Business transactions are the heart-and-soul of agile service networks, and as such need to be better understood. *Challenge*: To overcome this challenge, a better understanding is required of existing monitoring approaches, techniques and solutions, which are further scrutinized in both WP-JRA-1.2, as well as existing (automatic) approaches for quality assurance as discussed in WP-JRA-1.3. This challenge involves resolving the following two deficiencies of existing techniques and solutions: • Existing transaction monitors typically limit themselves to sniffing and aggregating system-level events. An integrated approach that realizes mechanisms and concepts for monitoring business-aware transactions is currently lacking. This sub-challenge will particularly benefit from ongoing research with regarding to system monitors and business activity monitors in WP-JRA-1.2. • A formal foundation underpinning business transactions is currently lacking. A modelling and formalization approach is required for the purpose of determining their correctness and consistency. Such an approach will also consider performance analysis concepts and techniques for business transactions.
IRF elements	*Framework*: BPM, SCC, SAM, SQDNA *Life Cycle*: requirements engineering and design; operation and management; *Infrastructure*: N/A
Related challenges	-
References	PO-JRA-2.1.1/2.1.2/2.1.3
Glossary	business process management, end-to-end processes, business transactions, transaction models, long-running transactions, ACID, composition, business activity monitoring
Keywords	-

2.1.5. Challenges from JRA-2.2

Name	Formal Models and Languages for QoS-Aware Service Compositions
Synopsis	This challenge will deal with formal models and Languages for QoS-aware service compositions. The challenge is substantiated by the facts, that firstly, there are no formal models for service

	compositions available that take into account the QoS and behavioural characteristics of these compositions and secondly, that the formal models are extremely important to guarantee that the final result of a composition services possesses the required characteristics.
Authors	Manuel Carro, Dimitris Plexousakis, Dimka Karastoyanova, WP-JRA-2.2
Description	**Motivation:** When composing several services into an aggregated one, it is usually necessary to fulfil several characteristics in the composed service: the composite service needs to deliver the information requested, behave as desired, and meet the quality standards required from it. In general, extremely difficult to ensure that a complex, final product will deliver what is required from it without resorting to a model of the system, its environment, and the requirements. The degree to which this model really reflects the real product / environment and to which reasoning within the model is feasible and accurate with respect to the modeled entities greatly impacts the applicability of such a model. Formal models have the advantage of being equipped with a non-ambiguous meaning and a way to reason on instances of the model in such a way that sound results are achieved—i.e., inferred properties are not in contradiction with the semantics of the model. Given the complexity of Service Oriented Computing and service composition, it is difficult to find a single existing proposal which can seamlessly and in a uniform way tackle all the issues. **Challenge:** The primary research objective will be to devise novel models for QoS-aware services and service compositions, based on the expertise on formal models of the partners. Models of QoS-aware service compositions need to provide means for reasoning about services and their compositionality based both on their functionality in a wide sense (i.e., semantics / behaviour) and on their QoS attributes. Such models need to be sufficiently expressive to describe a wide class of service compositions and QoS attributes, while at the same time constrained enough to ensure that the standard reasoning tasks performed on the model are decidable (at least in the common cases) and reasonably efficient. Determining (QoS-aware) compositionality assumes that service behavior is exposed in a declarative manner with the use of formal specification languages. As far as reasoning on service functionality is concerned, rich semantic formal models will need to be devised. These models should aim at describing the behavior of services and service compositions and offer a complete description of what the services provide under all circumstances. Among the formal basis to use in order to construct more general formal models and languages to describe and reason about service compositions, we plan to explore the use of temporal logic to specify message exchange patterns between software services and QoS constraints with respect to time. On the semantic side (utterly necessary in order to be able to perform automatic, dynamic service compositions), we foresee that description logics can be used to model service structures and, with suitable extensions still to be fully developed, QoS constraints. Modeling of service metadata is also an important aspect. QoS attributes of services will have to be included in the description of

	the services and of their compositions. The application of soft constraints for modelling and reasoning about QoS will also be examined. Formal models will form the formal substrate of execution languages which can be used as input for execution, monitoring, and later analysis.
IRF elements	**Framework:** - SCC - SI **Life Cycle:** - construction - deployment & provisioning **Infrastructure:** - Modelling Techniques
Related challenges	-
References	- PO-JRA-2.2.1 Overview of the state of the art in compositions and coordination of services - CD-JRA-2.2.2 Models and Mechanisms for Coordinated Service Compositions - First Draft - CD-JRA-2.2.4 Models, Mechanisms and Protocols for Coordinated Service Compositions - CD-JRA-2.2.6 QoS-aware, Coordinated Service Compositions – Mechanisms and Techniques
Glossary	Service Composition, Process Model, Service Model, Formal Specification
Keywords	-

Name	Monitoring of Quality Characteristics of Service Orchestrations and Service Choreographies
Synopsis	In the context of QoS-aware service compositions, our focus lies on monitoring of quality characteristics of service orchestrations and service choreographies. As service compositions implement business processes and at the same time run on IT infrastructure, their quality characteristics are influenced by both process-level and infrastructure-level metrics. A holistic monitoring approach for quality characteristics of service compositions involves monitoring of service orchestrations in terms of both process-level and infrastructure level factors and in addition monitoring of quality characteristics across participants in service choreographies.
Authors	Branimir Wetzstein, Martin Treiber, Manuel Carro, Dimka Karastoyanova, WP-JRA-2.2
Description	**Motivation:** Monitoring is the process of collecting relevant information from the execution data of service composition and involved services in order to evaluate properties of interest and report results of that evaluation. Monitored properties can be based on functional aspects (e.g., correctness properties) or non-functional aspects (e.g., QoS properties). In the context of QoS-aware

	service compositions, our focus lies on monitoring of quality characteristics. Current solutions to service composition monitoring mostly focus and are constrained to one layer or very specific aspects, e.g., process metrics as part of business activity monitoring, or QoS metrics as part of SLA monitoring and do not integrate information from all layers and deal with their dependencies. As service compositions implement business processes from the BPM layer, and at the same time are based on technical QoS properties of Web services and IT infrastructure used, monitoring of service compositions should take into account and integrate both business related metrics and technical QoS metrics. **Challenge:** S-Cube will devise mechanisms and corresponding development methods which aim to support a holistic monitoring approach for service compositions which integrates monitoring information from different layers and across choreography participants in the SCC layer. In particular, mechanisms will be devised which support: – Integrated Monitoring of process and QoS characteristics of service compositions: We want to be able to monitor metrics which define time, cost, and quality related properties of business processes (a.k.a. process performance metrics) and correlate them with technical QoS metrics of the underlying IT infrastructure. – Monitoring of quality characteristics in service choreographies: Mechanisms will be devised which enable monitoring of processes in service choreographies in cross-organizational scenarios. This type of monitoring has to take into account that on choreography level only public processes of the participating service orchestrations are available.
IRF elements	**Framework:** - SCC - SAM **Life Cycle:** - Operation & Management **Infrastructure:** - Monitoring Engine
Related challenges	- Analysis and Prediction of Quality Characteristics of Service Compositions - QoS Aware Adaptation of Service Compositions - Comprehensive and Integrated Adaptation / Monitoring Principles, Techniques and Methodologies
References	- PO-JRA-2.2.1 Overview of the state of the art in compositions and coordination of services - CD-JRA-2.2.2 Models and Mechanisms for Coordinated Service Compositions - First Draft - CD-JRA-2.2.4 Models, Mechanisms and Protocols for Coordinated Service Compositions - CD-JRA-2.2.5 Derivation of QoS and SLA specifications

	- CD-JRA-2.2.6 QoS-aware, Coordinated Service Compositions – Mechanisms and Techniques
Glossary	Service Composition, Service Orchestration, Service Choreography, Quality Attribute, Quality of Service Characteristic, Monitoring, Business Activity Monitoring
Keywords	-

Name	Analysis and Prediction of Quality Characteristics of Service Compositions
Synopsis	When monitoring of quality characteristics of service compositions reveals that KPIs do not meet their target values, users are interested in finding out the causes and the most influential factors in order to be able to adapt the composition to prevent those violations in future. Analysis and prediction mechanisms for quality characteristics will be devised, which are integrated with the monitoring mechanisms and provide input to the adaptation framework on which quality characteristics to adapt.
Authors	Branimir Wetzstein, Martin Treiber, Manuel Carro, Dimka Karastoyanova, WP-JRA-2.2
Description	**Motivation:** While *monitoring* focuses on reporting of values of monitored properties (what?) in a timely fashion, *analysis* is based on monitoring results and tries to find explanations for monitored values (why?) or predict future values. In this respect, analysis of service compositions may also be performed ahead of time (i.e., before the actual execution takes place) in order to infer emerging properties (or, quite often, approximations thereof) which are guaranteed to be universally valid — i.e., true any particular execution when the initial assumptions for the execution hold. Based on the results of monitoring and analysis the service composition can be optimized (QoS-aware Adaptation of Service Compositions). **Challenge:** Based on Monitoring of Quality Characteristics of Service Orchestrations and Service Choreographies, mechanisms will be devised which provide explanations and prediction of monitored values. When KPIs do not meet their target values, business users are interested in finding out the causes and the most influential factors. In our case, we want to be able to derive the most influential factors and dependencies of KPIs on process performance metrics and QoS characteristics of used services. In this context, prediction of KPI and QoS values will be supported, which should enable pro-active service adaptation. In that context, one possible approach is to use data mining techniques (to perform online and post-mortem analysis) and also design time/static analysis which can be used to warn of possible (and sometimes certain) problems before they appear.
IRF elements	**Framework:** - SCC - SAM

	Life Cycle: - Operation & Management **Infrastructure:** - Monitoring Engine
Related challenges	- Monitoring of Quality Characteristics of Service Orchestrations and Service Choreographies - QoS Aware Adaptation of Service Compositions - Proactive SBA Adaptation and Predictive Monitoring
References	- PO-JRA-2.2.1 Overview of the state of the art in compositions and coordination of services - CD-JRA-2.2.2 Models and Mechanisms for Coordinated Service Compositions - First Draft - CD-JRA-2.2.4 Models, Mechanisms and Protocols for Coordinated Service Compositions - CD-JRA-2.2.5 Derivation of QoS and SLA specifications - CD-JRA-2.2.6 QoS-aware, Coordinated Service Compositions – Mechanisms and Techniques
Glossary	Service Composition, Service Orchestration, Service Choreography, Quality Attribute, Quality of Service Characteristic, Monitoring, Quality of Service-Based Adaptation
Keywords	-

Name	QoS Aware Adaptation of Service Compositions
Synopsis	Adaptation of Service Compositions driven by changes in the environment and in particular by the changes in QoS characteristics still remains a major challenge in service-based applications. Mechanisms for enabling such adaptation will be developed as well as the major drivers for adaptation will be defined. The influence of the BPM and SI layers of SBAs on the adaptation of SC must be taken into account to ensure consistency of the adaptation steps.
Authors	Dimka Karastoyanova, Olha Danylevych, Salima Benbernou, WP-JRA-2.2
Description	**Motivation:** In general, QoS-aware adaptation refers to the approaches and mechanisms for adaptation that enable reaction to changes in QoS requirements on the service composition. This means that adaptation of Service Compositions (SCs) must be considered in relation to the measurement, aggregation and disaggregation of QoS parameters of the compositions (usually called Process Performance Metrics (PPMs)) and of the services they employ (QoS characteristics of the services). There is a gap in the current SOC related research with respect to classifications of adaptation types and adaptation drivers and identifying those types and drivers with particular importance for QoS-aware adaptation. Furthermore, mechanisms for reacting to such drivers must be developed, which is the major concern in WP-JRA-2.2 where such mechanisms will be devised and realized. The special focus is on service compositions. The classifications and mechanisms must be refined to include the requirements for integrated cross-layer adaptation of SBAs.

	Several areas with inadequate or missing solutions can be identified so far: cross-layer adaptation of SBAs and its influence on SCs driven mainly by changes in QoS characteristics; proactive adaptation based on monitoring and analysis results; Process fragmentation of service composition to improve reusability and flexibility of SBAs, including coordination protocols between process partitions: Leveraging the emerging Web 2.0 techniques related to service composition and adaptation will also be taken into account. **Challenge:** Our main objective is to devise adaptation mechanisms for service compositions to react to and predict different triggers, including those from the BPM and Service Infrastructure levels thus accounting for the interplay among the layers of SBAs. The focus will be mainly on mechanisms that consider QoS-awareness as a major criterion to trigger adaptation. Mechanisms for reactive adaptation will be provided to enable different adaptation types and will take into account QoS characteristics of services, QoS requirements of the SCs and those imposed by the BPM layer in terms of KPIs. Additionally, the mechanisms will consider the SLAs between the SC and the participating services. Pro-Active adaptation based on monitoring and analysis results (in particular based on prediction) is necessary in some cases in order to adapt instances of a service composition based on information provided by the execution of other instances of the same composition. The information used to enable this and trigger that kind of adaptation is the same as the one used during composition monitoring. Monitoring information about services and the business processes may also be used. Note that in this case our focus is on QoS characteristics measurements as well. Proactive changes are enabled using the same adaptation types as in the cases of reacting to changes due to unexpected situation. The difference to existing approaches is that there must be additional means to analyse process instances constantly to recognize possible critical situations in future. Process fragmentation of service composition will be utilized to improve reusability and flexibility of SBAs. The corresponding coordination protocols (if applicable) will also be the subject of our work. We shall also investigate the possibility to introduce adaptation features of Web 2.0 service composition models.
IRF elements	**Framework:** - SQDNA - SAM - SCC **Life Cycle:** - Operation and Management - Identify Adaptation Need - Enact adaptation **Infrastructure:** -
Related challenges	- Comprehensive and Integrated Adaptation / Monitoring Principles,

	Techniques and Methodologies - Proactive SBA Adaptation and Predictive Monitoring - - Multilevel and Self-adaptation
References	- PO-JRA-2.2.1 Overview of the state of the art in compositions and coordination of services - CD-JRA-2.2.2 Models and Mechanisms for Coordinated Service Compositions - First Draft - CD-JRA-2.2.3 Algorithms and Techniques for splitting and merging service compositions
Glossary	Service Composition, Adaptation, QoS-based adaptation evolution optimization, Design for Adaptation, Proactive Adaptation, Rebinding, Service Orchestration, Workflow
Keywords	-

2.1.6. Challenges from JRA-2.3

Name	Multi-level and self-adaptation
Synopsis	Provide support for dynamic adaptation of service-based applications
Authors	Françoise André, Jean-Louis Pazat
Description	Service-based applications must be dynamically adaptable in order to accommodate the continuous evolution of their environment. Existing approaches to the adaptation problem do not fully meet the requirements of highly dynamic, large-scale service ecosystems. Our objective is to support building adaptable service-based applications; not only individual adaptable services (addressed mainly in the challenge "Self-* in service execution, discovery and registries") but also adaptable compositions of services. The adaptations can be performed either because monitoring has revealed a problem or because the application identifies possible optimizations or because the execution context has changed. The context here includes the set of services available to compose the service-based application, the parameters and protocols being in place, the user preferences, and other environment characteristics (location, time, other running applications). Three levels of adaptation should be considered. The lowest level concerns adaptation of one service on its own. The second level concerns adaptation between services within a service composition in order to satisfy the needs of an application. Finally, the highest level concerns the adaptation of several applications running in parallel, each application being itself a composition of services.
IRF elements	*Conceptual research framework*: SI; SCC; SAM *Reference life-cycle*: Identify adaptation need; Identify adaptation strategy; Enact adaptation; Operation & management *Logical run-time architecture*: Adaptation engine *Logical design environment*: Modelling techniques
Related challenges	Deployment and execution management Proactive Adaptation and Predictive Monitoring
References	

Glossary	adaptable SBA, adaptation, monitoring, self-*
Keywords	multi-level, self-adaptation

Name	Deployment and execution management
Synopsis	Provide support for on-demand, dynamic provisioning of services
Authors	Zsolt Nemeth
Description	Deploying and decommissioning services in an on-demand, dynamic way is useful for establishing adaptability, self-healing, and other self-* properties. On-demand, dynamic service provisioning is a subset of general adaptation techniques and thus presents many similar research problems. This type of adaptation should be supported by past experience (learning), be able to take into consideration a complex set of conditions and their correlations, act proactively to avoid problems before they can occur and have a long lasting, stabilizing effect. The decision-making mechanism of such on-demand service provisioning should be investigated, which involves problem identification, analysis of symptoms, policies for various deployment scenarios, and a knowledge base for provisioning strategies. The realization of on-demand service provisioning includes discovery and analysis of discovery, which should also be investigated. Other specific research issues include on-demand service image creation, distribution and replication for recovery or preemption purposes, and offering various deployment features.
IRF elements	*Conceptual research framework*: SI; SAM *Reference life-cycle*: Deployment and provisioning; Operation & management *Logical run-time architecture*: Service container; Discovery and registry infrastructure; Adaptation engine *Logical design environment*: deployment techniques
Related challenges	Multi-level and self-adaptation
References	
Glossary	on-demand service deployment, automatic service deployment, service deployment
Keywords	deployment, dynamic provisioning

Name	Process mining for service discovery
Synopsis	Enable the discovery of human-provided activities in addition to traditional services and business process
Authors	Fabrizio Silvestri
Description	A modern discovery facility should support the discovery of human-based processes in addition to traditional services and business processes. In other words, we want to leverage the knowledge coming from how services (including human-provided services) are invoked and composed. There is a whole body of work in the literature showing how human activities can be traced down and analyzed in a very effective way. In our case, data may come from different sources. The most obvious one is data coming from the monitoring activity, which contains traces from

	the activities of processes, tasks, etc. The log of those activities can be used, for instance, to derive a new business model, or to detect failures and unexpected behaviour. In particular, we intend to study a new problem, which is related to process mining. We called it mashup discovery and it consists of discovering implicit human user activities in logs of events. One particular case study will be the case of Web search engines' query logs but the techniques developed will be also applicable to other fields, such as touristic activities.
IRF elements	*Conceptual research framework*: SI *Reference life-cycle*: Deployment and provisioning; Operation & management *Logical run-time architecture*: Discovery and registry infrastructure *Logical design environment*: modelling techniques
Related challenges	
References	
Glossary	service discovery, process mining
Keywords	process mining, mashup discovery

2.2. Research Questions

2.2.1. Questions from JRA-1.1

Name	Define in the life cycle phases to enable adaptation and evolution of SBA
Synopsis	There is the need to have a life cycle able to compose dynamically services and adapt and evolve the applications.
Authors	E. Di Nitto, V. Mazza
Type	Methodology
Description	Adaptable SBAs are characterized by the ability to monitor the state of the applications during execution, and, if some critical condition is detected, by the possibility to adapt themselves by means of recovery actions; the adaptation could be an automatic task requiring no external intervention (self-adaptation), or could be human guided (human in the loop adaptation). The development of an adaptable service based application requires a life cycle containing phases in which all requirements of the application are gathered, moreover requirements for adaptation must be collected and identified. Requirements for adaptation define the critical conditions and events requiring the triggering of recovery actions. Obviously, to identify a critical conditions and to evaluate the status of the execution of a SBA, a monitoring mechanism is needed to observe the properties of the applications. Adaptation for a service based application could require the substitution of an unsuitable service of a composition with a better one; consequently the development of adaptable and evolvable SBA have to contemplate a service discovery phase in the life cycle: either at runtime or at design time is needed to have the possibility to discover a suitable service among all the possible ones. At design time we cannot identify all the critical conditions or all the recovery actions for a given application, moreover if all the recovery actions are cabled in the application logic the infrastructure is not aware about the adaptation. Differently, the application could enter at runtime in a status not

	foreseen at design time; in this case the infrastructure has to react to the critical event and adapt the application choosing a suitable recovery action, deciding on the basis of the available knowledge.
Challenges	Definition of a coherent life cycle for adaptable and evolvable SBA
IRF elements	Lifecycle: • Early Requirements Engineering, • Requirements Engineering and Design, • Identify Adaptation Needs Framework: • SED • SAM
Related questions	-
References	http://bibadmin.s-cube-network.eu/show.php?id=266
Glossary	Life cycle model, service life cycle model
Keywords	Life cycle model, adaptation, evolution

Name	Associate adaptation strategies to the adaptation triggers.
Synopsis	Design for adaptation phase should provide a mean to associate properly adaptation strategies to the adaptation triggers
Authors	V. Mazza.
Type	Methodology
Description	Adaptable service-based applications are able to identify adaptation requirements; they should also be able to decide if and when to take them into consideration. At design time the possible adaptation strategies should have been programmed and the adaptation triggers defined. Adaptation triggers should be associated to the adaptation strategies when needed (before or during execution). Moreover there could be application states in which some adaptation requirements could not been used as they would lead the application into an inconsistent and unrecoverable case. Also, some requirements could be conflicting with each other and could require some reconciliation to take place before one of them is selected.
Challenges	Definition of a coherent life cycle for adaptable and evolvable SBA. Understand when an adaptation requirement should be selected
IRF elements	SED
Related questions	Define in the life cycle phases to enable adaptation and evolution of SBA
References	http://bibadmin.s-cube-network.eu/show.php?id=266
Glossary	-
Keywords	Adaptation strategies, adaptation mechanism

Name	How can we improve Business Process Management in Service Network?
Synopsis	We would like to have a mean for identifying some network patterns for exploiting intangible information provided by the entities participating to the network.

Authors	C. Nikolaou, D. Dubois
Type	Methodology
Description	The research in Business Process Management (BPM) has traditionally focused on the study of the interactions among companies in the process of offering a product of a service. Research in BPM is moving on analyzing all the characteristics on every single interaction to provide an estimation of the value created by the entire service network. To achieve this goal many methodologies have been developed for defining these interactions in a formal way (e.g., Business Process Languages and Service Level Agreements), for example by identifying the nature of the product/service, the contracts for stating its minimal quality characteristics, and information on how to use the service/product in other transformation steps. It would be useful identify some patterns in existing service networks and exploit them to reorganize the network by adding the capability to rapidly react to dynamic environment conditions and to changes in business requirements.
Challenges	Definition of a coherent life cycle for adaptable and evolvable SBA
IRF elements	SED; BPM
Related questions	-
References	Dubois D, "An Approach for Improving Business Process Management in Agile Service Networks" Minor Research Report
Glossary	BPM
Keywords	Business Process Management.

Name	How context information could be exploited during the lifecycle.
Synopsis	Context information could be exploited during the execution of an adaptable service based application.
Authors	V. Mazza, E. Di Nitto
Type	Methodology
Description	The lifecycle proposed in S-Cube for the development of adaptable service based applications, takes explicitly adaptation into account. It would be interesting analyze how the context information could be exploited in each phase of the lifecycle and how such information could be used during adaptation.
Challenges	Definition of a coherent life cycle for adaptable and evolvable SBA. Understand when an adaptation requirement should be selected. HCI and context aspects in the development of service based applications
IRF elements	SED; SAM
Related questions	-
References	-
Glossary	Context
Keywords	Context, life cycle model

Name	Identifying relevant HCI knowledge to inform SBA engineering
Synopsis	HCI being a broad domain, it is necessary to identify those areas

	of it that are relevant to, and have the potential to yield improvements for, SBA engineering
Authors	Neil Maiden, Angela Kounkou, Kos Zachos
Type	Method
Description	-
Challenges	- Measuring, controlling, evaluating and improving the life cycle and the related processes - HCI and context aspects in the development of service based applications - Context- and HCI-aware SBA monitoring and adaptation
IRF elements	**Framework:** • SED • SAM **Logical architectural model:** • Human service interface
Related questions	- identifying human stakeholders in SBA engineering - exploiting user model knowledge in SBA engineering - exploiting task model knowledge in SBA engineering - exploiting user error knowledge to inform SBA engineering
References	PO-JRA-1.1.3 Codified Human-Computer Interaction (HCI) Knowledge and Context Factors
Glossary	HCI
Keywords	Service based application, HCI, Service Based Application,

Name	Identifying human stakeholders in SBA engineering
Synopsis	Overviews of the various human actors involved in SBA engineering seem scarce in the literature. These stakeholders' roles and point of involvement in the SBA lifecycle are investigated here.
Authors	Angela Kounkou, Neil Maiden, Kos Zachos
Type	Method
Description	-
Challenges	HCI and context aspects in the development of service based applications
IRF elements	–
Related questions	Identifying relevant HCI knowledge to inform SBA engineering
References	CD JRA 1.1.5. Analysis on how to exploit codified HCI and codified context knowledge for SBA engineering (upcoming)
Glossary	HCI, Service based application
Keywords	HCI, Service based application

Name	Exploiting user model knowledge in SBA engineering
Synopsis	SBA engineering does not currently take into account end users' properties such as abilities, needs and preferences. User models, used in HCI to encapsulate this type of information, are investigated for use in SBA engineering.
Authors	Neil Maiden, Angela Kounkou, Kos Zachos
Type	Method
Description	-

Challenges	- HCI and context aspects in the development of service based applications - Measuring, controlling, evaluating and improving the life cycle and the related processes
IRF elements	**Life cycle:** • Early Requirements Engineering • Requirements Engineering and Design • Construction • Deployment and Provisioning • • Identify Adaptation Need **Framework:** • SED • SAM
Related questions	Identifying relevant HCI knowledge to inform SBA engineering
References	PO-JRA-1.1.3 Codified Human-Computer Interaction (HCI) Knowledge and Context Factors
Glossary	HCI, Service based application, User model
Keywords	HCI, Service based application, User model

Name	Exploiting task model knowledge in SBA engineering
Synopsis	Most existing business process and work flow modelling techniques model coarse-grain processes, and offer little support for finer-grain user tasks of different types and interactions with SBAs. Task models are used in HCI to represent knowledge about user tasks; thus they are investigated for use in SBA engineering.
Authors	Kos Zachos, Neil Maiden, Angela Kounkou
Type	Method
Description	-
Challenges	- HCI and context aspects in the development of service based applications - Measuring, controlling, evaluating and improving the life cycle and the related processes
IRF elements	**Life cycle:** • Early Requirements Engineering • Requirements Engineering and Design • Construction • Deployment and Provisioning • • Identify Adaptation Need **Framework:** • SED • SAM
Related questions	Identifying relevant HCI knowledge to inform SBA engineering
References	PO-JRA-1.1.3 Codified Human-Computer Interaction (HCI) Knowledge and Context Factors
Glossary	HCI, Service based application, Task model
Keywords	HCI, Service based application, Task model

Name	Exploiting user error knowledge to inform SBA engineering
Synopsis	HCI knowledge about user error can enhance SBA's recovery and error handling mechanisms
Authors	Angela Kounkou, Kos Zachos, Neil Maiden
Type	Method
Description	-
Challenges	- HCI and context aspects in the development of service based applications - Measuring, controlling, evaluating and improving the life cycle and the related processes
IRF elements	**Life cycle:** • Early Requirements Engineering • Requirements Engineering and Design • Construction • Deployment and Provisioning **Framework:** • SED • SAM
Related questions	Identifying relevant HCI knowledge to inform SBA engineering
References	PO-JRA-1.1.3 Codified Human-Computer Interaction (HCI) Knowledge and Context Factors CD JRA 1.1.5. Analysis on how to exploit codified HCI and codified context knowledge for SBA engineering (upcoming)
Glossary	HCI, Service based application, User error
Keywords	HCI, Service based application, User error

Name	Design for adaptation
Synopsis	Understand how to design SBA applications to make the adaptation easier and more structured
Authors	Antonio Bucchiarone, Raman Kazhamiakin, Marco Pistore
Type	Methodology
Description	Design for adaptation aims at extending the SBA engineering process in order to support adaptation of the SBA. This amounts to the engineering requirements for adaptation, the creation of principles, methodologies and architectures specifically supporting the monitoring and adaptability of the SBA, and the construction of adaptation-specific elements of the SBA.
Challenges	Definition of a coherent life cycle for adaptable and evolvable SBA Understand when an adaptation requirement should be selected
IRF elements	SED; Design Capabilities; A&M Capabilities
Related questions	Design for Monitoring Built-in adaptation
References	http://bibadmin.s-cube-network.eu/show.php?id=266 http://bibadmin.s-cube-network.eu/show.php?id=97
Glossary	-
Keywords	-

Name	Built-in adaptation
Synopsis	Understand how to anticipate at modeling time the deviations in the SBA behavior that are expected at run time, as well as the reactions to these deviations.
Authors	Raman Kazhamiakin, Marco Pistore
Type	Methodology, language
Description	The idea of built-in adaptation is to specify at design time expected deviations and the reactions to these deviations. The engineer is provided with the necessary design tools to represent adaptation strategies for the service composition behavior, depending on the occurrence of specific events. At deployment time, the underlying framework transforms these adaptation specifications in executable code that already includes the necessary facilities for detecting problems and reacting to them.
Challenges	Definition of a coherent life cycle for adaptable and evolvable SBA
IRF elements	SED; Modelling techniques; Transformation and Generation techniques
Related questions	Design for Adaptation
References	http://bibadmin.s-cube-network.eu/show.php?id=266
Glossary	-
Keywords	-

Name	Design for monitoring
Synopsis	Understand how to design SBA applications to enable and support monitoring
Authors	Raman Kazhamiakin, Marco Pistore
Type	Methodology
Description	Design for monitoring aims to provide novel principles and the realizing architecture that will support the service composition monitoring framework. This framework requires **new design principles and new monitoring architectures**, in particular for targeting advanced challenges such as **cross-layer monitoring** and **distributed monitoring**.
Challenges	Definition of a coherent life cycle for adaptable and evolvable SBA
IRF elements	SED; Design Capabilities; A&M Capabilities
Related questions	Design for Adaptation Cross-layer integrated monitoring mechanisms
References	http://bibadmin.s-cube-network.eu/show.php?id=26
Glossary	-
Keywords	-

Name	How can we measure, control, evaluate and improve the adaptation cycle?
Synopsis	To develop the S-Cube life-cycle, we have to understand how it

	can be used in practice. This understanding will come from both software engineering and service development processes, and will consist of developing lower levels of understanding within the current model. To do this, our focus will be on the adaptation cycle within the S-Cube life-cycle.
Authors	Ita Richardson and Stephen Lane
Type	Method
Description	The development of the S-Cube life-cycle requires that we understand what has to happen within the high-level processes which have been identified. While the life-cycle partially reflects what we understand as software engineering processes, the adaptation cycle is not something that has previously been considered when software engineering processes have been developed. This makes the adaptation cycle particulary interesting from a research perspective. Therfore, our research will focus on this cycle with a view to taking relevant elements from the Maintenance process and combining them with adaptation. We expect that the results from this research will be transferable to other phases within the S-Cube life-cycle.
Challenges	-
IRF elements	-
Related questions	-
References	-
Glossary	-
Keywords	-

Name	Service Protocol Engineering for Service Networks
Synopsis	Services communicate by messaging, but describing the coordination of messaging between services and their expected behaviour in the conditions experiences in service networks is difficult when using traditional approaches.
Authors	Michael Parkin (Tilburg)
Type	Methodology, Technique.
Description	**Motivation:** Current approaches to protocol specification (descriptions of allowed messages and the order in which they may be sent) find it difficult to provide a complete and unambiguous, verifiable protocol specification under conditions experienced in services network: asynchronous, concurrent messaging between services, each deployed across multiple physical servers and data stores for scalability and redundancy (e.g., in "a cloud"). The research question presented by the lack of expressivity in current specification languages is how we develop a method and techniques to produce a representation of a protocol that is complete, clear and verifiable and which leaves no ambiguity in what messages mean (in terms of their intended effects) and how the participants should behave, including under conditions where there is no guarantee on when or if messages will be delivered.
Challenges	Exploiting the concept of service-based applications in the internet

	of things setting
IRF elements	**Framework:** - SED - Design Capabilities. **Logical Design Environment:** - Modelling Techniques. - Verification Techniques. **Infrastructure:** - N/A
Related questions	-
References	CD-JRA-1.1.2: Separate design knowledge models for software engineering and service based computing.
Glossary	Service protocol specification
Keywords	Agile Service Network, Business Protocol, Service Description

Name	Evolution of Services
Synopsis	Services evolve as updates and new technology is introduced. The management of service evolution to ensure they remain compatible with service clients requires consistent and unambiguous changes and the ability to determine their effect on the service system.
Authors	Michael Parkin (Tilburg)
Type	Technique, Methodology.
Description	**Motivation:** Part of the service lifecycle is to evolve services by introducing upgrades and fixes in new versions of the service. Therefore, being able to describe, manage and control the evolution of services is therefore an important goal for the Service-Oriented paradigm. Evolution leads to a continuous service redesign and improvement effort, however the fundamental ingredients required for a comprehensive service evolution approach require identification and formalisation.
Challenges	Measuring, controlling, evaluating and improving the life cycle and the related processes
IRF elements	**Framework:** - SED - Design Capabilities. **Life Cycle:** - Identify Adaptation Strategy. - Operation & Management. - Enact Adaptation. **Infrastructure:** - N/A
Related Questions	-
References	CD-JRA-1.1.2: Separate design knowledge models for software engineering and service based computing.
Glossary	Service Evolution, Service
Keywords	Evolution, Service Description, Change Cycle.

Name	Lifecycle of service compositions

Synopsis	Derive models for the fitness of a service during its lifecycle.
Authors	TUW
Type	Methodology
Description	When dealing with adaptation in SBA, on the one side, is the requirements engineering phase which is now more flexible because of the SBA dynamic features. On the other side, the application has to be designed and developed in such a way that it is able to recognize an adaptation need and to act accordingly. Indeed, not only the application-specific requirements have to be elicited and addressed in the resulting implementation, but also the requirements for future adaptation needs to be identified or provide means of prediction. Thus, the question is how to define a methodology to measure the current fitness of a service in the present environment and circumstances.
Challenges	Definition of a coherent life cycle for adaptable and evolvable SBA
IRF elements	-
Related questions	-
References	-
Glossary	-
Keywords	-

Name	Continuous requirements engineering of service-based applications
Synopsis	How can requirements engineering techniques help to improve service-based applications at runtime?
Authors	Andreas Gehlert
Type	Method
Description	The key difference of SBAs compared to traditional systems is the possibility to adapt it to new situations and/or requirements easily, e.g. by exchanging the services constituting the SBA. Since a system can usually not fulfil all its requirements at the same time, there is still room for improving it. Therefore, techniques and methods are needed to adapt the SBA in such a way that it fulfils its requirements better than before. For instance, if a new service becomes available the technique method should allow assessing whether the SBA will fulfil its requirements better when this service is used.
Challenges	Definition of a coherent life cycle for adaptable and evolvable SBA Understand when an adaptation requirement should be selected
IRF elements	SED; SAM
Related questions	-
References	-
Glossary	-
Keywords	Requirements engineering, self optimisation

Name	Integrating self-optimisation and proactive adaptation.
Synopsis	How can online-testing, adaptation and self-optimisation techniques be integrated?

Authors	Andreas Gehlert, Julia Hielscher, Dimka Karastoyanova, Olha Danylevich, Andreas Metzger
Type	Method
Description	The key difference of service-based applications wrt. to traditional software systems is its adaptability to new situations. Therefore, it is easy not only to correct such a system in case of (potential) failures but also to adapt it to changing requirements. Given the fact that there are techniques for online testing to discover service faults, for adaptation at runtime and for self-optimisation, the question arises how these techniques could be integrated in a meaningful way in order to profit from the benefits of all the before-mentioned individual approaches.
Challenges	Definition of a coherent life cycle for adaptable and evolvable SBA Understand when an adaptation requirement should be selected
IRF elements	SED; Early Requirements Engineering; Service Composition and Coordination; Operation & Management.
Related questions	Continuous requirements engineering of service-based applications Online Testing for Quality Prediction
References	-
Glossary	-
Keywords	Requirements Engineering, Online Testing, Adaptation, Self-Optimisation

Name	The identification of process-oriented SOA viewpoints.
Synopsis	The need of service-oriented viewpoints to address specific concerns related to the development of SBAs. These viewpoints should provide guidance on the process perspectives of service engineering
Authors	Qing Gu, Patricia Lago
Type	Process modeling
Description	Since services are often designed under open-world assumptions, distributed across organizational boundaries and executed remotely at their service providers' environment, the traditional software engineering methods and tools are no longer sufficient to deliver SBAs. Consequently, the engineering of SBAs pose additional concerns. From the field of software architecture, the concept of viewpoints is often used to frame concerns. The research question is how to identify a set of aspects, that are of specific relevance to service-based development process and to develop a set of viewpoints to illustrate (in an effective and systematic way) how the concerns relevant to these service aspects are addressed.
Challenges	Definition of a coherent life cycle for adaptable and evolvable SBA
IRF elements	Life cycle Framework: SED
Related questions	-

References	[1] Q. Gu and P. Lago, "On Service-Oriented Architectural Concerns and Viewpoints," in 8th Working IEEE/IFIP Conference on Software Architecture (WICSA) Cambridge, UK, 2009, 4 pages. [2] Q. Gu and P. Lago, "Exploring service-oriented system engineering challenges: a systematic literature review". Service Oriented Computing and Applications, 2009. 3(3): p. 171-188 [3] Q. Gu, P. Lago, and E.D. Nitto. Guiding the Service Engineering Process: the Importance of Service Aspects. in 2nd IFIP WG5.8 Workshop on Enterprise Interoperability (IWEI 2009). 2009. Valencia, Spain: Springer, 14 pages [4]http://wwwp.dnsalias.org/wiki/ WICSA_2009_BAVF:Architecture_Viewpoints_and_Frameworks
Glossary	Architectural knowledge; service aspect; process model
Keywords	Architecture concern, architecture viewpoint, service aspect

Name	The identification of automation viewpoints of SBA adaptation.
Synopsis	The need of service-oriented viewpoints to address specific concerns related to the service adaptation process, in particular, concerns related to human participation. These viewpoints should provide guidance on the service adaptation process.
Authors	Qing Gu, Patricia Lago
Type	Modeling
Description	During the service adaptation process, often a decision has to be made between automating an activity and letting a human actor to take over the control. The decisions on automating adaptation activities are often influenced by some domain specific factors, such as the technical skill of the human actor, the characteristics of services and infrastructures, the feasibility of defining adaptation rules, etc. Thereby, making good decisions is one of the concerns of SOA architects. From the field of software architecture, the concept of viewpoints is often used to frame concerns. The challenge is to identify a set of concerns related to service adaptation process and to develop a set of viewpoints to illustrate (in an effective and systematic way) how the concerns are addressed.
Challenges	Mixed initiative SBA adaptation
IRF elements	Framework: - SAM - SED -Life Cycle: - Requirements engineering and design - Deployment and provisioning - Operation & management - Identify adaptation need - Identify adaptation strategy Infrastructure: - Monitoring engine - Adaptation engine Logical design environment:

	- Modelling techniques
Related questions	-
References	[1] Q. Gu and P. Lago, "On Service-Oriented Architectural Concerns and Viewpoints," in 8th Working IEEE/IFIP Conference on Software Architecture (WICSA) Cambridge, UK, 2009, 4 pages. [2] Q. Gu and P. Lago, "Exploring service-oriented system engineering challenges: a systematic literature review". Service Oriented Computing and Applications, 2009. 3(3): p. 171-188 [3]http://wwwp.dnsalias.org/wiki/ WICSA_2009_BAVF:Architecture_Viewpoints_and_Frameworks
Glossary	Architectural knowledge; service aspect; adaptation, HCI
Keywords	Architecture concern, architecture viewpoint, service aspect, HCI, service adaptation

Name	Service composition driven by dynamic service selection.
Synopsis	The question addresses the problem of devising mechanisms to enable the dynamic replacement of parts of an SBA to better match the requirements of a composition during its execution by taking into account that both requirements and/or service attributes may change.
Authors	Claudia Di Napoli, Maurizio Giordano.
Type	Mechanism
Description	Is it possible to model global requirements for an SBA in terms of quality attributes of each component service that can be negotiated upon with the service providers? Is it possible to provide a mechanism to select single services according to the needs coming from the entire composition? Is it possible to devise mechanisms enabling the dynamic replacement of parts of an SBA that take into account changing requirements or changing service attributes to better match the requirements of a composition during its execution?
Challenges	Multi-level and self-adaptation
IRF elements	*Conceptual research framework*: SI; SCC; SAM; SQDNA *Reference life-cycle*: Identify adaptation strategy; Enact adaptation *Logical run-time architecture*: Adaptation engine; Negotiation engine *Logical design environment*: Modelling techniques
Related questions	-
References	-
Glossary	Adaptation mechanism, Quality of Service-Aware Service Composition, Self-*.
Keywords	Adaptation, Quality, Service composition.

Name	How to incorporate in the C-Cube lifecycle the techniques developed by all JRAs?

Synopsis	The S-Cube lifecycle aims at integrating all design and service management techniques defined by the various WPs in a coherent engineering framework.
Authors	Elisabetta Di Nitto, Valentina Mazza
Type	Methodology
Description	S-Cube lifecycle proposes a set of phases involving all the activities starting from the early requirement engineering till the deployment and operation of the service based applications (SBA). Beside the phases typical of the classical software systems, it tries to address the phases that are specific for the adaptable service based applications. It is composed by two circles (each of them characterized by a sequence of activities) managing evolution and adaptation of adaptable SBA. Thanks to this, since the whole development and operation process is covered, all the techniques and methodologies developed by all the research work-packages could find a place in at least one of the phases of the lifecycle. Different approaches are developed by each WP addressing different aspects of service engineering. Service Engineering, Adaptation and Monitoring and Quality assurance approaches are developed focusing on different layers (BPM, Service Composition and Service Infrastructure). Each approach could be analyzed in order to find a place in the proposed lifecycle and it would be interesting define how all the techniques could be integrated among them. Such question could be seen strictly related to the definition of the high level scenarios in JRA-1.2 and IA-3.2. Three distinct research pillars were identified and three different scenarios were defined (Context-aware adaptation and monitoring scenario, Assumption-based multi-layer monitoring and adaptation scenario and QoS-driven multi-layer adaptation scenario). All of the scenarios were analyzed highlighting the mapping of the various contributions on the S-Cube lifecycle.
Challenges	Definition of a coherent life cycle for adaptable and evolvable SBA
IRF elements	Reference lifecycle: all elements Reference framework • Service adaptation and monitoring • Service engineering and design • Service composition and coordination
Related questions	Define in the life cycle phases to enable adaptation and evolution of SBA Associate adaptation strategies to the adaptation triggers How context information could be exploited during the lifecycle Design for adaptation Design for monitoring How can we measure, control, evaluate and improve the adaptation cycle? Evolution of Services Lifecycle of service compositions

	Continuous requirements engineering of service-based applications Integrating self-optimisation and proactive adaptation The identification of process-oriented SOA viewpoints Service composition driven by dynamic service selection
References	Deliverable "CD-IA-3.2.4, Results of the Second Validation" to be due at M36
Glossary	S-Cube lifecycle
Keywords	S-Cube lifecycle, Service Based Applications

Name	Can SBAs development be framed into the broader service design area?
Synopsis	Over the past decades, service design has emerged as an important discipline in the design field. One question now is whether SBA development fits within the general frame of reference of service design – and if so, how it relates to this field.
Authors	Angela Kounkou, Neil Maiden
Type	Methodology
Description	Following the rise in the service economy, the past few decades have seen a rise in service design as an important discipline in its own right within the design field. Unlike services in the SOA sense of the term, the definition of services in the broader sense is still the subject of an open debate. Increasingly however, both manners of services are thought to be correlated, with SOA often enabling the provision of business services, and software services being incorporated as elements of business service that have to integrate into an overarching service design. The relation between both service areas will be explored in terms of their general concepts, design activities and core stakeholders. The mapping of concepts from both domains and their similarities (e.g. SOA roles of developer, composer, assembler, provider, consumer vs SD product designer, service designer, provider, consumer, service staff) as well as differences (e.g. SOA specific management, adaptation and decommissioning vs SD's more direct human factors impact and consumption model) will be researched, with their respective tools and processes likely more challenging to contrast as service design does not yet offer stable/standard processes to develop, monitor and evolve services (indeed much of the design used to be conducted on an ad-hoc basis and/or in a fragmented manner by people not specialised in the matter rather than as a cohesive process).
Challenges	comparing and correlating both type of services' lifecycles in the absence of an agreed established service design process
IRF elements	Reference Life cycle: Early requirements engineering; Requirements Engineering and Design; Deployment and Provisioning; Operation and Management; Identify Adaptation Strategy; Identify Adaptation Need (i.e. all except "construction" and "enact adaptation") Conceptual research Framework: Service adaptation and monitoring; Service engineering and design; Service composition and coordination; Business process Management; Quality definition, negotiation and assurance Infrastructure: N/A
Related questions	Definition of a life cycle phases to enable adaptation and evolution of SBA Lifecycle of service compositions

	Design for adaptation How to measure, control, evaluate and improve the adaptation cycle Evolution of services KPI monitoring for SBA
References	CD-JRA-1.1.4 Coordinated design knowledge models for software engineering and service-based computing
Glossary	Service, service-based application, service life cycle model
Keywords	Life cycle model, service-based application

Name	How can we validate the adaptation processes of the S-Cube lifecycle?
Synopsis	The adaptation related processes of S-Cube life-cycle have been developed with input from relevant literature and industrial inquiries. It is now necessary to validate these processes so that they can be applied generally in the field.
Authors	Stephen Lane, Ita Richardson, Patricia Lago, Qin Gu
Type	Method
Description	
Challenges	Definition of a coherent life cycle for adaptable and evolvable SBA
IRF elements	Service Engineering and Design Service Adaptation and Monitoring
Related questions	Define in the life cycle phases to enable adaptation and evolution of SBA Associate adaptation strategies to the adaptation triggers How context information could be exploited during the lifecycle Design for adaptation How can we measure, control, evaluate and improve the adaptation cycle? Integrating self-optimisation and proactive adaptation Service composition driven by dynamic service selection
References	S. Lane, Q. Gu, P. Lago, I. Richardson, Adaptation of Service-Based Applications: A Maintenance Process?, Tech. Rep. Lero-TR-2010-08, Lero, the Irish Software Engineering Research Centre, University of Limerick, 2010
Glossary	
Keywords	Adaptation, Software process

Name	How to categorize and characterize SOA migration strategies?
Synopsis	Given many differences among SOA migration approaches it is hard to achieve a general understanding of 'How to perform SOA migration' and consequently it is hard to determine the SOA migration strategy. To define a migration strategy, various aspects such as what activities are needed for such migration, what are the available knowledge assets, and what should drive the whole migration, needs to be considered. Accordingly, to select a migration approach, to be used in the strategy, it is essential to know how those aspects are addressed in that specific approach. A reference that categorizes and characterizes different approaches using the mentioned aspects facilitates systematically determining the migration path to take.
Authors	Patricia Lago, Maryam Razavian
Type	Methodology
Description	To obtain SOA Migration categorization, a systematic review that

	extracts migration categories existing in the field will be conducted. The strength of systematic reviews in minimizing the bias in the review process will enhance the extraction of sound and meaningful categorization of the migration approaches. Such categorization will bring order on the existing SOA migration approaches and provides insight on 'how to perform SOA migration'.
Challenges	Identify best practices for SOA migration
IRF elements	Reference lifecycle: all elements
Related questions	What types of activities are covered? What types of knowledge drives SOA migration? How is the overall migration process organized?
References	
Glossary	S-Cube lifecycle, Migration
Keywords	Software evolution, migration of legacy systems

Name	How do practitioners carry out SOA migration from legacy systems?
Synopsis	Industry, nowadays, has a large number of software products that need to be modernized and made available as added-value services. These services draw on the functionality of pre-existing systems. Some of these may be legacy systems while others may still be technically-healthy and value-adding enterprise applications. To support the modernization, enterprises spend a significant amount of time and effort on devising migration strategies. Furthermore, the migration strategies employed in industrial practice are significantly different from the academic ones. Such differences root in the discrepancies in their requirements and goals as well as their perspective on 'what SOA migration entails'. Therefore, the identification of best practices and migration strategies for service engineering is of critical importance.
Authors	Patricia Lago, Maryam Razavian
Type	Methodology
Description	In order to gain an understanding of 'how migration is perfomed in industrial practice' and further identify the best practices, we will conduct a emprecial qualitative study in a set of SOA solution provider companies. This emperical study will use semi-structured interview technique. To aid decision-making concerning the SOA migration strategies, we will categorize the migration strategies in industry considering the following axes a) migration context (organization type, available resources, business domain properties and constraints), b) the migration process and c) the available best practices.
Challenges	Identify best practices for SOA migration
IRF elements	S-Cube lifecycle, Migration
Related questions	What are the SOA migration strategies used in industry? What are industrial best practices?
References	-
Glossary	S-Cube lifecycle, Migration
Keywords	Software evolution, migration of legacy systems

Name	What Context information is relevant to model Organizational Social

	Structures?
Synopsis	Enterprises are organizational social structures. The information to describe OSSs in terms of context models for enterprises can be first obtained via Systematic Literature Reviews of Social Structures with the goal of describing them in terms of their types and attributes.
Authors	Patricia Lago, Damian A. Tamburri
Type	Methodology
Description	Enterprises are complex organizations, their existence being heavily influenced by technical and social issues alike. Agile Service Networks are a promising mechanism to tackle the increasing complexity and scale of such organizations. To be successful, ASNs should be based on a sound scientific basis and engineered around industrial needs. To model an industrial setting as an ASN, contextual information is needed. Since an organization can be seen as an social context as well as a social organization, a survey of the literature concerning such social structures has the potential to provide the needed contextual data. An SLR (Systematic Literature Review) is a sound way to carry out such an investigation.
Challenges	- Envisioning Industrial contexts as social and technological contexts - Understanding Contextual Relations and hierarchical typing of Organizational Social Structures
IRF elements	Reference lifecycle: all elements
Related questions	- Are there standard attributes and types in organizational social structures that apply to industrial organizations? - Can a typing hierarchy be defined for organizational social structure? - Can Context information be used to deploy context-aware Agile Service Networks?
References	S-Cube Deliverables: CD-JRA-2.1.3, PO-JRA-2.1.1, CD-JRA-2.1.2
Glossary	Globalization
Keywords	Industrial Context, Industrial Social Network

2.2.2. Questions from JRA-1.2

Name	Cross-layer integrated monitoring mechanisms
Synopsis	In order to enable the analysis the effects and dependencies across different SBA layers, it is necessary to propagate and correlate different monitoring events across layers.
Authors	Raman Kazhamiakin (FBK) Marco Pistore (FBK)
Type	technique, mechanism
Description	Different SBA layers generate and are bound to different types of activities and events. These events, however, are often not isolated but depend on or reflect the situations at other layers. To be able to properly analyze the failures or changes in a holistic way, as well as to properly react to those changes, it is critical to be able to propagate and correlate events at different layers to

	have a complete picture.
Challenges	Comprehensive and integrated adaptation and monitoring principles, techniques, and methodologies
IRF elements	Conceptual Research Framework: SAM; A&M Capabilities; Integrated A&M capabilities; Reference Life-Cycle: Identify adaptation needs; Logical run-time environment: Monitoring Engine;
Related questions	• Means to identify adaptation needs across layers • Cross-layer integrated and coordinated SBA adaptation mechanisms • Means to identify adaptation strategies across layers • Process Monitoring in Service Choreographies • Monitoring of Process Performance Metrics in Service Compositions • Business Process Management Monitoring and Adaptation: Managing key performance indicators (KPIs) within Agile Service Networks (ASN) • Non-intrusive QoS monitoring of services and service compositions
References	http://bibadmin.s-cube-network.eu/show.php?id=250 http://bibadmin.s-cube-network.eu/show.php?id=26 http://bibadmin.s-cube-network.eu/show.php?id=269 http://bibadmin.s-cube-network.eu/show.php?id=270
Glossary	Monitored Event, Monitoring Mechanisms
Keywords	-

Name	Cross-layer identification of adaptation needs
Synopsis	Understand how to locate the source of identified problems across functional layers
Authors	Raman Kazhamiakin, Marco Pistore
Type	technique
Description	In complex SBAs the violation of application requirements may be caused by variety of problems. Properly understanding the source of the problem, i.e., the specific element(s) at a particular functional layer is one of the key requirements to drive adaptation actions.
Challenges	Comprehensive and integrated adaptation and monitoring principles, techniques, and methodologies
IRF elements	SAM; A&M Capabilities; Identify Adaptation Need
Related questions	Cross-layer integrated monitoring mechanisms Means to identify adaptation strategies across layers
References	http://bibadmin.s-cube-network.eu/show.php?id=250 http://bibadmin.s-cube-network.eu/show.php?id=269 R. Kazhamiakin, B. Wetzstein, D. Karastoyanova, M. Pistore, and F. Leymann: “Adaptation of Service-Based Applications Based on Process Quality Factor Analysis”. In Proc. 2nd Intl. Workshop on Monitoring, Adaptation, and Beyond (MONA+), 2009.
Glossary	-

Keywords	-

Name	Means to identify and select adaptation strategies across layers
Synopsis	Understand how to identify, validate, evaluate, filter, and compose adaptation actions into a coherent adaptation strategy
Authors	Raman Kazhamiakin (FBK) Marco Pistore (FBK) Annapaola Marconi (FBK)
Type	Technique
Description	To address the problems of the adaptation compatibility and integrity, the mechanisms for the identification and selection of the adaptation strategies should be able to (i) validate the adaptation strategies against the whole model of the application; (ii) foresee whether the adaptation strategies are sufficient to achieve the corresponding requirements; (iii) to identify appropriate adaptation strategies when the previously selected strategies are insufficient or may in turn trigger some other adaptations; (iv) select, among a set of functionally equivalent strategies the best one in terms of performances (cost/time).
Challenges	Comprehensive and integrated adaptation and monitoring principles, techniques, and methodologies
IRF elements	**Framework:** SAM; A&M Capabilities **Lifecycle:** Identify Adaptation Need
Related questions	Means to identify adaptation needs across layers Cross-layer integrated monitoring mechanisms Cross-layer integrated and coordinated SBA adaptation mechanisms Adaptation of QoS-aware Service Compositions based on Influential Factor Analysis and Prediction How can cost-based derivation of data-aware QoS for a service composition be used to drive adaptation? QoS-Aware Optimization of Service Compositions with Transactional Properties
References	R. Kazhamiakin, B. Wetzstein, D. Karastoyanova, M. Pistore, and F. Leymann: “Adaptation of Service-Based Applications Based on Process Quality Factor Analysis”. In Proc. 2nd Intl. Workshop on Monitoring, Adaptation, and Beyond (MONA+), 2009.
Glossary	-
Keywords	-

Name	Predictive SBA monitoring techniques
Synopsis	Approaches that apply existing analysis and QA techniques (testing, monitoring, verification, and simulation) into the adaptation process as a mean to predict – and therefore prevent – future failures.
Authors	Andreas Metzger, Osama Sammodi (UniDue)
Type	Technique
Description	We will work on specific approaches that apply existing analysis and QA techniques (testing, monitoring, verification, and simulation) into the adaptation process as a mean to predict – and therefore prevent – future failures. Possible directions are to augment monitoring with online testing or to use run-time simulation/verification, and post-mortem analysis to learn “bad”

	and "good" scenarios, etc.
Challenges	Proactive Adaptation and Predictive Monitoring Quality Prediction Techniques to Support Proactive Adaptation Run-time Quality Assurance Techniques
IRF elements	-
Related questions	Online Testing for Quality Prediction Run-time Verification for Quality Prediction
References	http://bibadmin.s-cube-network.eu/show.php?id=7 http://bibadmin.s-cube-network.eu/show.php?id=129 http://bibadmin.s-cube-network.eu/show.php?id=131 http://bibadmin.s-cube-network.eu/show.php?id=11 http://bibadmin.s-cube-network.eu/show.php?id=23 http://bibadmin.s-cube-network.eu/show.php?id=75 http://bibadmin.s-cube-network.eu/show.php?id=123
Glossary	-
Keywords	-

Name	Context-driven adaptation based on requirements models and techniques
Synopsis	Exploiting requirements models and techniques to specify the assumptions about the context, thus driving the context-driven adaptation.
Authors	Andreas Gehlert, FBK, CITY
Type	Technique
Description	Service-based systems need to possess the ability to continuously adapt themselves in reaction to context changes such as evolving (user) requirements or the appearance of differentiated and new services. In addition, service-based systems need to possess the ability to predict problems, such as potential degradation scenarios, future erroneous behaviour, and exceptions/deviations from expected behaviour, and move toward resolving them, if required under the guidance and supervision of human actors, before they occur. In such a setting it is not only important to monitor the system itself but its context. One question is which elements of the context to monitor and how. To this end, we will investigate how models and techniques from requirements engineering (such as the explicit documentation and analysis of assumptions about the context) can be applied in the service domain.
Challenges	Context- and HCI-aware SBA monitoring and adaptation Run-time Quality Assurance Techniques HCI and context aspects in the development of service based applications
IRF elements	-
Related questions	-
References	http://bibadmin.s-cube-network.eu/show.php?id=7 http://bibadmin.s-cube-network.eu/show.php?id=129 http://bibadmin.s-cube-network.eu/show.php?id=131 http://bibadmin.s-cube-network.eu/show.php?id=11

Glossary	-
Keywords	-

Name	Monitoring and adaptation for autonomous SBA components
Synopsis	Monitoring and adaptation approaches that support the creation and sustainable usage of autonomous components covering the full lifecycle of a SBA
Authors	Gabor Kecskemeti (SZTAKI) Attila Kertesz (SZTAKI) Ivona Brandic (TUW)
Type	Methodology
Description	Autonomous behaviour of the different SBA components requires the identification of those adaptation strategies that could be applied on a single component of the SBA. This single component should autonomously fire these strategies based on the monitoring events describing the actual behaviour of the component. The identification of the strategies excludes those adaptation strategies that would affect the environment of the autonomous component.
Challenges	Comprehensive and integrated adaptation and monitoring principles, techniques, and methodologies Mixed initiative SBA adaptation
IRF elements	Conceptual Research Framework: A&M capabilities Reference Life-Cycle: identify adaptation strategy, enact adaptation Logical run-time environment: Service Infrastructure
Related questions	• Self-optimization and self-healing of a single service • On-demand, dynamic service provisioning
References	http://bibadmin.s-cube-network.eu/show.php?id=135
Glossary	Self-adaptation, autonomic resource virtualization, autonomic system
Keywords	-

Name	Context and HCI aware adaptation of SBA monitors
Synopsis	Research the significance of user context in monitoring an SBA and how the change in user context may affect the monitoring of SBA.
Authors	Andrea Zisman and Ricardo Contreras (City)
Type	Technique
Description	Context characterizes the state of a certain *entity* by the identification of all factors surrounding the entity, including stakeholders, other IT systems, rules and regulations as well as business objects, end-user settings and even physical environment. Context monitoring and HCI monitoring can facilitate the overall objective of SBAs monitoring to a great extent as monitoring of different types of properties (e.g. security, or reliability) of SBAs often depends on the surrounding situation of the SBA system or its user (e.g. in ATM

	systems security measures need to be tightened at the evening hours). However, most exisiting context monitoring approaches mainly focus on physical context (e.g. location, surrounding resources for computation, temperature) ignoring the user context. Nevertheless, the context of the user of an SBA (e.g. skill, role preferences of the user) may have significant impact on the monitoring of SBA. For example with the improvement of user skills user starts to use advanced features of an SBA and hence requires the monitoring of the advanced features of the SBA. The objective of this research question is to find a solution that supports the adaptation of the monitor (and the SBA) due to the change of the context of the users' of the SBA.
Challenges	HCI and context aspects in the development of service based applications
IRF elements	- SAM - Identify adaptation need - Monitoring engine
Related questions	–
References	- CD-JRA-1.2.2 Taxonomy of Adaptation Principles and Mechanisms - PO-JRA-1.2.3 Baseline of Adaptation and Monitoring PTMs across Functional SBA Layers
Glossary	-
Keywords	-

Name	Using models and aspect to design and adapt SBS
Synopsis	Use of the combination of model-driven design, aspect-oriented approaches, and variability modeling as the way to address the problem of dynamic self-adaptation of complex SBA systems.
Authors	INRIA
Type	Method
Description	High-variability of features in Dynamic Adaptive Systems (DAS) introduces an explosion of possible runtime system configurations (often called modes) and mode transitions. Designing these configurations and their transitions is tedious and error-prone, making the system feature evolution difficult. For self-adaptation of services, we want to adapt quickly because 1) the evolution of the context of the application (services) is dynamic and changes can appear in a short laps of time and 2) the evolution of SBA itself should be reflected on the fly. Uniform modeling with the automated adaptation support are required in these settings. This research question aims to study the use of Model-Driven Design and Aspect-Oriented Modeling (AOM) to tame the combinatorial explosion of DAS modes. Using AOM techniques, one could derive a wide range of modes by weaving aspects into an explicit model reflecting the runtime system and to use these generated modes to automatically adapt the system. Model representation can help to detect adaptation needs before they appear thus enabling proactive SBA adaptation.

Challenges	• Proactive adaptation and predictive monitoring; • Quality Prediction Techniques to Support Proactive Adaptation • Comprehensive and integrated adaptation and monitoring principles, techniques, and methodologies
IRF elements	Conceptual Research Framework: SAM; SQDNA; SCC; SI; Integrated A&M Capabilities; QA Capabilities Reference Life-Cycle: Requirements Engineering and Design; Identify Adaptation Need; Identify Adaptation Strategy Logical Run-Time Architecture: Monitoring Engine; Adaptation Engine; Run-Time QA Engine Logical Design Environment: Modelling Techniques
Related questions	• Cross-layer monitoring mechanisms • Predictive SBA monitoring techniques • Design for adaptation • Associate adaptation strategies to the adaptation triggers
References	• B. Morin, T. Ledoux, M. Ben Hassine, F. Chauvel, O. Barais, J.M. Jezequel. "Unifying Runtime Adaptation and Design Evolution". In CIT 2009
Glossary	Evolution, self-adaptation
Keywords	Model-driven design, aspect-oriented programming, models@runtime

Name	Process Mining to devise complex monitoring and adaptation mechanisms and tools
Synopsis	Use of process mining techniques to support the monitoring and adaptation of SBAs
Authors	CNR
Type	Mechanism
Description	Process Mining joins ideas of process modeling and analysis on the one hand and data mining and machine learning on the other. This approach provides means to extract from the previously collected data an additional knowledge not explicitly modeled before. In this way, it is possible to reveal the patterns and relations in the SBA behavior that are different from those expected by the SBA designer. These patterns and relations may characterize the deviations that are critical for the SBA functioning and adaptation, thus enabling prediction and smarter adaptation decisions in the application management.
Challenges	Proactive adaptation and predictive monitoring
IRF elements	Conceptual Research Framework: SAM; BPM; Integrated A&M Capabilities; Reference Life-Cycle: Identify adaptation need; Operation and Management; Identify Adaptation Strategy; Logical run-time environment: Adaptation Engine; Monitoring Engine;
Related questions	• Analysis of Influential Factors of KPIs and SLA Violations Based on Machine Learning techniques • Runtime Prediction of KPIs and SLA Violations Based on Machine Learning Techniques
References	CD-JRA-1.2.2 Taxonomy of Adaptation Principles and

	Mechanisms
Glossary	Process Mining; Predictive Monitoring; Machine Learning;
Keywords	-

Name	Service evolution
Synopsis	Approach to handle the evolution of services
Authors	Vasilios Andrikopoulos, Salima Benbernou, Mike Papazoglou
Type	Technique
Description	In an environment of constant change, driven by competition and innovation, a service can rarely remain stable - especially when it depends on other services to fulfill its functionality. However, uncontrolled changes can easily break the existing relationships between a service and its environment (its customers and providers). The need is to propose an approach that allows for the controlled evolution of a service by leveraging the loosely-coupled nature of the SOA paradigm
Challenges	Comprehensive and integrated adaptation and monitoring principles, techniques, and methodologies
IRF elements	requirements engineering and design
Related questions	-
References	The deliverable CD JRA 1.1.4, CD JRA 1.2.5
Glossary	-
Keywords	Contract, service versioning, evolution, compatibility

Name	Adaptation of monitors to handle SBA and context changes
Synopsis	Identify new techniques to (semi-) automatically adapt SBA monitors as a reaction to changes/adaptations in the application and user context.
Authors	Annapaola Marconi (FBK) Ricardo Contreras (CITY)
Type	Technique
Description	Monitoring is a key issue in SBA life-cycle that enables all forms of proactive and reactive adaptation at the different layers of the application. Monitoring techniques are based on a set of captors attached to different entities in the system and in the environment capturing the events that are relevant for the application, and on a set of monitoring formulae aggregating and correlating these events into complex system properties. The dynamicity and adaptability of SBA may affect the entities to which the captors are attached and thus invalidate/alter the system properties to be monitored. The objective of this research question is to investigate new techniques dealing with the (semi-) automatic adaptation of SBA monitors (e.g. monitor rules) as a reaction to changes/adaptation in the application and user interaction.
Challenges	Context- and HCI-aware SBA monitoring and adaptation Comprehensive and integrated adaptation and monitoring principles, techniques, and methodologies

IRF elements	**Framework**: SAM, Integrated A&M Capabilities **Infrastructure**: Monitoring engine
Related questions	Context and HCI aware adaptation of SBA monitors Monitoring and adaptation for autonomous SBA components Means to identify adaptation strategies across layers
References	R. Contreras, A. Zisman, "A Pattern-based Approach for Monitor Adaptation", SwSTE10 IEEE International Conference on Software – Science, Technology & Engineering, Herzlia, Israel, June 15-16, 2010. R. Contreras, A. Zisman, "Identifying, Modifying, Creating, and Removing Monitor Rules for Service Oriented Computing", Third International Workshop on Principles of Engineering Service-Oriented Systems (PESOS), 2011. CD-JRA-1.2.2 Taxonomy of Adaptation Principles and Mechanisms CD-JRA-1.2.5 Comprehensive, integrated adaptation and monitoring principles, techniques and methodologies across functional SBA layers considering context and HCI
Glossary	Monitoring Mechanisms; Self-adaptation; Autonomic system, Context
Keywords	SBA Monitoring, self-adaptive monitors

2.2.3. Questions from JRA-1.3

Name	End-to-End Quality definition Language
Synopsis	Understand how to express quality requirements and constraints in SBA
Authors	Kyriakos Kritikos, Cinzia Cappiello, Pierluigi Plebani, Barbara Pernici (Polimi)
Type	Language
Description	Quality of service (QoS) can be a critical element for achieving the business goals of a service provider, for the acceptance of a service by the user, or for guaranteeing service characteristics in a composition of services, where a service is defined as software and software-support (i.e., infrastructural) services which are available on any type of network or electronic channel. A common model for expressing quality constraints and requirements is needed to make possible an agreement between providers and users
Challenges	End-to-End Quality Reference Model Rich and Extensible Quality Definition Language
IRF elements	
Related questions	
References	http://bibadmin.s-cube-network.eu/show.php?id=249
Glossary	-
Keywords	Quality model, Quality meta-model

Name	KPI monitoring for SBA
Synopsis	Understand how the lack of information due to the involvement of

	external services affects the KPI monitoring
Authors	Cinzia Cappiello, Kyriakos Kritikos, Pierluigi Plebani (Polimi), Branimir Wetzstein (USTUTT)
Type	Method
Description	Performance measurement of business processes is typically performed in terms of Key Performance Indicators (KPIs), which are key metrics for evaluating the processes in terms of time, cost, and quality dimensions. The evaluation of KPIs is based on measurement data obtained by monitoring process activities. The provision of needed measurement data is often costly, in particular for non-IT based process activities, or KPIs measurement is simply not possible, for example, if some parts of the process are performed as a service by an external organization. For these reasons, the KPI evaluation is hampered.
Challenges	End-to-End Quality Reference Model Run-time Quality Assurance Techniques Monitoring of Quality Characteristics of Service Orchestrations and Service Choreographies
IRF elements	Operation & Management; Monitoring Engine
Related questions	-
References	-
Glossary	Key Performance Indicator
Keywords	-

Name	Negotiation capabilities under the open-world assumption
Synopsis	How to ensure a proper selection of services able to satisfy non-functional constraints
Authors	M. Comuzzi (CITY), K. Kritikos, P. Plebani (POLIMI)
Type	Model
Description	Negotiation is required before invoking a service in order to identify how the invocation must occur in terms of functional and non-functional criteria. This process is possible when all the involved parties agree on the same negotiation protocol (e.g., bilateral negotiations). Considering a Service Oriented Architecture (SOA), this negotiation protocol cannot be predefined, but it must be selected by considering the negotiation capabilities of the involved services.
Challenges	Exploiting user and task models for automatic quality contract establishment
IRF elements	SED; SQDNA; Integrated quality DN&A capabilities; construction; Operation and Management; Negotiation Engine
Related questions	-
References	http://bibadmin.s-cube-network.eu/show.php?id=21
Glossary	Quality of Service Negotiation, Service Level Agreement Negotiation
Keywords	-

Name	Service composition run-time validation of non-functional requirements
Synopsis	How to ensure a proper selection of services able to satisfy non-functional constraints
Authors	Carlo Ghezzi, Luciano Baresi, and Sam Guinea (POLIMI)
Type	Methodology
Description	Specifying functional and non-functional properties only at the level of interfaces is required to support lifelong validation of dynamically evolvable compositions, which massively use late-binding mechanisms. Indeed, at design time a service refers to externally invoked services through their required interface. At run time, the service will resolve its bindings with external services that provide a matching interface, i.e., their provided QoS conforms to the one defined at design time.
Challenges	End-to-End Quality Reference Model Run-time Quality Assurance Techniques Monitoring of Quality Characteristics of Service Orchestrations and Service Choreographies
IRF elements	Operation & Management; Monitoring Engine
Related questions	-
References	Luciano Baresi, Elisabetta Di Nitto, Carlo Ghezzi, "Toward Open-World Software: Issue and Challenges," Computer, vol. 39, no. 10, pp. 36-43, Oct. 2006.
Glossary	Validation, Service Composition
Keywords	-

Name	Automated quality negotiation and agreement in diverse service infrastructures
Synopsis	Examine and provide a way for unified quality assurance for service execution in various environments like Clouds and SOAs
Authors	Attila Kertesz (SZTAKI)
Type	Methodology
Description	SLA usage is highly studied within the Service and the Grid communities, but the lack of standards for SLA negotiations and assurance are dominating in most research fields of S-Cube. This question looks for common protocols that are needed for SLA negotiation, agreement and cancellation, capable of handling different aspects ranging from Cloud infrastructures to human-provided services. The aim is to seek for unified solutions by integrating grid-related aspects of quality guarantees with other research fields of S-Cube.
Challenges	Run-time Quality Assurance Techniques Proactive SLA negotiation and agreement End-to-End Quality Reference Model
IRF elements	-
Related questions	-
References	http://bibadmin.s-cube-network.eu/show.php?id=135
Glossary	-
Keywords	-

Name	Runtime Prediction of KPIs and SLA Violations Based on Machine Learning Techniques
Synopsis	Understand how to use machine learning techniques for runtime prediction of KPIs and SLA Violations in SBAs.
Authors	Branimir Wetzstein (USTUTT), Philipp Leitner (TUW)
Type	Technique
Description	Quality prediction is an essential prerequisite for triggering the proactive adaptation of service-based applications. We will thus investigate how existing machine learning techniques can be used for analyzing event data at runtime for providing predictions for KPIs and SLA violations.
Challenges	Quality Prediction Techniques to Support Proactive Adaptation Analysis and Prediction of Quality Characteristics of Service Compositions Proactive Adaptation and Predictive Monitoring
IRF elements	-
Related questions	-
References	http://bibadmin.s-cube-network.eu/show.php?id=263
Glossary	-
Keywords	-

Name	Online Testing for Quality Prediction
Synopsis	Understand how to use online testing techniques to predict future failures of an SBA.
Authors	Andreas Metzger, Osama Sammodi (UniDue)
Type	Technique
Description	Quality prediction is an essential prerequisite for triggering the proactive adaptation of service-based applications. We will thus investigate in how far existing software and service testing techniques can be used as a means for quality prediction. This involves understanding synergies with monitoring.
Challenges	Quality Prediction Techniques to Support Proactive Adaptation Run-time Quality Assurance Techniques Proactive Adaptation and Predictive Monitoring
IRF elements	-
Related questions	-
References	http://bibadmin.s-cube-network.eu/show.php?id=7 http://bibadmin.s-cube-network.eu/show.php?id=129 http://bibadmin.s-cube-network.eu/show.php?id=131 http://bibadmin.s-cube-network.eu/show.php?id=11 http://bibadmin.s-cube-network.eu/show.php?id=23 http://bibadmin.s-cube-network.eu/show.php?id=75 http://bibadmin.s-cube-network.eu/show.php?id=123
Glossary	-
Keywords	-

Name	Run-time Verification for Quality Prediction
Synopsis	Understand how to exploit run-time verification to predict the deviation from requirements.
Authors	Andreas Metzger, Andreas Gehlert (UniDue)
Type	Technique
Description	Quality prediction is an essential prerequisite for triggering the proactive adaptation of service-based applications. One important research question thus is to understand in how far existing verification techniques can be used as a means for quality prediction. This involves understanding synergies with monitoring, as well as a concise specification of the requirements and context assumptions.
Challenges	Quality Prediction Techniques to Support Proactive Adaptation Run-time Quality Assurance Techniques Proactive Adaptation and Predictive Monitoring HCI and context aspects in the development of service based applications
IRF elements	-
Related questions	-
References	http://bibadmin.s-cube-network.eu/show.php?id=7 http://bibadmin.s-cube-network.eu/show.php?id=129 http://bibadmin.s-cube-network.eu/show.php?id=131 http://bibadmin.s-cube-network.eu/show.php?id=11
Glossary	-
Keywords	-

Name	Advantages of non-intrusive QoS monitoring of services and service compositions
Synopsis	Explore ways of system observations that influence regular operation the less and benefit from the result to estimate current available QoS
Authors	TUW
Type	Technique
Description	Quality prediction is an essential prerequisite for triggering the proactive adaptation of service-based applications. There are different ways to monitor the quality of a service. We will investigate non-intrusive approaches that estimate QoS from the client's as well as from the server's perspective. This involves the runtime validation of given SLA parameters and determine current compliances or violations.
Challenges	Quality Prediction Techniques to Support Proactive Adaptation Run-time Quality Assurance Techniques Proactive SLA negotiation and agreement
IRF elements	-
Related questions	-
References	-
Glossary	-
Keywords	-

Name	Lifecycle of service compositions
Synopsis	Research and predict the trend of service changes on the basis of bio-inspired models. Derive models for service evolutions.
Authors	TUW
Type	Methodology, Technique
Description	Researching the lifecycle of service compositions can include different methodologies. We aim at the creation of techniques for the analysis of service dependencies in complex service based systems with regard to the changes using biological principles. The resulting models of service changes and evolutions could be exploited to predict the expected deviations of the usual operation of the service-based applications.
Challenges	End-to-End Quality Reference Model
IRF elements	-
Related questions	-
References	-
Glossary	-
Keywords	-

Name	Online QA approaches
Synopsis	Understand how to exploit existing analysis and QA techniques at SBA run-time to capture and even predict possible failures and problems
Authors	Marco Pistore, Raman Kazhamiakin
Type	Technique
Description	To be able to ensure the expected functional and non-functional quality of the dynamic and highly adaptable SBAs online analysis and QA techniques are necessary. In this way, the problem that cannot be analyzed at design time will be detected and even predicted. This will include the use of the existing techniques, such as testing, verification and simulation at run-time.
Challenges	Run-time Quality Assurance Techniques Quality Prediction Techniques to Support Proactive Adaptation
IRF elements	SQDNA; Operation and Management; Run-time QA Engine
Related questions	Online QA approaches
References	http://bibadmin.s-cube-network.eu/show.php?id=23 Gehlert, A. Bucchiarone, R. Kazhamiakin, A. Metzger, M. Pistore, and K. Pohl: "Exploiting Assumption-Based Verification for the Adaptation of Service-Based Applications". In Proc. SOAP track at Symposium on Applied Computing (SOAP@SAC), 2010. To appear
Glossary	-
Keywords	-

Name	Adaptation quality framework
Synopsis	Quality requirements, quality assurance and analysis for the

	adaptation aspect of SBAs.
Authors	Raman Kazhamiakin, Marco Pistore
Type	Methodology, technique
Description	There is a need to understand the specific requirements and specific techniques that aim to ensure their correct and robust adaptation of SBAs. This should include taxonomy of requirements and problems concerning the robustness of the adaptation aspects of SBAs, specifying these problems both at the conceptual level and through concrete scenarios and examples; taxonomy of QA approaches and techniques that could potentially be applied to these adaptation aspects; novel techniques and extensions of existing QA techniques.
Challenges	End-to-End Quality Reference Model Run-time Quality Assurance Techniques
IRF elements	SQDNA; Requirements Engineering and Design; Verification Techniques
Related questions	Online QA approaches
References	http://bibadmin.s-cube-network.eu/show.php?id=28 http://bibadmin.s-cube-network.eu/show.php?id=269
Glossary	-
Keywords	-

Name	Automatic identification of relevant concepts to model QoS evolution
Synopsis	Approaches that try to validate adaptation need to generate QoS test data to stress the adaptation logic.
Authors	Sagar Sen – Benoit Baudry - Olivier Barais
Type	Method
Description	Composite services operate in an environment where each of its atomic services show constant change in quality of service (QoS). For example, the variation in response times of each atomic service results in a variation of response times of a composite service. We model the variability or the different scenarios in QoS of services using a QoS meta-model. However, we often observe that a composite service uses only a subset of the QoS metamodel to describe its QoS requirements rendering a large part of the QoS metamodel unnecessarily complex for a given objective. What is this subset of relevant concepts to model QoS variability ?
Challenges	End-to-End Quality Reference Model Run-Time Quality Assurance Techniques Quality Prediction Techniques to Support Proactive Adaptation
IRF elements	-
Related questions	-
References	Models 09 s-cube paper
Glossary	-
Keywords	Model based testing of SBS

Name	Generation of test scenario to stress QoS of SBS
Synopsis	Approach to generate QoS test data scenarios to stress test the adaptation logic.
Authors	Sagar Sen
Type	Method
Description	Manually enumerating all possible QoS scenarios conforming to a QoS metamodel is impossible due to constraints and a combinatorial number of possibilities. Therefore, enumerating different QoS scenarios to validate or test a composite service requires the application of a formal method with automatic instance generation capabilities. Transforming the entire QoS metamodel to a formal method for scenario generation is not scalable. What heuristics can be applied to reduce the search space of a formal method to a maximum extent such that we generate only relevant scenarios?
Challenges	End-to-End Quality Reference Model Run-Time Quality Assurance Techniques Quality Prediction Techniques to Support Proactive Adaptation
IRF elements	-
Related questions	-
References	-
Glossary	-
Keywords	Predictive monitoring, resource usage, cost, data-awareness

Name	Models@Runtime to check and optimize the adaptation plan
Synopsis	Find algorithms to optimize and guarantee an execution plan
Authors	Erwan Daubert and Françoise André and Olivier Barais
Type	Method
Description	Decision, planning and execution for adaptation take time in the context of complex systems. For self-adaptation of services, we want to adapt quickly because the evolution of the context of the application (services) is dynamic and changes can appear in a short laps of time. To avoid this problem, proactive adaptation is a solution. Model representation can help to detect adaptation needs before they appear.
Challenges	(JRA 1.2) Proactive adaptation / predictive monitoring (JRA 1.3) Quality Prediction Techniques to Support Proactive Adaptation
IRF elements	Conceptual Research Framework: SAM; SQDNA; SCC; SI; Integrated A&M Capabilities; QA Capabilities Reference Life-Cycle: Requirements Engineering and Design; Identify Adaptation Need; Identify Adaptation Strategy; Logical Run-Time Architecture: Monitoring Engine; Adaptation Engine; Run-Time QA Engine Logical Design Environment: Modelling Techniques
Related questions	-
References	-

Glossary	-
Keywords	-

Name	Proactive SLA negotiation and agreement
Synopsis	Research the necessity of proactive SLA negotiation to handle the violation of an agreed SLA in order to provide uninterrupted service without affecting the performance of the service.
Authors	George Spanoudakis and Khaled Mahbub (City)
Type	Technique
Description	SLA negotiation is the process where the service provider and the service consumer resolve disputes and reach an agreement on desired level of service and other individual or collective advantages/disadvantages that satisfies each partner involved in the negotiation process. In today's service oriented environment most services are composed hierarchically, i.e. a service provider needs to access one or more services to offer a specific service. In such settings several SLAs need to be agreed by the participating parties contributing to the final service delivered to the client. Inability of any of the participating party to meet the service level objective of the agreed SLA may affect the overall service, e.g. suspension of the service provisioning or premature termination of the agreement. Most research efforts focus to handle the violation of an agreed SLA either by provisioning penalties depending on the importance of the service level objectives or suggesting runtime renegotiation where either the service level objectives of the agreement are revised to accept service from the existing provider or a new SLA is provisioned with a new service provider terminating the existing SLA. All these approaches are reactive in nature that offers corrective actions only after a service level agreement has been violated. These either affect the quality of the delivered service or fail to guarantee uninterrupted service. The aim of this research question is to find a solution that supports proactive negotiation of service level agreement to handle runtime violation of service level agreements without interrupting services or affecting the quality of services.
Challenges	Proactive SLA negotiation and agreement
IRF elements	– SAM – SQDNA – Negotiation Engine – Discovery and Registry Infrastructure
Related questions	–
References	–
Glossary	-
Keywords	-

Name	Design, Specification & Verification of a Negotiation & Contract Agreement Protocol
Synopsis	Important and often ignored distributed computing limitations requires a new SLA negotiation and agreement protocol to be

	designed, specified and verified.
Authors	Michael Parkin (Tilburg)
Type	Technique.
Description	The vision of a distributed, service-oriented architecture (SOA) providing on-demand services lacks a protocol through which SLAs can be negotiated and agreed between a service provider and their potential customers in a fault-tolerant manner. Current protocols for agreeing SLAs do not take into account the inherent uncertainty in distributed computing environments (ref. Two Generals Paradox[1] and Brewer's conjecture[2]). As a result, the traditional, predictive interaction models, such as two-phase commit, and the transactional ACID properties no longer apply: stateful protocols like these couple services, block underlying resources and limit the availability and scalability of a service, all of which are undesirable when agreeing SLAs. In order to fulfil this vision, a shared specification (since services only share protocol specifications and nothing else in order to be interoperable[3]) is required of an abstract, implementation, technology and domain-independent protocol to negotiate and agree binding SLAs. Questions will be encountered in both the description and verification of the protocol to ensure it captures and can handle the concurrency, (partial) failure and race conditions inherent in distributed environments.
Challenges	Proactive SLA negotiation and agreement
IRF elements	**Framework:** - SQDNA **Life Cycle:** - Requirements Engineering & Design; Construction. **Infrastructure:** - N/A
Related questions	-
References	PO-JRA-1.3.1 Survey of quality related aspects relevant for SBAs CD-JRA-1.3.2 Quality Reference Model for SBA CD-JRA-1.3.3 Initial Concepts for Specifying End-to-End Quality Characteristics
Glossary	Service Level Agreement, Quality of Service Negotiation.
Keywords	Service Level Agreement (SLA), Negotiation.

Name	Optimisation of Business Processes
Synopsis	Configuring generic process with the 'best' services to meet user-specified multidimensional end-to-end QoS requirements from the many services that may be a functional match.

1 J. Gray: "Notes on Data Base Operating Systems". LNCS 60: Operating Systems, An Advanced Course, pp. 393-481, 1978.
2 S. Gilbert, N. Lynch: "Brewer's conjecture and the feasibility of consistent, available, partition-tolerant Web services". ACM SIGACT News 33(2), 2002.
3 P. Helland: "Data on the Inside, Data on the Outside: An Examination of the Impact of Service Oriented Architecture on Data". MSDN Library, 2006. http://msdn.microsoft.com/en-us/library/ms954587.aspx.

Authors	Michael Parkin.
Type	Technique.
Description	**Motivation:** Generic business processes – also referred to as process skeletons, frameworks, fragments or templates – encapsulate generic know-how about the structural and operational semantics of a particular business process. Their generality refers to their capacity to be changed, tailored or parametrized to user-specific quality of service requirements and constraints. An important question to address in the efficient 'on-demand' deployment of service based-applications is the ability of a service end-user (or client application) to take a generic business process and configure it according to desired quality of service (QoS) requirements. These QoS requirements may be manifold and be across different logical layers of the application, from business-related to system infrastructure; i.e., they are *multidimensional*. The research question here is determining what techniques can be used to find the optimal configuration of services differentiated by their qualities of service that satisfy the preferences and constraints of the users when configuring (or re-configuring) a service-based application.
Challenges	Quality prediction techniques to support proactive adaptation. Run-time quality assurance techniques.
IRF elements	**Framework:** - SQDNA **Life Cycle:** - Deployment & Provisioning; Operation & Management. **Infrastructure:** - N/A
Related Questions	-
References	CD-JRA-1.3.4: Initial set of principles, techniques and methodologies for assuring end-to-end quality and monitoring SLAs.
Glossary	Business Process, Business Process Pattern, Process Fragment, Process Model, Business Process Optimisation
Keywords	Service Selection, Differentiated Services, End-to-End QoS,

Name	Validation of service behaviour.
Synopsis	In order to assure consistent service actions (and ensure service interoperability) the validation of service behaviour confirms a service supports a protocol specification, i.e., that the service behaves according to interactions described in the specification.
Authors	Michael Parkin (Tilburg)
Type	Technique.
Description	The underlying, often unacknowledged, assumption in SOA is that services behave (i.e., take actions) according to messages sent between them. Message exchanges follow agreed protocols, or shared specifications of allowed messages and the order in which they may be sent. Validating and assuring correct service behaviour is critical to

	ensuring service interoperability, the cornerstone of 'on-demand' service provision. The validation of service behaviour is critical in order for a provider using a particular protocol can demonstrate the service supports that protocol. Service clients benefit from being assured the service will follow predictable, consistent patterns of behaviour. Current methods for achieving validation often require intimate knowledge of the service code-base (e.g., when using unit and functional testing approaches), making each validation process an individual solution. Such al methodology requires a protocol specification capable of being formally analysed and deriving the interaction (service behaviour validation) patterns from it. These patterns should be described abstractly so they can be bound at a later time to one of many network transports or technologies a service could support. It is anticipated that the methodology for validating service behaviour will be through the analysis of a shared, formal protocol specification to produce a set of abstract interaction patterns the service must support. In order to develop this methodology, techniques from black-box, clean-room and statistical testing[4] should be investigated and adapted for a service-oriented environment.
Challenges	Run-time quality assurance techniques.
IRF elements	**Framework:** - SQDNA **Life Cycle:** - Requirements Engineering & Design; Construction **Infrastructure:** - N/A
Related Questions	-
References	T-JRA-1.3.3: Assuring and Monitoring End-to-End Quality Provision and SLA Conformance.
Glossary	Service, Service Interaction Pattern, Service Specification, Service Analysis.
Keywords	Quality Assurance, Service Interoperability.

Name	SLA Negotiation for non functional QoS
Synopsis	Approach to handle the evolution of non Functional QoS e.g., privacy in an SLA. A game theory based negotiation protocol is provided.
Authors	Salima Benbernou, Hassina Meziane (ParisDescartes/UCBL)
Type	Technique
Description	In order to take into account the privacy concerns of the individuals in SBA, the organizations (e.g., Web services) provide privacy policies as promises describing how they will handle personal data of the individual. However, privacy policies do not convince potential individuals to disclose their personal data, do not guarantee the protection of personal information, and do not provide how to handle

4 S.J. Prowell, C.J. Trammell, R.C. Linger, J.H. Poore: "Cleanroom Software Engineering: Technology and Process". Addison-Wesley Professional, 1999.

	the dynamic environment of the policies.
Challenges	Exploiting user and task models for automatic quality contract establishment Rich and Extensible Quality Definition Language
IRF elements	**Conceptual research framework:** SQDNA
Related questions	Run-time Verification for Quality Prediction
References	The deliverable CD JRA 1.3.2
Glossary	-
Keywords	Agreement, SLA, privacy, negotiation

Name	Relaxing QoS in SBA and techniques
Synopsis	Relaxing QoS of requirements in SLA, thus driving web service selection while composing services.
Authors	Salima Benbernou, Manuel Carro, Mohand-Said Hacid, Mohamed Zemini
Type	Technique
Description	Guarantee terms correctness is no more verified in case of service unavailability or failure. But the customer, one part of the agreement, wants to see his business work at anytime with the attributes he has chosen and that makes the service useful. In case of failure, techniques are to be provided to exchange the faulty service for another with same properties using CSP concept. In that way, in some cases, it is not easy to fulfill this condition. In fact, two services can put forward some attributes with the same values but not all of them because most problems are over-constrained and would not be solvable if we insist that all their requirements are strictly met.
Challenges	Run-time Quality Assurance Techniques Rich and Extensible Quality Definition Language
IRF elements	SAM; SQDNA
Related questions	-
References	Ongoing deliverables CD JRA 2.2.4 and JRA 1.3.5
Glossary	-
Keywords	-

Name	How can cost-based derivation of data-aware QoS for a service composition be used to drive adaptation?
Synopsis	Several interesting classes of QoS attributes can be related with the problem of cost in terms of consumption of some logical resources, related to events that are accounted for during execution of a composition. Safe upper and lower bounds on composition costs can be deduced statically by taking into account features of input data. Such resource usage information can be useful to inform and/or trigger adaptation of a composition.
Authors	Manuel Carro, Dragan Ivanovic (UPM)
Type	method

Description	Deriving information on safe data-aware cost functions gives a possibility to drive adaptation with respect to both environmental constraints, and QoS constraints required by the user. The notion of QoS is related to the notion of generalized resource usage, i.e. cost.
Challenges	Proactive adaptation / predictive monitoring End-to-End Quality Reference Model Run-Time Quality Assurance Techniques Quality Prediction Techniques to Support Proactive Adaptation QoS Aware Adaptation of Service Compositions
IRF elements	Conceptual Research Framework: SAM; SQDNA; SCC; SI; Integrated A&M Capabilities; QA Capabilities Reference Life-Cycle: Requirements Engineering and Design; Identify Adaptation Need; Identify Adaptation Strategy Logical Run-Time Architecture: Monitoring Engine; Adaptation Engine; Run-Time QA Engine Logical Design Environment: Modelling Techniques
Related questions	-
References	-
Glossary	-
Keywords	Proactive adaptation, resource usage, cost, data-awareness

Name	How can cost-based derivation of data-aware QoS for a service composition be used for predictive monitoring?
Synopsis	Several interesting classes of QoS attributes can be related with the problem of cost in terms of consumption of some logical resources, related to events that are accounted for during execution of a composition. Safe upper and lower bounds on composition costs can be deduced statically by taking into account features of input data. Such resource usage information, in combination with measured or estimated environmental factors at the infrastructural level, can be used for predicting possible violations of QoS constraints (or absence thereof) ahead of time.
Authors	Manuel Carro, Dragan Ivanovic (UPM)
Type	Method
Description	Deriving information on safe data-aware cost functions gives a possibility for predictive monitoring with respect to both environmental constraints, and QoS constraints required by the user. The notion of QoS is related to the notion of generalized resource usage, i.e. cost.
Challenges	Proactive adaptation / predictive monitoring End-to-End Quality Reference Model Run-Time Quality Assurance Techniques Quality Prediction Techniques to Support Proactive Adaptation Monitoring of Quality Characteristics of Service Orchestrations and Service Choreographies
IRF elements	Conceptual Research Framework: SAM; SQDNA; SCC; SI; Integrated A&M Capabilities; QA Capabilities Reference Life-Cycle: Requirements Engineering and Design;

	Identify Adaptation Need; Identify Adaptation Strategy Logical Run-Time Architecture: Monitoring Engine; Adaptation Engine; Run-Time QA Engine Logical Design Environment: Modelling Techniques
Related questions	-
References	-
Glossary	-
Keywords	Predictive monitoring, resource usage, cost, data-awareness

Name	Quality estimation using service invocations.
Synopsis	End-to-End quality estimation using Link-Analysis techniques.
Authors	Fabrizio Silvestri, Franco Maria Nardini, Gabriele Tolomei
Type	Methodology, Technique.
Description	End-to-End quality estimation using Link-Analysis techniques. Service invocations can be represented as a graph where each node is a service and each directed edge is an invocation among two services. Each edge can also be weighted representing one or more "costs" of the invocation among two services. A service network can thus be represented as a directed weighed graph. Is it possible to exploit past services invokation patterns to effectively evaluate the quality of a service (and in general of service providers)?
Challenges	Quality Prediction Techniques to Support Proactive Adaptation
IRF elements	Conceptual research framework: SI; SCC; SAM; SQDNA
Related questions	-
References	-
Glossary	-
Keywords	Link-Analysis Techniques, Quality Estimation.

Name	How can end-to-end quality be assured through extension Software Development Quality Assurance Processes?
Synopsis	Modification of existing software engineering and software engineering management processes so that the required end-to-end quality can be implemented in the service.
Authors	Ita Richardson and Sajid Hashmi
Type	Method
Description	The major type of run-time quality assurance is monitoring. However, this needs to be enhanced through the use of software engineering quality assurance techniques. In our research, we are interested in how existing techniques, such as those specified in ISO15504, can be extended to support monitoring for the assurance of end-to-end quality. To do this, we will investigate extensions to software engineering processes such as validation and verification. Furthermore, this research will investigate at least one software engineering management process, e.g. configuration management, studying whether it can be modified to assure end-to-end quality. Our ultimate aim is to ensure end-to-end quality in the final service, and our research will demonstrate whether this can be done through extension of both software engineering and software engineering management

	processes.
Challenges	Run-time Quality Assurance Techniques
IRF elements	-
Related questions	-
References	-
Glossary	-
Keywords	-

Name	Predictable factors for Pro-active SLA negotiation
Synopsis	Investigate the range of predictable factors that can affect the utility of pro-active SLA negotiation.
Authors	CITY
Type	-
Description	Proactive SLA negotiation reduces the time required for runtime replacement of services but may also lead to a waste of system resources due to negotiation of SLA with service providers whose services might never be used. Hence, the process of selecting the services/providers for proactive SLA negotiation needs to be integrated with prediction capabilities for different factors that affect the chances of using pre-negotiated SLA (e.g. the potential for needing to replace the service for which a particular provider offers an alternative, the potential of ending up with a successfully pre-negotiated SLA with a particular provider etc). City will investigate the range of predictable factors that can affect the utility of pro-active SLA negotiation.
Challenges	Proactive SLA negotiation and agreement Quality prediction techniques to support proactive adaptation End-to-End Quality Reference Model
IRF elements	-
Related questions	Proactive SLA negotiation and agreement
References	T-JRA-1.3.2 (Specifying and Negotiating End-to-End Quality and SLAs)
Glossary	-
Keywords	SLA, proactive SLA negotiation, predictable factors

Name	Integration of prediction mechanisms with proactive SLA negotiation
Synopsis	Investigate ways of integrating related prediction mechanisms with the proactive SLA negotiation framework
Authors	CITY
Type	-
Description	Proactive SLA negotiation reduces the time required for runtime replacement of services but may also lead to a waste of system resources due to negotiation of SLA with service providers whose services might never be used. Hence, the process of selecting the services/providers for proactive SLA negotiation needs to be integrated with prediction capabilities for different factors that affect the chances of using pre-negotiated SLA (e.g. the potential for needing to replace the service for which a particular provider offers an alternative, the potential of ending up with a successfully

	pre-negotiated SLA with a particular provider etc). City will investigate the ways of integrating related prediction mechanisms with the proactive SLA negotiation framework that it has developed in S-Cube.
Challenges	Proactive SLA negotiation and agreement Quality prediction techniques to support proactive adaptation End-to-End Quality Reference Model
IRF elements	-
Related questions	Proactive SLA negotiation and agreement
References	T-JRA-1.3.2 (Specifying and Negotiating End-to-End Quality and SLAs)
Glossary	-
Keywords	SLA, proactive SLA negotiation, quality prediction

Name	Agent-based technology and chemical programming for proactive SLA negotiation
Synopsis	Using agent-based technology exploiting chemical programming methods to devise effective negotiation mechanism, to proactively fire negotiations before possible failures arise.
Authors	CNR
Type	-
Description	Proactiveness is deemed an important feature of service-based systems. Research mostly focuses on prediction of quality and related quality assurance techniques (see TJRA-1.3.3). However, negotiation (due to considerable time and resource requirements) can become an obstacle to achieving proactiveness. Thus, CNR will study the use of agent-based technology exploiting chemical programming methods to devise effective negotiation mechanisms. In particular, CNR wants to study the possibility of proactively fire negotiations before possible failures arise.
Challenges	End-to-End Quality Reference Model Proactive SLA negotiation and agreement Quality prediction techniques to support proactive adaptation
IRF elements	-
Related questions	Proactive SLA negotiation and agreement
References	T-JRA-1.3.2 (Specifying and Negotiating End-to-End Quality and SLAs)
Glossary	-
Keywords	Agent-based technology, chemical programming, proactive SLA negotiation

Name	Data mining techniques to support proactive adaptation
Synopsis	Exploiting data mining techniques to predict the need for proactive adaption
Authors	CNR
Type	-
Description	Observations of the current trends in service research and exchange with the S-Cube associate members have shown a very strong relevance and interest in work on run-time quality

	assurance for service-based systems, especially considering quality prediction to trigger pro-active adaptation. Thus, CNR will investigate into exploiting data mining techniques to predict the need for proactive adaption
Challenges	Proactive SLA negotiation and agreement Quality prediction techniques to support proactive adaptation Proactive Adaptation and Predictive Monitoring End-to-End Quality Reference Model
IRF elements	-
Related questions	-
References	T-JRA-1.3.3 (Assuring and Monitoring End-to- End Quality Provision and SLA Conformance)
Glossary	-
Keywords	Data mining, proactive adaptation

Name	Framework for automating SLA negotiation
Synopsis	Definition of a framework for automating the negotiation of service level agreements
Authors	Polimi
Type	-
Description	Proactiveness is deemed an important feature of service-based systems. Research mostly focuses on prediction of quality and related quality assurance techniques (see TJRA-1.3.3). However, negotiation (due to considerable time and resource requirements) can become an obstacle to achieving proactiveness. Thus, Polimi aims at defining a framework for automating the service level agreements negotiation.
Challenges	End-to-End Quality Reference Model Proactive SLA negotiation and agreement Exploiting user and task models for automatic quality contract establishment
IRF elements	-
Related questions	-
References	T-JRA-1.3.2 (Specifying and Negotiating End-to-End Quality and SLAs)
Glossary	-
Keywords	Automated SLA negotiation

Name	Support for Negotiation Models
Synopsis	Enhancing support for SLA negotiation models
Authors	SZTAKI
Type	
Description	Proactiveness is deemed an important feature of service-based systems. Research mostly focuses on prediction of quality and related quality assurance techniques (see TJRA-1.3.3). However, negotiation (due to considerable time and resource requirements) can become an obstacle to achieving proactiveness. Thus, SZTAKI will investigate into enhancing support for negotiation models of service level agreement
Challenges	Proactive SLA negotiation and agreement

	Exploiting user and task models for automatic quality contract establishment End-to-End Quality Reference Model
IRF elements	-
Related questions	Proactive SLA negotiation and agreement
References	T-JRA-1.3.2 (Specifying and Negotiating End-to-End Quality and SLAs)
Glossary	-
Keywords	SLA, negotiation models

Name	Process Mining for Quality Prediction
Synopsis	Quality predictions based on process mining techniques
Authors	SZTAKI
Type	-
Description	Observations of the current trends in service research and exchange with the S-Cube associate members have shown a very strong relevance and interest in work on run-time quality assurance for service-based systems, especially considering quality prediction to trigger pro-active adaptation. Thus, CNR will investigate into exploiting process mining techniques to predict quality of the business process.
Challenges	Quality prediction techniques to support proactive adaptation Proactive Adaptation and Predictive Monitoring End-to-End Quality Reference Model
IRF elements	-
Related questions	-
References	T-JRA-1.3.3 (Assuring and Monitoring End-to- End Quality Provision and SLA Conformance)
Glossary	-
Keywords	process mining, quality prediction

Name	The impact of data-related characteristics on the accuracy of QoS predictions
Synopsis	Investigate how data-related characteristics can impact the accuracy of predictions of QoS in realistic systems
Authors	UPM
Type	-
Description	Observations of the current trends in service research and exchange with the S-Cube associate members have shown a very strong relevance and interest in work on run-time quality assurance for service-based systems, especially considering quality prediction to trigger pro-active adaptation. Thus, UPM will continue working on studying how taking into account data-related characteristics can impact the accuracy of predictions of QoS in realistic systems. UPM's thesis (shared by other members of the consortium) is that in reality the concrete data plays an important role on the behavior of service-based systems and cannot be ignored when making predictions. In this line, UPM wants to compare their approach with that generated based on data-mining approaches and find out what is the best

	combination based on the type of services and services compositions involved in a computation.
Challenges	Quality prediction techniques to support proactive adaptation Proactive Adaptation and Predictive Monitoring End-to-End Quality Reference Model
IRF elements	-
Related questions	-
References	T-JRA-1.3.3 (Assuring and Monitoring End-to- End Quality Provision and SLA Conformance)
Glossary	-
Keywords	Data-related characteristics, accuracy of QoS prediction, data mining

Name	Synergies between proactive negotiation and run-time QA
Synopsis	Investigating into the synergies between proactive negotiation and run-time QA
Authors	UniDue
Type	-
Description	Proactiveness is deemed an important feature of service-based systems. Research mostly focuses on prediction of quality and related quality assurance techniques (see TJRA-1.3.3). However, negotiation (due to considerable time and resource requirements) can become an obstacle to achieving proactiveness. Thus, UniDue will investigate into synergies between proactive negotiation and run-time QA
Challenges	Proactive SLA negotiation and agreement Run-time Quality Assurance Techniques Quality prediction techniques to support proactive adaptation Proactive Adaptation and Predictive Monitoring End-to-End Quality Reference Model
IRF elements	Operation & Management; Quality definition, Negotiation and Assurance; Adaptation and Monitoring; Runtime-QA Engine
Related questions	Proactive SLA negotiation and agreement
References	T-JRA-1.3.2 (Specifying and Negotiating End-to-End Quality and SLAs)
Glossary	-
Keywords	run-time QA

Name	Usage-based online testing for proactive adaptation
Synopsis	Exploration of usage-based online testing for proactiveness
Authors	UniDue
Type	-
Description	Observations of the current trends in service research and exchange with the S-Cube associate members have shown a very strong relevance and interest in work on run-time quality assurance for service-based systems, especially considering quality prediction to trigger pro-active adaptation. Thus, UniDue will investigate (together with the associate

	members UPC and CERTH) into the use of usage-based online testing to support proactive adaptation.
Challenges	Run-time Quality Assurance Techniques Quality prediction techniques to support proactive adaptation Proactive Adaptation and Predictive Monitoring End-to-End Quality Reference Model
IRF elements	Operation & Management; Quality definition, Negotiation and Assurance; Adaptation and Monitoring; Runtime-QA Engine
Related questions	Online Testing for Quality Prediction, Online QA Approaches
References	T-JRA-1.3.3 (Assuring and Monitoring End-to- End Quality Provision and SLA Conformance)
Glossary	Technique
Keywords	Online testing, usage-based testing, quality prediction, proactive adaptation

2.2.4. Questions from JRA-2.1

Name	End-to-end processes in Service Networks
Synopsis	How to develop and validate design-time concepts, mechanisms and languages for specifying, analyzing, and simulating end-to-end processes in agile service networks?
Authors	JRA-2.1
Type	Method
Description	**Motivation:** Design time concepts, mechanisms and languages for specifying, analyzing and simulation of end-to-end processes including the protocols that govern them- are still ill understood. **Challenge:** In particular, this challenge involves at least overcoming the following three impediments: - Exploring, developing and validating effective techniques, concepts, languages and mechanisms for analyzing, modelling and simulating end-to-end business processes in ASNs. In particular, deeper understanding of existing service engineering methodologies is needed in collaboration with SED. - Developing and validating approaches exist for analysis and formal verification of business protocols involving bi-lateral and multi-lateral agreements between network nodes. Solutions will be grounded on existing approaches and techniques in protocol engineering in connection with SED, as well as devising Quality of Service for SBAs and Service Level Agreements in SQDN. - Developing and validating analysis and design of business-aware transaction concepts and mechanisms to support business protocols in ASNs are typically very traditional in nature addressing traditional, short-running database transactions ignoring important business semantics including multi-party agreements on QoS. In particular, this sub-challenge is also related to the SQDNA and SED.
IRF elements	**Framework:** - BPM - SCC - SED - SQDN **Life Cycle:**

	- **Infrastructure:** - N/A
Related challenges	-Business transactions in service networks
References	-PO-JRA-2.1.1/2.1.2/2.1.3
Glossary	- business process management, optimization, end-to-end processes, protocols, simulation, analysis, choreography, conversations, QoS, composition
Keywords	-Service Network

Name	Business Transactions in Service Networks
Synopsis	How to develop and validate concepts, mechanism and languages for run-time monitoring of business transactions?
Authors	JRA-2.1
Type	Technique
Description	**Motivation:** Business transactions are the heart-and-soul of agile service networks, and as such need to be better understood. **Challenge:** To overcome this challenge, a better understanding is required of existing adaptation and monitoring approach, techniques and solutions, which are scrutinized in the Service Adaptation & Monitoring (SAM) plane, as well as existing (automatic) approach for quality assurance of SEBs (SQDNA). This challenge involves resolving the following two deficiencies of existing techniques and solutions: -Existing transaction monitors typically limit themselves to sniffing and aggregating system-level events. An integrated approach including mechanisms and concepts for monitoring and measuring business events raised by business-aware transactions and related protocols and processes is currently lacking. This sub-challenge will particularly benefit from ongoing research with regarding to system monitors and business activity monitors in the SAM plane. -The existing business transaction monitors may be able to detect and measure system-level errors and anomalies in service-based applications, mechanisms and concepts for adapting business-aware transactions and related protocols and processes in ASNs are not effectively supported. In particular, development of adaptation of business-aware transactions will be grounded on existing adaptation techniques and methodologies that will be assessed in the SAM plane.
IRF elements	**Framework:** - BPM - SCC - SAM - SQDNA **Life Cycle:** - Requirements Engineering and Design - Identify Adaptation Need - Identify Adaptation Strategy

	- Enact Adaptation - **Infrastructure:** - N/A
Related challenges	- End-to-end processes in Service Networks
References	- PO-JRA-2.1.1/2.1.2/2.1.3
Glossary	- business process management, end-to-end processes, business transactions, transaction models, long-running transactions, ACID, composition, business activity monitoring
Keywords	-

Name	Understanding the Implications of Service Network Relational Structures on Service Performance Analytics.
Synopsis	Through the lens of actor network theory (ANT) and the application of social network analysis (SNA), we explore service network performance within the public sector.
Authors	Noel Carroll, Eoin Whelan, Ita Richardson
Type	Technique, Model
Description	Nowadays, organisations are becoming increasingly interested in understanding the operations of service networks as a means to adapt to the ever-changing environment. In order to deliver effective services, providers are being advised to 'innovate' their service delivery systems. Innovation in this context often refers to technology, technique or restructuring improvements. There is a growing body of evidence which supports that actor network theory (ANT) allows us to gain a greater understanding of networks within the IS discipline. Specifically, we examine the effectiveness of a technique called 'social network analysis' (SNA) in extending business process management to enhance the manageability of service networks.
Challenges	- Understand IT-enabled business process measurement in the public sector. - Develop a systematic view to consider the infrastructure which supports service networks - Explore service networks through an ANT research lens. - Apply SNA theory in the context of service network process relations and visualisation. - Develop a Service Network Performance Analytics framework within the public sector
IRF elements	Framework: BPM Life Cycle: analysis/design
Related questions	- How can we measure key performance indicators (KPIs) of IT-enable business processes across service networks? - How much does a business process contribute to the success of the service network? - What are the implications of relational structures (characteristics, etc) on service network performance? - How can we visualise service network interactions and their impact on the nature of a service network?
References	JRA 2.1.4
Glossary	- business process management, optimization, end-to-end

	processes, analysis
Keywords	Service network, performance analytics, actor network theory, social network analysis, business process management, Service Network Performance Analytics, key performance indicators.

Name	Formal verification and validation of business transactions specification
Synopsis	Propose formal concepts and techniques for design-time verification and validation of business transactions.
Authors	Francois Hantry (UCBL)
Type	Design-time verification technique
Description	The formal verification and validation concepts and techniques will be designed for formally ascertaining consistency and correctness of business transactions. Formal logic families that will be considered include-but are not restricted to: temporal logic, deontic logic, and, defeasible and transactional logic. The approach to logically underpin business transactions will be highly iterative, driving each iteration closer toward
Challenges	formalizing the business transaction language relying on a combination of formal languages. mapping informal (e.g., graphical) representations of BTL into its formal counterpart developing and validating formal verification concepts and techniques, possibly against S-Cube case studies.
IRF elements	*Conceptual model*: Design and deployment of business transactions concepts
Related questions	Business Transactions in Service Networks
References	The deliverable CD JRA 2.1.3, CD JRA 2.1.4
Glossary	-
Keywords	Formalization, Verification, Correctness, Consistency

Name	Modelling of the Agile Service Networks
Synopsis	Develop modelling notation for description of Service Networks
Authors	USTUTT (Olha Danylevych, Dimka Karastoyanova, Frank Leymann)
Type	Language/notation
Description	The variety of available modeling approaches for Agile Service Network originate either in the business or the technical domains. The approaches coming from the business domain lack the necessary linkage to the BPM stack. Technically-oriented approaches typically consider only a subset of necessary elements to represent the business nature of the Service Networks. We will answer this research question by investigating the requirements for a modelling notation of Agile Service Networks that bridges effectively the business and technical aspects of SOA by (1) reusing the knowledge on service/business networks from the business domain and (2) providing mappings from the ASN notation to Business Processes and Service Compositions.
Challenges	End-to-end processes in Service Networks;
IRF elements	Business Process Management; Service Composition and Coordination

References	http://bibadmin.s-cube-network.eu/show.php?id=42 http://bibadmin.s-cube-network.eu/show.php?id=63
Glossary	Agile Service Networks
Keywords	List of keywords to facilitate search.

Name	Linkage between Business Transactions and Service Compositions
Synopsis	Mechanisms for mapping of Business Transactions to the Service Compositions
Authors	USTUTT(Christoph Fehling, Olha Danylevych, Branimir Wetzstein, Dimka Karastoyanova, Frank Leymann)
Type	Mechanism
Description	Develop the mapping between the Business Transactions and Service Compositions and its fragments. The service composition fragments are annotated with different QoS and have diverse transactional properties. The information about the fragments together with the definition of a business transaction will serve as the basis of the linkage mechanisms. We will answer this question by introducing (1) models of reusable service composition fragments annotated with QoS properties, and (2) mechanisms to map a business transaction into a set of QoS-annotated service composition fragments. Further on this line of work, we will investigate how the changes applied to a business transaction propagate to the underpinning service compositions, triggering their adaptation, e.g. through the replacement of fragments with others.
Challenges	QoS Aware Adaptation of Service Compositions; Business Transactions in Service Networks
IRF elements	Agile Service Networks, BPM, Service Composition
Glossary	Service Composition, Business Transaction, Process Fragment
Keywords	BPM, Service Composition, Business Transaction, Process Fragment

Name	Monitoring of Business Transactions
Synopsis	Providing high level information about the status of the distributed and decentralized execution of Business Transactions.
Authors	Kristof Hamann (UniHH)
Type	Mechanism
Description	Involved participants of Business-aware Transactions should be able to obtain information about the current status of its execution. However, due to the inherently distributed and decentralized nature of Business Transactions, interested parties have no direct access to the required data. Hence, there is a need for a mechanism which is able to collect status information from involved participants, aggregate the data and provide high level information about business data. This involves, e.g., information about business objects which are processed by the Business Transaction, and business events which appear during the execution of business processes. This research question is strongly related to the mapping of Business Transactions to

	Service Compositions.
Challenges	Business Transactions in Service Networks
IRF elements	Framework: BPM, SCC Lifecycle: operation & management
Related questions	Business Transactions in Service Networks, Linkage between Business Transactions and Service Compositions
References	None
Glossary	Business Aware-Transaction, Business Activity Monitoring, Service Composition, Business Process, Business Transaction, Process Fragment
Keywords	Business Object, Business Events

2.2.5. Questions from JRA-2.2

Name	Linkage between Business Transactions and Service Compositions
Synopsis	Mechanisms for mapping of Business Transactions to the Service Compositions
Authors	USTUTT(Christoph Fehling, Olha Danylevych, Branimir Wetzstein, Dimka Karastoyanova, Frank Leymann)
Type	Mechanism
Description	Develop the mapping between the Business Transactions and Service Compositions and its fragments. The service composition fragments are annotated with different QoS and have diverse transactional properties. The information about the fragments together with the definition of a business transaction will serve as the basis of the linkage mechanisms. We will answer this question by introducing (1) models of reusable service composition fragments annotated with QoS properties, and (2) mechanisms to map a business transaction into a set of QoS-annotated service composition fragments. Further on this line of work, we will investigate how the changes applied to a business transaction propagate to the underpinning service compositions, triggering their adaptation, e.g. through the replacement of fragments with others.
Challenges	**QoS Aware Adaptation of Service Compositions** Business Transactions in Service Networks
IRF elements	BPM; SCC
Related questions	-
References	-
Glossary	Service Composition, Business Transaction, Process Fragment
Keywords	BPM, Service Composition, Business Transaction, Process Fragment

Name	Analysis of Influential Factors of KPIs and SLA Violations Based on Machine Learning techniques
Synopsis	Understand how to use machine learning techniques for analyzing influential factors of KPI target violations and SLA Violations in SBAs.
Authors	Branimir Wetzstein (USTUTT), Philipp Leitner (TUW)

Type	Technique
Description	Analyzing the influential factors of KPI targets and SLA violations is the prerequisite for adaptation. We will investigate how existing machine learning techniques can be used for analyzing event data at runtime determining influential factors. This involves understanding synergies with monitoring.
Challenges	Analysis and Prediction of Quality Characteristics of Service Compositions
IRF elements	-
Related questions	Runtime Prediction of KPIs and SLA Violations Based on Machine Learning Techniques;
References	http://bibadmin.s-cube-network.eu/show.php?id=127
Glossary	-
Keywords	-

Name	Runtime Prediction of KPIs and SLA Violations Based on Machine Learning Techniques
Synopsis	Understand how to use machine learning techniques for runtime prediction of KPIs and SLA Violations in SBAs.
Authors	Branimir Wetzstein (USTUTT), Philipp Leitner (TUW)
Type	Technique
Description	Quality prediction is an essential prerequisite for triggering the proactive adaptation of service-based applications. We will thus investigate how existing machine learning techniques can be used for analyzing event data at runtime for providing predictions for KPIs and SLA violations.
Challenges	Quality Prediction Techniques to Support Proactive Adaptation **Analysis and Prediction of Quality Characteristics of Service Compositions** Proactive Adaptation and Predictive Monitoring
IRF elements	-
Related questions	Analysis of Influential Factors of KPIs and SLA Violations Based on Machine Learning techniques
References	http://bibadmin.s-cube-network.eu/show.php?id=263
Glossary	-
Keywords	-

Name	Adaptation of QoS-aware Service Compositions based on Influential Factor Analysis and Prediction
Synopsis	Understand how to adapt service compositions after analyzing influential factors of KPIs and SLA violations
Authors	Branimir Wetzstein, Dimka Karastoyanova (USTUTT)
Type	technique
Description	When process quality factor analysis reveals the influential factors of KPIs and SLA violations in service compositions, one has to identify an adaptation strategy which adapts the service composition. The challenges include a modeling approach for adaptation actions, algorithms for identification of adaptation

	strategies, and mechanisms for adaptation enactment at process runtime.
Challenges	QoS Aware Adaptation of Service Compositions
IRF elements	-
Related questions	Analysis of Influential Factors of KPIs and SLA Violations Based on Machine Learning techniques Runtime Prediction of KPIs and SLA Violations Based on Machine Learning Techniques
References	-
Glossary	-
Keywords	-

Name	Cross-Partner Process Monitoring based on Service Choreographies
Synopsis	Understand how to monitor quality characteristics of processes which are spread across organizational boundaries based on service choreography models
Authors	Branimir Wetzstein, Dimka Karastoyanova (USTUTT)
Type	Technique
Description	Monitoring of processes which are distributed across organizational boundaries (e.g., due to outsourcing) has to take into account that information on private processes (as modelled in executable service orchestrations) is not available due to privacy issues. We want to investigate how partners can create cross-organizational monitoring solutions in service choreographies.
Challenges	Monitoring of Quality Characteristics of Service Orchestrations and Service Choreographies
IRF elements	-
Related questions	-
References	http://bibadmin.s-cube-network.eu/show.php?id=64
Glossary	-
Keywords	-

Name	Specification of Non-functional Parameters for Runtime Decomposition
Synopsis	A dynamic decomposition and evaluation of non-functional constraints for the execution of (distributed) processes requires an appropriate description language which facilitates runtime decomposition.
Authors	Kristof Hamann, Sonja Zaplata, Winfried Lamersdorf
Type	Language
Description	The distribution and execution of service compositions should be adapted to relevant changes in the underlying service infrastructure, e.g. considering classical non-functional aspects such as availability and price, but also advanced context requirements such as location and security issues. Especially in dynamic environments (e.g. in mobile ad-hoc networks), service providers enter and leave the system spontaneously and quality-of-service parameters change very often. In consequence, non-

	functional characteristics of services cannot be determined before the actual execution of each single activity of a process instance. Thus, *temporarily* most suitable participants must be selected -- which means in particular, that it is not possible to calculate an optimal configuration of service assignment for the entire process, but that each local service selection has to comply to a suitable global solution at any time. In order to respect the original interests and intentions of the process modeler and/or initiator in face of such necessary adaptations, non-functional requirements have to be expressed in a way which supports an expressive description as well as an efficient runtime decomposition and evaluation of non-functional characteristics. Based on these observations, existing languages for specification of QoS parameters have to be evaluated and an appropriate language and service selection algorithm have to be proposed.
Challenges	QoS Aware Adaptation of Service Compositions
IRF elements	Framework: Service Composition and Coordination Life Cycle: Operation and Management
Related questions	Algorithm for Runtime Decomposition of Non-functional Requirements, Context-Aware Execution of Distributed Processes.
References	S-Cube Deliverable CD-JRA-2.2.5
Glossary	Process Fragmentation, Service Orchestration
Keywords	Adaptation, Context, Decomposition, QoS, Service Orchestration

Name	Algorithm for Runtime Decomposition of Non-functional Requirements
Synopsis	A runtime decomposition and evaluation of non-functional constraints for the execution of (distributed) processes requires an appropriate algorithm which considers the special characteristics of service selection in dynamic environments.
Authors	Kristof Hamann, Sonja Zaplata, Winfried Lamersdorf
Type	Algorithm
Description	The distribution and execution of service compositions should be adapted to relevant changes in the underlying service infrastructure, e.g. considering classical non-functional aspects such as availability and price, but also advanced context requirements such as location and security issues. Especially in dynamic environments (e.g. in mobile ad-hoc networks), service providers enter and leave the system spontaneously and quality-of-service parameters change very often. In consequence, non-functional characteristics of services cannot be determined before the actual execution of each single activity of a process instance. Thus, *temporarily* most suitable participants must be selected -- which means in particular, that it is not possible to calculate an optimal configuration of service assignment for the entire process, but that each local service selection has to comply to a suitable global solution at any time. Based on an appropriate description of non-functional

	characteristics and requirements, an efficient algorithm is needed in order to select a temporarily adequate solution based on a runtime decomposition of global requirements on process level into local requirements on service level. As runtime execution of the algorithm and quick reactions are required, especially heuristic approaches should be considered.
Challenges	QoS Aware Adaptation of Service Compositions
IRF elements	Framework: Service Composition and Coordination Life Cycle: Operation and Management
Related questions	Specification of Non-functional Parameters for Runtime Decomposition, Context-Aware Execution of Distributed Processes.
References	S-Cube Deliverable CD-JRA-2.2.5
Glossary	Process Fragmentation, Service Orchestration
Keywords	Adaptation, Context, Decomposition, QoS, Service Orchestration

Name	Automatic derivation of composite service specifications
Synopsis	Synthesize specifications for service compositions, given the composition schema and the specifications of the participating services.
Authors	George Baryannis (UoC), Manuel Carro (UPM)
Type	Method
Description	While existing service description frameworks attempt to describe service compositions using a variety of composition models, no framework attempts to handle the problem of automatically producing specifications for a composite service, based on the specifications of participating services. Such composite specifications are of crucial importance for the verification of compositions, providing the ability to check whether a composition satisfies given requirements, or whether changes to the participating services lead to composition with the same or less requirements and/or results. The main objective is to calculate the preconditions and postconditions for each fundamental control construct (sequential execution, different flavors of parallel execution and so on). This will lead to generic specification templates which can be combined for more complex compositions. A further step would be to attempt to simplify the resulting composite specifications using simple syntactical equivalences or by exploiting logical equivalences between conditions in order to weaken preconditions or strengthen postconditions.
Challenges	Formal Models and Languages for QoS-aware service compositions
IRF elements	Requirements Engineering and Design Service Composition and Coordination
Related questions	-
References	-
Glossary	Formal Specification, Service Description, Service Composition, Service Specification, Composition Schema
Keywords	-

Name	QoS-Aware Optimization of Service Compositions with Transactional Properties
Synopsis	Optimization of service compositions with transactional properties in order to optimally fragment or merge the service compositions regarding chosen QoS and cost criteria.
Authors	Olha Danylevych, Dimka Karastoyanova, Frank Leymann (USTUTT)
Type	Method, technique
Description	The performance of applications is influenced by the way its operations are grouped into global transactions. This in turns influences the performance of business processes which utilize these applications as implementations of process activities/steps. Stratified transactions, as produced by the stratification approach is a way to manage a global transaction by combining the more elemental transactions coordinated using the two-phase commit protocol and queued transactions. The stratification approach should be applied on process-based service compositions with transactional properties in order to optimally fragment/merge the service compositions regarding chosen QoS and cost criteria. The research question requires both (1) definition of appropriate model and evaluation criteria (2) application of different optimization methods to discover optimized solution.
Challenges	QoS Aware Adaptation of Service Compositions
IRF elements	Framework: Service Composition and Coordination Life Cycle: Enact Adaptation, Identify Adaptation Strategy Logical Run-Time Architecture: Adaptation Engine
Related questions	-
References	S-Cube Deliverable CD-JRA-2.2.3
Glossary	Quality of Service-Based Adaptation
Keywords	Fragmentation, Service Composition, Split and Merge of Service Compositions, Stratification of Transactions

Name	Monitoring of Process Performance Metrics in Service Compositions
Synopsis	Process performance on service composition level is assessed in terms of process performance metrics (PPMs). We will investigate how to model and monitor PPMs in service orchestrations.
Authors	Branimir Wetzstein, Dimka Karastoyanova, Frank Leymann (USTUTT)
Type	Method, technique
Description	Process performance on service composition level is assessed in terms of process performance metrics (PPMs). We will investigate how to model and monitor PPMs in service orchestrations. This involves creating a language for modeling different types of PPMs (such as time, quality, and cost related) based on service orchestration models (in particular WS-BPEL), deployment of monitoring models and runtime monitoring.

Challenges	Monitoring of Quality Characteristics of Service Orchestrations and Service Choreographies
IRF elements	Framework: Service Composition and Coordination Life Cycle: Operation and Management. Logical Run-Time Architecture: Montoring Engine
Related questions	Cross-Partner Process Monitoring based on Service Choreographies
References	S-Cube Deliverable CD-JRA-2.2.2
Glossary	Service Orchestration, Business Activity Monitoring, Process Performance Metric
Keywords	-

Name	Context-Aware Execution of Distributed Processes.
Synopsis	The main goal here is to enable a flexible, context-based adaptation of the responsibilities for the execution of a business process (in whole or in part) to dynamically changing situations at runtime.
Authors	Sonja Zaplata, Kristof Hamann, Winfried Lamersdorf
Type	Method, technique
Description	Service-based applications should be able to adapt to changes in the system's overall context, e.g. considering aspects such as business partners, locations, technological differences, security issues and classical non-functional aspects such as availability and workload. This is especially relevant for the execution of long-running or ad-hoc business processes which are initiated in environments where potential process participants can enter and leave the system dynamically or where quality-of-service parameters change very often. Therefore, the ability to split a given process instance based on current context data is a vital characteristic in order to allow for outsourcing process parts to (temporarily) most suitable participants at runtime - while respecting the original interests and intentions of the process modeler and/or initiator.
Challenges	QoS Aware Adaptation of Service Compositions
IRF elements	Framework: Service Composition and Coordination Life Cycle: Operation and Management, Identify Adaptation Need, Identify Adaptation Strategy, Enact Adaptation.
Related questions	Execution of Parallel Paths within Distributed Processes
References	S-Cube Deliverable CD-JRA-2.2.3
Glossary	Adaptation, Context, Process Fragmentation, Service Orchestration
Keywords	Context-Awareness, Distribution, Runtime Adaptation, Process

Name	Execution of Parallel Paths within Distributed Processes
Synopsis	The execution of a business process can be distributed to different participants which are each responsible for the execution of one of the parallel paths of the process. An efficient and flexible synchronization of control flow and data requires advanced

	synchronization and coordination mechanisms.
Authors	Kristof Hamann , Sonja Zaplata, Winfried Lamersdorf
Type	Mechanism
Description	As part of a flexible outsourcing, fragmentation or decentralization mechanism, process execution often involve the distribution of tasks which have to be run in parallel. However, if parts of such a parallel section of a process are distributed to several different parties, advanced synchronization and coordination mechanisms are required. If furthermore shared data objects are used in more than one of these parallel fragments, a separate execution could lead to undesired or even wrong results. Therefore, adequate concepts have to be developed in order to ensure a flexible distributed execution of parallel process paths as intended by the process modeller while avoiding as much coordination overhead as possible.
Challenges	QoS Aware Adaptation of Service Compositions
IRF elements	Framework: Service Composition and Coordination Life Cycle: Operation and Management
Related questions	Context-Aware Execution of Distributed Processes.
References	S-Cube Deliverable CD-JRA-2.2.3
Glossary	Process Fragmentation, Service Orchestration
Keywords	Distribution, Process, Parallelism, Data dependencies, Correctness, Synchronisation

Name	Addressing the frame problem in service specifications
Synopsis	Solving the frame problem in the domain of Web services
Authors	George Baryannis, Dimitris Plexousakis (UoC)
Type	Technique
Description	Preparing formal service specifications comes with a great deal of issues, one of which is the frame problem. The frame problem stems from the fact that including clauses that state only what is changed when preparing formal specifications is inadequate. Instead, one should also include clauses, called frame axioms, that explicitly state that apart from the changes declared in the rest of the specification, nothing else changes. Solving the frame problem essentially means finding a way to state frame axioms concisely without resulting in extremely lengthy, complex, possibly inconsistent, obscure specifications and at the same time retaining the ability of proving formal properties of the specifications. This solution should take into account both atomic services and service compositions.
Challenges	Formal Models and Languages for QoS-Aware Service Compositions
IRF elements	Conceptual Research Framework: Service Engineering and Design, Service Composition and Coordination Reference life-cycle: Requirements Engineering and Design
Related questions	Addressing the frame problem in service specifications
References	- http://bibadmin.s-cube-network.eu/show.php?id=141
Glossary	Formal Specification, Service Composition, Service Description, Service Specification

Keywords	Frame Problem

Name	Addressing the ramification and qualification problems in service specifications
Synopsis	Application of the ramification and qualification problems in the domain of Web services
Authors	George Baryannis (UoC)
Type	Method
Description	Apart from the frame problem, which deals with expressing what remains unchanged in a formal specification, there are two other problems (sometimes described as facets of the frame problem), the ramification and qualification problems. The ramification problem concerns the adequate representation and inference of information about the indirect effects (ramifications) that might accompany the direct effects of an action or an event. The qualification problem deals with the circumstances and conditions that must be met prior to the execution of an action and how to update such qualifications when new knowledge is acquired. It would be interesting to examine the application of these problems in the domain of Web services (both for atomic and composite service specifications), the effects they may have and how existing solutions can be adapted to the services domain. This research directionmay lead to the definition and formalization of a specification language for Web service and service compositions that offers robust solutions to all facets of the frame problem based on its foundations.
Challenges	Formal Models and Languages for QoS-Aware Service Compositions
IRF elements	Conceptual Research Framework: Service Engineering and Design, Service Composition and Coordination Reference life-cycle: Requirements Engineering and Design
Related questions	Addressing the frame problem in service specifications
References	R. Miller, Three problems in logic-based knowledge representation, Aslib Proceedings: New Information Perspectives, Vol. 58, Issue 1/2, pp. 140-151, 2006
Glossary	Formal Specification, Service Composition, Service Description, Service Specification
Keywords	Qualification Problem, Ramification Problem

Name	Determining whether two service specifications are equivalent
Synopsis	The problem of equivalence involves proving that two different services have the same effect in the world state and produce semantically equivalent outputs. The general problem is undecidable but it should be interesting to explore restrictions that make the problem decidable.
Authors	George Baryannis (UoC)
Type	Method
Description	The problem of equivalence involves proving that two different services have the same effect in the world state and produce

	semantically equivalent outputs, if given semantically equivalent inputs. This is of particular importance in the case of substituting one service with another in a composition, since one would need to guarantee that the substitution is transparent to the end user. Equivalence between two services can be expressed using the notion of containment, where the first service contains the second and vice-versa. The general problem is undecidable but it should be interesting to explore restrictions (e.g. to the number and form of inputs and outputs, preconditions and effects) that make the problem decidable.
Challenges	Formal Models and Languages for QoS-aware service compositions
IRF elements	Requirements Engineering and Design
Related questions	-
References	- Fan, W., Geerts, F., Gelade, W., Neven, F., and Poggi, A. 2008. Complexity and composition of synthesized web services. In Proceedings of the Twenty-Seventh ACM SIGMOD-SIGACT-SIGART Symposium on Principles of Database Systems (Vancouver, Canada, June 09 - 12, 2008). PODS '08. ACM, New York, NY, 231-240
Glossary	Adaptation, Formal Specification, Service Composition, Service Specification
Keywords	Containment, Equivalence

Name	Service composition run-time validation of non-functional requirements
Synopsis	How to ensure a proper selection of services able to satisfy non-functional constraints
Authors	Carlo Ghezzi, Luciano Baresi, and Sam Guinea (POLIMI)
Type	Methodology
Description	Specifying functional and non-functional properties only at the level of interfaces is required to support lifelong validation of dynamically evolvable compositions, which massively use late-binding mechanisms. Indeed, at design time a service refers to externally invoked services through their required interface. At run time, the service will resolve its bindings with external services that provide a matching interface, i.e., their provided QoS conforms to the one defined at design time.
Challenges	End-to-End Quality Reference Model Run-time Quality Assurance Techniques Monitoring of Quality Characteristics of Service Orchestrations and Service Choreographies
IRF elements	Operation & Management; Monitoring Engine
Related questions	-
References	Luciano Baresi, Elisabetta Di Nitto, Carlo Ghezzi, "Toward Open-World Software: Issue and Challenges," Computer, vol. 39, no. 10, pp. 36-43, Oct. 2006.
Glossary	Validation, Service Composition
Keywords	-

Name	KPI monitoring with incomplete information
Synopsis	Understand how the lack of information due to the involvement of external services affects the KPI monitoring
Authors	Cinzia Cappiello, Kyriakos Kritikos, Pierluigi Plebani (Polimi), Branimir Wetzstein (USTUTT)
Type	Method
Description	Performance measurement of business processes is typically performed in terms of Key Performance Indicators (KPIs), which are key metrics for evaluating the processes in terms of time, cost, and quality dimensions. The evaluation of KPIs is based on measurement data obtained by monitoring process activities. The provision of needed measurement data is often costly, in particular for non-IT based process activities, or KPIs measurement is simply not possible, for example, if some parts of the process are performed as a service by an external organization. For these reasons, the KPI evaluation is hampered.
Challenges	End-to-End Quality Reference Model Run-time Quality Assurance Techniques Monitoring of Quality Characteristics of Service Orchestrations and Service Choreographies
IRF elements	Operation & Management; Monitoring Engine
Related questions	Cross-Partner Process Monitoring based on Service Choreographies
References	-
Glossary	Key Performance Indicator
Keywords	-

Name	Foundations of Analysis for Service-Based Systems
Synopsis	What could be the common denominator which would make it possible to effectively analyze large, heterogenous systems to discover hidden properties?
Authors	Manuel Carro (UPM)
Type	Principle
Description	Automatically and statically inferring emerging properties at design time is very advantageous as it makes it possible to detect some regularities and misbehaviors ahead of time - before the system in being executed. The range of inferred properties can be very wide, as well as their application: from forecasting resource usage to detecting system-wide invariants to ensure coherence under e.g. aborted transactions or transformations (adaptations or whatever) of the compositions. Analysis, in this sense, has to be distinguished from verification in the sense that the latter checks provided properties, while the former infers existing properties. Deriving properties in a safe way requires the analysis to work on a representation of the system with a perfectly defined semantics. In order for the whole range of interconnected systems to be automatically analyzed as a whole, a unified semantics and representation syntax has to be created.

Challenges	QoS Aware Adaptation of Service Compositions; Adaptation of Service Compositions; Formal Models and Languages for QoS-Aware Service Compositions; Quality Prediction Techniques to Support Proactive Adaptation; End-to-End Quality Reference Model; Analysis and Prediction of Quality Characteristics of Service Compositions
IRF elements	Logical Design Environment: Modelling Techniques, Verification Techniques Conceptual Research Framework: Design Capabilities Reference life-cycle: Early Requirements Engineering
Related questions	Quality estimation using service invocations How can cost-based derivation of data-aware QoS for a service composition be used for predictive monitoring? Adaptation of QoS-aware Service Compositions based on Influential Factor Analysis and Prediction How can end-to-end quality be assured through extension Software Development Quality Assurance Processes? Business Transactions in Service Networks
References	-
Glossary	Analytical Quality Assurance, Verification
Keywords	Analytical Quality Assurance, Verification

Name	Foundations for data semantics in service-based systems
Synopsis	Data needs to be taken into account for many fine-grained analyses gearing towards ensuring / verifying QoS and semantical compliance. This aspect of SOC has probably not been paid attention enough.
Authors	Manuel Carro (UPM)
Type	Principle
Description	Data flowing through a service-based system can indeed impact its behavior: it is not always the case that channels / compositions do not have knowledge of the data which flows through them. Therefore, having information about the data (e.g., data invariants) can help in shaping the semantics of the system as a whole (e.g., deduce system invariants). More sophisticated languages than e.g. XML schemata are necessary to capture in a richer way he relationships between different data pieces, expected invariants, etc., the problem being not so much the syntax as the formal semantics and the tools to work with these semantic descriptions.
Challenges	Formal Models and Languages for QoS-Aware Service Compositions
IRF elements	Logical Design Environment: Verification Techniques Conceptual Research Framework: Service Composition and Coordination; Service Quality Definition, Negotiation and Assurance
Related questions	How can cost-based derivation of data-aware QoS for a service composition be used for predictive monitoring? End-to-End Quality definition Language
References	-

Glossary	Data-Related Quality, Data-Aware QoS, Data Reliability, Data Accuracy, Data Completeness, Data Validity, Data Integrity
Keywords	Data-Related Quality, Data-Aware QoS, Data Reliability, Data Accuracy, Data Completeness, Data Validity, Data Integrity

Name	Describe behavior and semantics uniformly
Synopsis	Finding a formalism to uniformly describe semantics and behavior of service compositions.
Authors	Manuel Carro (UPM)
Type	Principle
Description	Behavior and semantics have usually been described under different perspectives and using a different set of tools. An all-encompassing theory needs to bridge this gap, either by finding strong connections between these two areas or by finding a formalism to uniformly describe semantics and behavior. This is relevant not only to describe services in themselves, but also to be able to describe both what is expected from a service compositions and (if possible automatically) to derive what service composition gives.
Challenges	Formal Models and Languages for QoS-Aware Service Compositions
IRF elements	Logical Design Environment: Modelling Techniques Conceptual Research Framework: Service Composition and Coordination Reference life-cycle: Requirements Engineering and Design
Related questions	Foundations for data semantics in service-based systems
References	
Glossary	Semantic Web Services Composition, Semantic Web Services
Keywords	Behavior, semantics, description logics, petri net

Name	Applying the sharing-based analysis to the problem of service composition fragmentation
Synopsis	Applying the general concept of sharing to model and analyze both the control structures of a composition and its data flow.
Authors	Dragan Ivanovic (UPM),Manuel Carro (UPM), Manuel Hermenegildo (UPM, IMDEA)
Type	Method
Description	Composition notations and languages, such as BPMN [17], and WS-BPEL [16], allow process modelers and designers to view a composition from the point of business logic and processing requirements related to parallelism and data flow. The now fashionable service mash-ups are also tools for building (usually simplified) customized workflows from known service components in a user-centric way. Finally, com- positions can be programmed in any common programming language, such as Java, with infrastructure that provides the necessary constructs and libraries for establishing client connections to, and exposing Web services. This calls for a neutral, language independent notion of fragmentation and fragmentation possibilities. The notion of sharing-based fragmentation is based on the very

	general notion of independence between parts of a composition. The underlying idea is that workflows have a certain degree of freedom in (re-)arranging their activities, without violating the overall inter-process business protocol, and while preserving their essential prop- erties, such as correctness and transactional integrity. The question is how to apply the general concept of sharing to model and analyze both the control structures of a composition (usually already presented at the level of workflow design), and its data flow, which is usually not present in many workflow designs, but which may induce dependencies between parts of the composition thay may disrecommend treating them as fragments.
Challenges	QoS Aware Adaptation of Service Compositions
IRF elements	Logical Design Environment: Transformation and Generation Techniques Conceptual Research Framework: Service Composition and Coordination Reference life-cycle: Construction, Identify Adaptation Need
Related questions	-
References	- S-Cube Deliverable CD-JRA-2.2.3
Glossary	Adaptation Mechanism, Service Composition
Keywords	Fragmentation, Service Composition, Split and Merge

Name	Managing the Key Ecological Indicators of Business Processes
Synopsis	Understand how to use Key Ecological Indicators (KEI) for analysing the environmental impact of business processes.
Authors	Alexander Nowak (USTUTT)
Type	Method
Description	To identify the environmental impact of business processes different aspects need to be considered. We want to investigate, how organizations may (1) define ecological characteristics, (2) sense and measure these ecological characteristics, (3) identify, localize and visualize their environmental impact, and (4) develop appropriate adaptation strategies in order to optimize their environmental impact without neglecting the organization’s competitiveness.
Challenges	Monitoring of Quality Characteristics of Service Orchestrations and Service Choreographies QoS Aware Adaptation of Service Compositions
IRF elements	**Framework:** Adaptation and Monitoring **Lifecycle:** Requirements Engineering & Design, Deployment & Provisioning, Operation & Management, Identify Adaptation Need, Identify Adaptation Strategy, Enact Adaptation
Related questions	Monitoring of Process Performance Metrics in Service Compositions
References	S-Cube Deliverable CD-JRA-2.2.6
Glossary	Key Performance Indicator, Monitoring, Adaptation, Analysis, Service Composition, Business Process
Keywords	Business Processes, Process Views, Process Monitoring, Adaptation, Environmental Impact, Green Business Process Reengineering

Name	Preventing SLA Violations via Runtime Substitution of Process Fragments
Synopsis	Understand how to adapt service compositions by substituting arbitrary composition fragments at runtime in order to prevent SLA violations

Authors	Branimir Wetzstein (USTUTT), Philipp Leitner (TUW)
Type	Technique
Description	For preventing SLA violations in running service compositions, service substitution is often not enough. A technique is needed which enables adapting the running composition by substituting arbitrary composition fragments. The goal of the substitution is to prevent a predicted SLA violation.
Challenges	QoS Aware Adaptation of Service Compositions, Proactive Adaptation and Predictive Monitoring
IRF elements	**Framework:** Service Composition and Coordination
Related questions	Adaptation of QoS-aware Service Compositions based on Influential Factor Analysis and Prediction
References	http://s-cube-network.eu/refbase/show.php?record=383
Glossary	Composition Fragment, Proactive Adaptation
Keywords	-

Name	Dynamic context-aware composition of process fragments
Synopsis	Dynamically retrieve and compose local and partial process knowledge to achieve a specific goal and to target a specific context.
Authors	Annapaola Marconi (FBK)
Type	Method
Description	A critical aspect for real world applications is the possibility to discover and use process knowledge at run time depending on the specific context (e.g. environment properties, user preferences). However, addressing this problem is not trivial since there is the need to i) define modeling tools and languages that allow to describe partial, local, and context-aware process specifications, ii) providing means to retrieve relevant process specification given a specific context and goal, iii) automatically generate an executable process that, composing the selected partial specifications, achieves the goal.
Challenges	Formal Models and Languages for QoS -Aware Service Compositions; QoS Aware Adaptation of Service Compositions
IRF elements	**Framework:** Service Composition and Coordination **Lifecycle:** Operation & Management; Enact Adaptation
Related questions	- Service composition driven by dynamic service selection - How context could be exploited during the lifecycle - Automatic derivation of composite service specifications - Context-Aware execution of Distributed Processes
References	-
Glossary	Adaptation mechanism, Quality of Service-Aware Service Composition, Self-*
Keywords	Context-aware composition, Adaptation

Name	Soft-Constraint based Approach for QoS-aware Service Selection
Synopsis	Investigate a soft-constraint based approach for selecting replacements of services in case of run-time failure of underperformance.
Authors	Mohamed Anis Zemni, Salima Benbernou (UCBL) Manuel Carro (UPM)
Type	Method
Description	As part of the dynamicity and adaptability expected from service based systems, it is desirable that, in case of faults which make a service underperform or even stop working, the service-based system should be able to heal itself by seeking for a suitable replacement at runtime.

	However, it may be the case that none of the available services meets all the constraints. In that case, the system is likely to grind to a halt. In such a situation, it is more reasonable to select alternatives which, in spite of not fulfilling all the constraints, allow the system to proceed normally. For that we propose a soft constraint based approach.
Challenges	QoS Aware Adaptation of Service Compositions, Formal Models and Languages for QoS-Aware Service Compositions
IRF elements	**Framework:** Service Composition and Coordination
Related questions	-
References	-
Glossary	Service Level Agreement, Constraint solving problem
Keywords	Soft constraint, SLA, QoS-aware

Name	A Penalty-based Approach for QoS Dissatisfaction using Fuzzy Rules
Synopsis	Investigate an approach, based on fuzzy logic, that defines penalties in case of QoS violation according to the degree of violation
Authors	Barbara Pernici, Hossein Siadat (POLIMI) Salima Benbernou, Mourad Ouziri (UPD)
Type	Method
Description	Quality of Service (QoS) guarantees are commonly defined in Service Level Agreements (SLAs) between provider and consumer of services. Such guarantees are often violated due to various reasons. QoS violation requires a service adaptation and penalties have to be associated when promises are not met. However, there is a lack of research in defining and assessing penalties according to the degree of violation. The goal is to provide an approach based on fuzzy logic for modeling and measuring penalties with respect to the extent of QoS violation.
Challenges	QoS Aware Adaptation of Service Compositions, Formal Models and Languages for QoS-Aware Service Compositions
IRF elements	**Framework:** Service Composition and Coordination
Related questions	-
References	-
Glossary	QoS, Service level agreement
Keywords	QoS, SLA, penalty, fuzzy logic

Name	Privacy-aware Business Process Fragment for reusing
Synopsis	Fragmentation of business processes in order to reuse the fragments for building new business processes at the same time privacy aware the fragmentation
Authors	Mohamed Anis Zemni, Salima Benbernou, Soror Sahri (UCBL)
Type	Method
Description	There is a growing need for the ability to fragment ones business processes in an agile manner, and be able to reuse these fragments for building new processes. Decomposition aims at clustering workflow activities into fragments according to business constraints. Additionally, individuals are becoming more and more concerned about the privacy of their personal data. The goal is to investigate a fragment identification approach that is aware of privacy concern. The approach is to exploit the so-called formal concept analysis approach, while integrating a technique for avoiding the association of sensitive information.
Challenges	QoS Aware Adaptation of Service Compositions, Formal Models and Languages for QoS-Aware Service Compositions

IRF elements	**Framework:** Service Composition and Coordination
Related questions	-
References	-
Glossary	-
Keywords	Formal concept analysis, privacy, reusing, business process fragment

2.2.6. Questions from JRA-2.3

Name	Scalable and fault tolerant techniques for service discovery
Synopsis	How to implement scalable and reliable service discovery for dynamic service ecosystems
Authors	CNR, INRIA, SZTAKI, TUW, UoC
Type	Mechanism
Description	As the size and dynamicity of service-based systems continues to increase, the ability to discover services in a scalable and fault-tolerant way is becoming essential. Current discovery architectures are not well prepared to deal with the scale and dynamicity of the emerging service ecosystem. We will thus investigate novel decentralised discovery infrastructures, robust in the face of failures and heavy load. Implementing such infrastructures requires mechanisms for collecting, consolidating and disseminating metadata among registries, service providers and consumers. Robust dissemination mechanisms will thus also be studied.
Challenges	Multi-level and self-adaptation
IRF elements	-
Related questions	-
References	-
Glossary	-
Keywords	-

Name	Self-optimization and self-healing of a single service
Synopsis	How to implement autonomic behaviour for services, enabling them to remain healthy and to continue to conform to their SLAs while making the best use of underlying resources
Authors	CNR, INRIA, SZTAKI, TUW, UoC
Type	Mechanism
Description	Realising the next-generation service ecosystem requires that individual services autonomously and dynamically recover from abnormal states and optimise their resource use. A key research question is what frameworks and mechanisms offer effective and usable support for providing self-healing and self-optimisation properties to services. This question considers autonomic properties for individual services rather than service compositions, which are considered in “Supporting adaptation of service-based applications”. Specific research topics include implementing mechanisms for monitoring services and their context, devising appropriate adaptation strategies, and effecting changes on the service.
Challenges	Multi-level and self-adaptation
IRF elements	-

Related questions	Supporting adaptation of service-based applications
References	-
Glossary	-
Keywords	-

Name	Supporting adaptation of service-based applications
Synopsis	What mechanisms and frameworks are needed to support the self-adaptation of service-based applications
Authors	CNR, INRIA, SZTAKI, TUW, UoC
Type	Mechanism
Description	Service-based applications are built from several services, some of them being themselves composite. Moreover, the services are typically distributed on heterogeneous environments (such as grids, clusters or mobile networks) and use different service-oriented platforms (such as OSGi or ESB). Supporting self-adaptation for distributed, heterogeneous, multi-level services raises several research issues. One issue involves investigating programming paradigms and associated infrastructures that are well-suited to designing autonomic service-based applications. The chemical paradigm, for example, has emerged as a promising approach to composing and dynamically adapting services. Another issue is making coherent adaptation decisions, which requires investigating appropriate coordination algorithms. Finally, there is the challenging issue of planning and executing adaptations in distributed environments. Indeed, to satisfy performance criteria, adaptation actions should be executed in a distributed and parallel way, which requires appropriate synchronization of the actions.
Challenges	Multi-level and self-adaptation
IRF elements	-
Related questions	Self-optimization and self-healing of a single service
References	-
Glossary	Adaptation mechanisms
Keywords	-

Name	On-demand, dynamic service provisioning
Synopsis	How to establish dynamic service provisioning for service execution in various environments such as Clouds, Grids and SOAs
Authors	CNR, INRIA, SZTAKI, TUW, UoC
Type	Methodology
Description	Various aspects of negotiation, brokering and deployment are investigated to provide an integrated framework for on-demand dynamic service deployment with SLA-observations.
Challenges	Deployment and execution management Multi-level and self-adaptation Proactive SLA negotiation and agreement
IRF elements	Conceptual research framework: SI; SAM Reference life-cycle: Deployment and provisioning; Operation & management Logical run-time architecture: Service container; Discovery and registry infrastructure; Adaptation engine Logical design environment: deployment techniques
Related questions	-
References	http://bibadmin.s-cube-network.eu/show.php?id=135
Glossary	Self-*, self-adaptation, service deployment, service level agreement, SLA negotiation, brokering
Keywords	Negotiation, brokering, deployment, dynamic provisioning

Name	Selecting Web Services Based on Structured and Unstructured User Feedback
Synopsis	The first step in modelling Quality of Experience (QoE) for Internet of Services services is to capture the past experience of users in a simple structured way, e.g., using numerical rating. However, additionally, a more unstructured way of providing feedback is necessary.
Authors	CNR, INRIA, SZTAKI, TUW, UoC
Type	Technique
Description	The main research question with regard to structured and unstructured user feedback is how to best integrate those two fundamentally different types of data. Additionally, more complex issues arrive, such as how tags can be merged, how trust issues can be handled or how context information can be taken into account.
Research challenges	-
IRF elements	-
Related questions	-
References	-
Glossary	-
Keywords	-

Name	Light-weight Service Metadata for Service Registries
Synopsis	Provide a rich but lightweight set of metadata for Web services, including past transaction information

Authors	CNR, INRIA, SZTAKI, TUW, UoC
Type	Technique
Description	This research question discusses the issue of storing expressive metadata about Web services in service registries. Such metadata includes but is not limited to service interface information, quality information, and context information. Additionally, this also includes historical data about earlier usages of the service, in order to enable service selection based on past user feedback (see question “Selecting Web Services Based on Structured and Unstructured User Feedback”).
Related questions	Selecting Web Services Based on Structured and Unstructured User Feedback
Research challenges	-
IRF elements	-
Related questions	-
References	-
Glossary	-
Keywords	-

Name	Runtime SLA Violation Prevention
Synopsis	How to prevent SLA violations by adapting service compositions
Authors	CNR, INRIA, SZTAKI, TUW, UoC
Type	Technique
Description	This research question discusses possibilities to use the predictions of SLA violations as covered in “Runtime Prediction of KPIs and SLA Violations Based on Machine Learning Techniques” to automatically adapt service compositions with the goal of ultimately preventing SLA violations as far as possible.
Related questions	Runtime Prediction of KPIs and SLA Violations Based on Machine Learning Techniques
Research challenges	Multi-level and self-adaptation
IRF elements	-
Related questions	-
References	-
Glossary	-
Keywords	-

Name	Cost-Based Optimization of Adaptations
Synopsis	Generally, adaptations of service compositions are done with monetary aims in mind, e.g., to prevent SLA violations (and, therefore, penalty payments). However, adaptations also cost money. It is therefore a research challenge to find a cost-optimal subset of possible adaptations to apply.
Authors	CNR, INRIA, SZTAKI, TUW, UoC
Type	Approach
Description	Many approaches to automated adaptation of service compositions assume that it is always a good idea to apply all possible adaptations if an optimization in the process can be achieved, e.g., if the process is faster after the adaptation.

	However, other important factors are not taken into account. Most importantly, service composers in real life need to consider the trade-off between the possible improvement of an adaptation and the cost of the adaptation action. Considering this it is often optimal to not apply some adaptations, even if an improvement is theoretically possible, because it is not cost-efficient to do so. The research question is to find ways to extract the subset of possible adaptation actions that are cost-optimal to apply, i.e., the total costs for the owner are minimal.
Related questions	Runtime Prediction of KPIs and SLA Violations Based on Machine Learning Techniques Runtime SLA Violation Prevention
Research challenges	Multi-level and self-adaptation
IRF elements	-
Related questions	-
References	-
Glossary	-
Keywords	-

2.3. Research Results

2.3.1. Results from JRA-1.1

Name	Subset of HCI knowledge relevant to SBA engineering
Synopsis	HCI knowledge areas and corresponding techniques deemed relevant to SBA engineering
Authors	Neil Maiden, Angela Kounkou, Kos Zachos
Type	Method
Description	-
Research questions	Identifying relevant HCI knowledge to inform SBA engineering
Related research results	-
References	PO-JRA-1.1.3 Codified Human-Computer Interaction (HCI) Knowledge and Context Factors.
Glossary	HCI, service based application
Keywords	HCI, service based application

Name	Map of human stakeholders in SBA engineering
Synopsis	Representation of human stakeholders' roles and points of involvement mapped on an SBA's lifecycle.
Authors	Angela Kounkou, Neil Maiden, Kos Zachos
Type	technique
Description	-
Research questions	Identifying human stakeholders in SBA engineering
Related research results	-
References	CD JRA 1.1.5. Analysis on how to exploit codified HCI and codified context knowledge for SBA engineering (upcoming)
Glossary	HCI, Service based application
Keywords	HCI, Service based application

Name	Codified user model knowledge for SBA engineering
Synopsis	User model data extracted and presented in usable form to inform SBA engineering (more specifically, discovery and selection)
Authors	Angela Kounkou, Neil Maiden, Kos Zachos
Type	technique
Description	-
Research questions	Exploiting user model knowledge in SBA engineering
Related research results	-
References	PO-JRA-1.1.3 Codified Human-Computer Interaction (HCI) Knowledge and Context Factors CD JRA 1.1.5. Analysis on how to exploit codified HCI and codified context knowledge for SBA engineering (upcoming)
Glossary	HCI, Service based application, User model
Keywords	HCI, Service based application, User model

Name	Codified task model knowledge for SBA engineering
Synopsis	Task model data extracted and presented in usable form to inform SBA engineering (more specifically, composition)
Authors	Kos Zachos, Neil Maiden, Angela Kounkou
Type	technique
Description	-
Research questions	Exploiting task model knowledge in SBA engineering
Related research results	-
References	PO-JRA-1.1.3 Codified Human-Computer Interaction (HCI) Knowledge and Context Factors CD JRA 1.1.5. Analysis on how to exploit codified HCI and codified context knowledge for SBA engineering (upcoming)
Glossary	HCI, Service based application, Task model
Keywords	HCI, Service based application, Task model

Name	Codified user error knowledge to inform SBA engineering
Synopsis	User error knowledge presented in usable form to inform SBA engineering
Authors	Kos Zachos, Neil Maiden, Angela Kounkou
Type	technique
Description	-
Research questions	Exploiting user error knowledge to inform SBA engineering
Related research results	-
References	PO-JRA-1.1.3 Codified Human-Computer Interaction (HCI) Knowledge and Context Factors CD JRA 1.1.5. Analysis on how to exploit codified HCI and codified context knowledge for SBA engineering (upcoming)
Glossary	HCI, Service based application, User error
Keywords	HCI, Service based application, User error

Name	Design for Adaptation of Service-Based Applications: Main Issues and Requirements
Synopsis	The work discusses the issues, requirements, and patterns for the design of adaptable SBAs
Authors	Antonio Bucchiarone, Cinzia Cappiello, Elisabetta Di Nitto, Raman Kazhamiakin, Valentina Mazza and Marco Pistore
Type	Method
Description	In order to design and develop highly dynamic and adaptable SBAs, mechanisms that enable adaptation should be introduced in the life-cycle of applications, both in the design and in the runtime phases. Existing design methodologies do not take into account the problem of SBA adaptation in a holistic way, but only in a fragmented way, proposing specific solutions for particular cases. In this work an extension of a basic iterative SBA life-cycle with elements able to deal with the adaptation-specific needs is proposed. It focuses, in particular, on the design phase and suggests a number of design principles and guidelines that are suitable to enable adaptation. Real-world scenarios over various types of service-based applications are used to evaluate the effectiveness and applicability of the approach.
Research questions	Design for Adaptation Associate adaptation strategies to the adaptation triggers.
Related research results	-
References	http://bibadmin.s-cube-network.eu/show.php?id=266
Glossary	-
Keywords	-

Name	Control Flow Requirements for Automated Service Composition
Synopsis	A language and a automated technique for developing adaptable service compositions
Authors	Piergiorgio Bertoli, Raman Kazhamiakin, Massimo Paolucci, Marco Pistore, Heorhi Raik and Matthias Wagner
Type	technique, language
Description	Adaptive service compositions should be able to react to different external events and situations occurring during their execution. The work presents a language for expressing such adaptation requirements and an automated service composition approach that is able to generate a composed service from a set of candidate stateful services. This is accomplished by associating so-called objects to services, and by introducing a simple yet powerful notation to express composition requirements on them and by exploiting planning techniques to generate executable and adaptive service composition.
Research questions	Built-in adaptation Design for adaptation
Related research results	-
References	http://bibadmin.s-cube-network.eu/show.php?id=271
Glossary	-
Keywords	-

Name	An Integrated Approach for the Run-Time Monitoring of BPEL Orchestrations
Synopsis	The approach integrates different complementary monitoring approaches in order to achieve more comprehensive, cross-layer monitoring solution
Authors	Luciano Baresi, Sam Guinea, Raman Kazhamiakin and Marco Pistore
Type	technique, language
Description	While there exists several approaches for monitoring the execution of service compositions that concentrate on different properties, adopt different languages, work at different levels of abstraction, and assume different perspectives, there is a need to push a cooperative approach based on the integration of different solutions. The work describes a monitoring framework which is obtained by integrating two well-known approaches, namely Dynamo and Astro. This integration, which happens both for the language used for expressing the properties to be monitored, and for the architecture of the monitoring framework, allows to combine the advantages of the two approaches and to obtain a general, comprehensive solutions for BPEL monitoring.
Research questions	Cross-layer integrated monitoring mechanisms Design for monitoring
Related research results	-
References	http://bibadmin.s-cube-network.eu/show.php?id=26 http://bibadmin.s-cube-network.eu/show.php?id=270
Glossary	-
Keywords	-

Name	Investigating whether adaptation of services can be considered a maintenance process.
Synopsis	We examine how the software maintenance process is understood by software engineers. We also examine how adaptation is considered by the services community. We merge principles from both disciplines to help developers of the adaptation cycle follow software engineering processes to ensure that adaptation is carried out following quality principles.
Authors	Stephen Lane (Lero), Qing Gu (VUM), Patricia Lago (VUM), Ita Richardson (Lero)
Type	Exploratory study
Description	While the S-Cube life-cycle shows the Adaptation Cycle and breaks it into three constituent parts – Identify adaptation needs, Identify adaptation strategy, Enact adaptation - we need to define what practices should occur within each of these. During this research, we carried out two distinct phases. In the Phase I development, we identified the adaptation-related activities within existing service oriented architecture (SOA) approaches, thus providing practices which should be included in the S-Cube

	Adaptation life-cycle as defined by SOA. During Phase II development, we carried out a gap-analysis comparing SOA adaptation and the software engineering maintenance process, focusing particularly on ISO/IEC 14764. Through this analysis, we identified that there are other practices, which, for effective implementation of Adaptation of Services, should be included within the more detailed level of the life-cycle. Through this process we have defined a detailed life-cycle for the Adaptation process of services software development.
Research questions	-
Related research results	-
References	-
Glossary	-
Keywords	-

Name	Calculating Service Fitness in Service Networks
Synopsis	What is the fitness of services in a service network? How can fitness be defined? How can it be calculated?
Authors	Martin Treiber, Vasilios Andrikopoulos, and Schahram Dustdar
Type	Technique
Description	The proposed service fitness is a measure of the success of a service provider in a service network. It is important to notice that the notion of fitness of services depends highly on the context. Changes to the context of the services are reflected on the market share of the service and we can therefore observe them as changes to the service fitness. These changes take place within a certain boundary which we refer as fitness corridor. A fitness corridor is defined by an upper bound that denotes the best possible fitness (as calculated using the available data) and a lower bound which is calculated with stochastic methods. The final fitness formula and evaluation compares actual service use to potential service use.
Research questions	-
Related research results	-
References	Martin Treiber and Vasilios Andrikopoulos and Schahram Dustdar. Calculating Service Fitness in Service Networks. In 2nd Workshop on Monitoring, Adaptation and Beyond (MONA+) at the ICSOC 2009 Conference, December 2009.

Name	Self-Optimisation of SBAs
Synopsis	A method is proposed to continuously evolve a SBA to enhance the fulfilment of its requirements. The basis of this method is a set of TROPOS goal models.
Authors	Andreas Gehlert
Type	Technique
Description	The proposed method addresses the issue of self-optimisation that is the continuous improvement of the SBA wrt. to the fulfilment

	of its requirements. The method is based on TROPOS goal models and assumes that the requirements of the SBA are expressed with such goal models. In addition, it assumes that service providers provide goal models together with their services. When a new service becomes available the method allows checking whether this service would in principle fit in the SBA (by using model comparison techniques) and in the positive case whether the service improves the fulfilment of the SBA's requirements. The fulfilment of the SBA's requirements is expressed as goal satisfaction ratios and the formal TROPOS propagation algorithm is used to propagate the new satisfaction ratios through the entire goal model. The new service should be used if the fulfilment of all goals remains at least at their previous level and at least one goal fulfilment is enhanced (pareto principle).
Research questions	Continuous requirements engineering of service-based applications
Related research results	-
References	GEHLERT, A.; HEUER, A.: Towards Goal-Driven Self Optimisation of Service Based Applications. In: MÄHÖNEN, P. (Hrsg.); POHL, K. (Hrsg.); PRIOL, T. (Hrsg.): Proceedings of the 1st International Conference of the Future of the Internet of Services (ServiceWave 2008), December 10--13, 2008, Madrid, Spain. Springer (Lecture Notes in Computer Science), 5377, Berlin, Heidelberg, 2008, p.13—24 GEHLERT, A.; BRAMSIEPE, N.; POHL, K.: Goal-Driven Alignment of Services and Business Requirements. In: Proceedings of the 4th International Workshop on Service-Oriented Computing Consequences for Engineering Requirements (SOCCER 2008), September 8, 2008, Barcelona, Spain. , 2008
Glossary	-
Keywords	Requirements engineering, self optimisation, goal modelling

Name	Integration self-optimisation, online testing and adaptation techniques.
Synopsis	The proposed technique integrates requirements engineering, online testing and adaptation techniques by the means of a shared and protected enterprise service registry.
Authors	Andreas Gehlert
Type	Technique
Description	The proposed technique integrates requirements engineering techniques used to self-optimise SBAs, online testing techniques used to pro-actively detect possible faults in the SBA and adaptation techniques used to actually carry out a necessary adaptation. Therefore, the method achieves both perfective maintenance, e.g. continuously improving the SBA wrt. to its requirements and corrective maintenance, e.g. continuously removing faults from the running system.

	The main idea here is to have an enterprise service registry restricting the dynamism in a meaningful way as the SBA can only use services from this registry. The requirements engineer continuously searches the web for new services and decides whether this service is beneficial for the SBA. In the positive case s/he adds the service to the enterprise service registry. The tester continuously tests the services used by the SBA at run-time. If a failure of such a service is detected, the service is removed from the enterprise service registry. Dynamic binding techniques known from the workflow domain are, finally, used to bind the best fitting service from the enterprise service registry at runtime.
Research questions	Integrating self-optimisation and proactive adaptation.
Related research results	Self-Optimisation of SBAs Proactive Adaptation Framework Based on Online Testing (PROSA)
References	GEHLERT, A.; HIELSCHER, J.; DANYLEVYCH, O.; KARASTOYANOVA, D.: Online Testing, Requirements Engineering and Service Faults as Drivers for Adapting Service Compositions. In: KARASTOYANOVA, D.; KAZHAMIAKIN, R.; METZGER, A.; PISTORE, M. (Eds.): Proceedings of the International Workshop on Service Monitoring, Adaptation and Beyond (MONA+ 2008), December 13, 2008, Madrid, Spain. , 2008, S.39—50
Glossary	-
Keywords	Requirements engineering, self optimisation, goal modelling

2.3.2. Results from JRA-1.2

Name	An Integrated Approach for the Run-Time Monitoring of BPEL Orchestrations
Synopsis	The approach integrates different complementary monitoring approaches in order to achieve more comprehensive, cross-layer monitoring solution
Authors	Luciano Baresi, Sam Guinea, Raman Kazhamiakin and Marco Pistore
Type	technique, language
Description	While there exist several approaches for monitoring the execution of service compositions that concentrate on different properties, adopt different languages, work at different levels of abstraction, and assume different perspectives, there is a need to push a cooperative approach based on the integration of different solutions. The work describes a monitoring framework which is obtained by integrating two well-known approaches, namely Dynamo and Astro. This integration, which happens both for the language used for expressing the properties to be monitored, and for the architecture of the monitoring framework, allows to combine the advantages of the two approaches and to obtain a general, comprehensive solutions for BPEL monitoring.
Research questions	Cross-layer integrated monitoring mechanisms Design for monitoring
Related research results	-

References	http://bibadmin.s-cube-network.eu/show.php?id=26 http://bibadmin.s-cube-network.eu/show.php?id=270
Glossary	-
Keywords	-

Name	Cross-layer Adaptation and Monitoring of Service-Based Applications
Synopsis	The work studies the problem of cross-layer SBA adaptation and monitoting
Authors	Raman Kazhamiakin, Marco Pistore, Asli Zengin
Type	Principle
Description	Most of the research works focus on a particular element of the SBA architecture, they do not consider the effect of changes and adaptations on the whole stack of the functional layers of SBA. In this work the problem of cross-layer SBA monitoring and adaptation and define the requirements for the novel, integrated approaches that provide coherent and holistic solutions for monitoring and adapting the whole application is presented. It is illustrated using a series of case studies. Based on the taxonomy of those requirements, the necessary mechanisms and techniques that constitute an integrated cross-layer framework are identified.
Research questions	Cross-layer integrated monitoring mechanisms Means to identify adaptation strategies across layers
Related research results	-
References	http://bibadmin.s-cube-network.eu/show.php?id=269
Glossary	-
Keywords	-

Name	Exploiting Assumption-Based Verification for the Adaptation of Service-Based Applications
Synopsis	The assumptions about services and context are monitored and analyzed to identify the source of the problem and to trigger appropriate adaptation
Authors	Andreas Gehlert, Antonio Bucchiarone, Raman Kazhamiakin, Andreas Metzger, Marco Pistore, Klaus Pohl
Type	Method
Description	While typically monitoring is used to identify critical changes and to trigger an adaptation of the SBA, the existing monitoring approaches have critical limitation: they are not able to discover a real cause of the problem when the SBA requirement is violated. The approach presented in the work addresses that limitation by explicitly encoding assumptions that the constituent services of an SBA will perform as expected. Based on those assumptions, formal verification is used to assess whether the SBA requirements are satisfied and whether a violation of those assumptions during run-time leads to a violation of the SBA requirements. In this way the approach allows for pro-actively deciding whether the SBA requirements will be violated based on

	monitored failures, and identifying the specific root cause for the violated requirements.
Research questions	Cross-layer identification of adaptation needs Online QA approaches
Related research results	-
References	Gehlert, A. Bucchiarone, R. Kazhamiakin, A. Metzger, M. Pistore, and K. Pohl: "Exploiting Assumption-Based Verification for the Adaptation of Service-Based Applications". In Proc. SOAP track at Symposium on Applied Computing (SOAP@SAC), 2010. To appear
Glossary	-
Keywords	-

Name	Adaptation of Service-Based Applications Based on Process Quality Factor Analysis
Synopsis	The analysis of the SBA quality factors is exploited in order to properly identify the adaptation needs at different modules of SBA and to extract an appropriate adaptation strategy.
Authors	Raman Kazhamiakin, Branimir Wetzstein, Dimka Karastoyanova, Marco Pistore, and Frank Leymann
Type	Technique
Description	When KPIs of an SBA do not reach target values, the influential factors have to be analyzed and corresponding adaptation actions have to be taken. In this paper a novel adaptation approach for service-based applications (SBAs) based on a process quality factor analysis is presented. This approach uses decision trees for showing the dependencies of KPIs on process quality factors from different functional levels of an SBA. The monitoring and analysis approach is extended to come up with an adaptation strategy leading to an SBA that satisfies KPI values. The approach includes creation of a model which associates adaptation actions to process quality metrics, extraction of adaptation requirements based on analysis results, and identification of an adaptation strategy which can consist of several adaptation actions on different functional levels of an SBA.
Research questions	Cross-layer identification of adaptation needs Means to identify adaptation strategies across layers
Related research results	-
References	R. Kazhamiakin, B. Wetzstein, D. Karastoyanova, M. Pistore, and F. Leymann: "Adaptation of Service-Based Applications Based on Process Quality Factor Analysis". In Proc. 2nd Intl. Workshop on Monitoring, Adaptation, and Beyond (MONA+), 2009.
Glossary	-
Keywords	-

Name	Proactive Adaptation Framework Based on Online Testing (PROSA)
Synopsis	The PROSA framework prescribes the required online testing activities and how they lead to adaptation requests.
Authors	Andreas Metzger, Julia Hielscher, Raman Kazhamiakin, Marco Pistore
Type	Technique

Description	The PROSA framework (PRO-active Self-Adaptation) aims at exploiting online testing solutions to proactively trigger adaptations. Online testing means that testing activities are performed during the operation phase of service-based applications (in contrast to offline testing which is done during the design phase). Obviously, an online test can fail; e.g., because a faulty service instance has been invoked during the test. This points to a potential problem that the service-based application might face in the future of its operation; e.g., when the application invokes the faulty service instance. In such a case, PROSA will proactively trigger an adaptation to prevent undesired consequences. The PROSA framework prescribes the required online testing activities and how they lead to adaptation requests.
Research questions	Online Testing for Quality Prediction Predictive SBA monitoring techniques
Related research results	-
References	http://bibadmin.s-cube-network.eu/show.php?id=23 http://bibadmin.s-cube-network.eu/show.php?id=75 http://bibadmin.s-cube-network.eu/show.php?id=123
Glossary	-
Keywords	-

Name	Autonomic Resource Virtualization in Cloud-like Environments
Synopsis	The proposal of autonomous behaviour through specifying the initial adaptation actions that can take place on different failure events of the infrastructure.
Authors	Gabor Kecskemeti (MTA-SZTAKI), Attila Kertesz (MTA-SZTAKI), Ivona Brandic
Type	Technique
Description	The SRV architecture (SLA-based Resource Virtualization) covers the spectrum of service execution from the negotiation phase through the brokering and deployment phases to finally arrive to the actual service request on a specific instance. The autonomous behaviour introduced in the SRV architecture in order to overcome the main disadvantage of the multi phased service execution: a service call could fail between the requester and the service instance even though both are fully functional. With the help of SLAs we also enable the autonomous decision making process on the different components of the architecture in case monitoring events suggest problems with the lower level components.
Research questions	Monitoring and adaptation for autonomous SBA components
Related research results	-
References	http://bibadmin.s-cube-network.eu/show.php?id=135
Glossary	-
Keywords	-

Name	Context and HCI aware adaptation of SBA monitors
Synopsis	This result argues about the significance of user context in monitoring an SBA and presents a framework that supports adaptation of the monitoring of SBA due to the changes in the context of the users' of SBA.

Authors	Andrea Zisman and Ricardo Contreras (City)
Type	Technique
Description	The proposed framework focuses on the different context types related to the user of SBA that affect the way in which monitoring is performed. For instance, the "role" of a user triggers a change in the monitoring rules so a part of the system should be monitored that was not monitored before. The idea is to come up with a set of rule patterns for each of the different user context types including skills, knowledge, role, selection(need) and preferences in addition to the physical contexts such as (location, time, temperature etc). At runtime these rule patterns are applied to adapt the monitoring according to some policies if a change in the corresponding context is detected.
Research questions	Context and HCI aware adaptation of SBA monitors
Related research results	-
References	Paper under preparation.
Glossary	-
Keywords	-

Name	Self-supervising BPEL Processes
Synopsis	The work presents the language and the framework where the monitoring and adaptation of service compositions are unified.
Authors	Luciano Baresi, Sam Guinea
Type	Language
Description	Different efforts were lead in literature to address the issues related to monitoring and recovery of the processes. Each of these approaches is particularly effective in its own sub-domain and does not provide a holistic solution. Due to this, different solutions can be combined to exploit their main advantages and meet different users' needs. In particular, instead of searching for one definitive solution, an integrated framework combining different approaches is provided. This approach augments BPEL processes with self-supervising capabilities. This is achieved by defining appropriate supervision rules. A supervision rule also contains a set of supervision parameters. This meta-level information is used at run time to decide whether a rule needs to be considered or not. The reason is that supervision necessarily introduces a performance overhead, and we want to be able to tailor the exact amount of supervision depending on the needs at hand without changing or redeploying the process.
Research questions	-
Related research results	-
References	L. Baresi, S. Guinea, L. Pasquale: Integrated and Composable Supervision of BPEL Processes. In Proc. ICSOC 2008.
Glossary	-
Keywords	-

Name	A view based Monitoring for Privacy –Aware Web Services
Synopsis	The privacy agreement framework provides an SLA for handling non functional QoS that support the evolution of policies and violation of non functional QoS requirements.
Authors	Hassina Meziane, Salima Benbernou, Mohand-Said Hacid, Mike Papazoglou
Type	Technique
Description	We address the problem of monitoring the compliance of privacy agreement cross layers, that spells out a consumer's privacy rights and how their private information must be handled by the service provider. We present a Privacy Agreement Monitoring system (PDUF), an easy-to-use, and an efficient tool for tightly controlling the private data usage flow dynamically in the area of web services. Some reasoning can be made upon the observations, to enhance the compliance of the privacy agreement, and enrich the knowledge on misuses. We introduce the concept of *usage flow view* that gives a virtual/abstract representation of relevant usage performed on a particular collected personal data in terms actions (1) used to complete the service activity for the *current* purpose for which it was provided (2) used by a service to achieve, other activities than those for which they are provided (*extra-activity*), and their properties (e.g., role, execution time). The usage flow views can be used as a basis to query information maintained by log database. The usage flow view is introduced while composing service. The usage flow view (playing the same role to that of database view in databases) provides views from the abstract PDUF (from business level) corresponding to the triggering clauses of the privacy agreement "output of business layer".
Research questions	Cross-layer integrated monitoring mechanisms Means to identify adaptation strategies across layers
Related research results	-
References	Hassina Meziane, Salima Benbernou, Mohand-Said Hacid, Mike Papazoglou A view based monitoring for priavcy –aware web services to appear at 26th IEEE International Conference on Data Engineering ICDE' 2010.
Glossary	-
Keywords	View-based query, SLA

Name	Evolving Services from a Contractual Perspective
Synopsis	An approach that allows for the controlled evolution of a service by leveraging the loosely-coupled nature of the SOA paradigm
Authors	Vasilios Andrikopoulos, Salima Benbernou, Mike Papazoglou
Type	Technique
Description	An approach that allows for transparency in the evolution of a service as viewed from the perspective of both clients and providers, in the context of the loosely-coupled nature of the SOA paradigm. For that purpose we introduce the contract construct as

	the means to leverage the decoupling of the interacting parties. We present a contract constructing function that bridges the gap between service matching and service mapping. Following on, we build on contractual invariance and contractual evolution to show how to effectively deal with shallow changes to the service provider and client interaction - without the need for adaptation which may lead in turn to deep changes. We plan to investigate how we can build on this work to deal with deep changes and the propagation mechanisms that run through them.
Research questions	Service evolution
Related research results	-
References	Vasilios Andrikopoulos, Salima Benbernou, Mike Papazoglou: Evolving Services from a Contractual Perspective. CAiSE 2009: 290-304
Glossary	-
Keywords	Contract, service versioning, evolution, compatibility

2.3.3. Results from JRA-1.3

Name	A Survey on Service Quality Description
Synopsis	The survey compares the approaches to QoS description nowadays presented in the literature, where several models and meta-models are included.
Authors	K. Kritikos, S. Benbernou, I. Brandic, C. Cappiello, M. Carro, M. Comuzzi, A. Kertész, M. Parkin, B. Pernici, P. Plebani
Type	Survey
Description	The survey compares the approaches to QoS description nowadays presented in the literature, where several models and meta-models are included. Our survey is done by inspecting the characteristics of the available approaches, to reveal which are the consolidated ones and to discuss which are the ones specific to given aspects, and to analyze where the need for further research and investigation is. The approaches here illustrated have been selected based on a systematic review of conference proceedings and journals spanning various research areas in Computer Science and Engineering including: Distributed, Information, and Telecommunication Systems, Networks and Security, and Service-Oriented and Grid Computing.
Research questions	End-to-End Quality definition Language
Related research results	A Survey on Service Quality Description
References	K. Kritikos et al, “A Survey on Service Quality Description”, submitted to ACM Computing Survey, November 2009
Glossary	-
Keywords	-

Name	Service Quality Reference Model
Synopsis	This reference model is intended to provide the S-Cube consortium with a unified terminology for describing different quality attributes of service-based applications.

Authors	A. Metzger, A. Gehlert (UniDUE)
Type	Model
Description	The S-Cube Quality Reference Model will serve as a foundation for defining a quality definition language to be used during quality negotiation and assurance. The quality attributes included in the reference model refers to ten categories: performance, dependability, security, data-related quality, configuration-related quality, network- and infrastructure-related quality, usability, quality of use context, cost, other.
Research questions	End-to-End Quality definition Language
Related research results	A Survey on Service Quality Description
References	http://bibadmin.s-cube-network.eu/show.php?id=229
Glossary	-
Keywords	-

Name	A model for evaluating the KPI measurement in terms of uncertainty
Synopsis	A model for evaluating the KPI measurement in terms of uncertainty defined in terms of confidence and precision.
Authors	Cinzia Cappiello, Kyriakos Kritikos, Pierluigi Plebani (Polimi), Branimir Wetzstein (USTUTT)
Type	Model
Description	Even when some activities of a service-based business processes could not be monitored we need to evaluate KPI. In this case, such a measurement may be affected by the uncertainty due to the lack of monitored information. As a consequence, we introduce the concept of KPI uncertainty, and the two related properties of confidence and precision, which enable to evaluate the trustworthiness of a KPI measurement. The model considers how those properties can be calculated during KPI measurement by relying on a real case study.
Research questions	KPI monitoring for SBA End-to-End Quality definition Language
Related research results	-
References	-
Glossary	Key Performance Indicator
Keywords	-

Name	SAVVY-WS
Synopsis	A Methodology for Specifying and Validating Web Service Compositions
Authors	Carlo Ghezzi, Luciano Baresi, and Sam Guinea (POLIMI)
Type	Methodology
Description	SAVVY-WS's goal is to support the designers of composite services during the validation phase, which extends from design time to run time. SAVVY-WS assumes that service composition is achieved by means of the BPEL workflow language, which

	orchestrates the execution of external Web services..
Research questions	Service Composition run-time validation of non-functional requirements
Related research results	-
References	http://bibadmin.s-cube-network.eu/show.php?id=107 http://bibadmin.s-cube-network.eu/show.php?id=104 http://bibadmin.s-cube-network.eu/show.php?id=124
Glossary	-
Keywords	-

Name	SLA-based resource virtualization approach for on-demand service provision
Synopsis	The SLA-based resource virtualization (SRV) architecture provides a technique for quality assurance for service execution in Clouds
Authors	Attila Kertesz, Gabor Kecskemeti and Ivona Brandic
Type	Technique
Description	The SLA-based resource virtualization architecture provides an extensive solution for executing user applications in Cloud-like environments. This solution combines SLA-based resource negotiations with resource virtualization in terms of on-demand service provision. The architecture description focuses on three topics: agreement negotiation, service brokering and deployment using virtualization.
Research questions	Automated quality negotiation and agreement in diverse service infrastructures
Related research results	-
References	http://bibadmin.s-cube-network.eu/show.php?id=135
Glossary	-
Keywords	-

Name	Runtime Prediction of Service Level Agreement Violations for Composite Services
Synopsis	An approach for predicting SLA violations at runtime, which uses measured and estimated process and QoS metrics as input for a prediction model that is based on machine learning regression techniques and trained using historical service composition instances.
Authors	Philipp Leitner, Branimir Wetzstein, Florian Rosenberg, Anton Michlmayr, Schahram Dustdar, Frank Leymann
Type	technique
Description	For service providers, it is essential to prevent SLA violations as much as possible to enhance customer satisfaction and avoid penalty payments. Therefore, it is desirable for providers to predict possible violations before they happen, while it is still possible to set counteractive measures. We propose an approach for predicting SLA violations at runtime, which uses measured and estimated facts (instance data of the composition or QoS of

	used services) as input for a prediction model. The prediction model is based on machine learning regression techniques, and trained using historical process instances. We present the architecture of our approach and a prototype implementation, and validate our ideas based on an illustrative example.
Research questions	Runtime Prediction of KPIs and SLA Violations Based on Machine Learning Techniques
Related research results	Monitoring and Analyzing Influential Factors of Business Process Performance
References	http://bibadmin.s-cube-network.eu/show.php?id=263
Glossary	-
Keywords	-

Name	Run-time Verification Framework based on Assumptions
Synopsis	The framework describes the required artefacts and activities to determining, during run-time, the violation of requirements.
Authors	Andreas Gehlert, Antonio Bucchiarone, Raman Kazhamiakin, Andreas Metzger, Marco Pistore, Klaus Pohl
Type	Technique
Description	The framework demonstrates how monitoring techniques can be beneficially augmented with verification techniques to support the adaptation of service-based applications. The basic idea of the approach is to start from explicitly documented requirements and assumptions. Assumptions address functional and quality properties of third-party services (e.g., as documented in service-level agreements). A verification step at design time ensures that the SBA fulfils its requirements under the specified assumptions. During run-time, monitoring the assumptions allows detecting violations (e.g., service failures). A violation of SBA's requirements can then be determined by re-verifying the SBA given the violated set of assumptions. If that verification fails, an adaptation, to compensate for the violation of the assumptions, is triggered. Our approach exploits formal verification techniques. By doing so, we limit our approach to those requirements and assumptions, which can be formally expressed. In addition, the verification of complex systems may take considerable resources so that it may no be feasible to use these techniques at run-time. Both issues are subject to future work.
Research questions	Run-time Verification for Quality Prediction
Related research results	-
References	Andreas Gehlert, Antonio Bucchiarone, Raman Kazhamiakin, Andreas Metzger, Marco Pistore, Klaus Pohl: "Exploiting Assumption-Based Verification for the Adaptation of Service-Based Applications", to be published in Proceedings 2010 ACM Symposium on Applied Computing (SAC), 2010
Glossary	-
Keywords	-

Name	Comprehensive QoS Monitoring of Web Services and Event-Based SLA Violation Detection
Synopsis	How can server and client side QoS monitoring be integrated into a SOA environment to inform about current QoS and possible QoS (SLA) violations
Authors	Anton Michlmayr, Florian Rosenberg, Philipp Leitner, Schahram Dustdar
Type	Technique
Description	Integrated into the VRESCo service runtime environment on the client side a monitor named QUATSCH schedules QoS monitoring intervals representing a history of QoS snapshots. The server side monitoring is realized using WPC an integral part of the .NET framework. The SLA monitoring approach works by attaching obligations to services. In a further step the QoS measurements are transferred to an event processing engine. This engine is also aware of the SLA obligations and thus fires according events if violations occur. Interested clients listen to the events and can on-the-fly adapt their invocation behaviors.
Research questions	Advantages of non-intrusive QoS monitoring of services and service compositions
Related research results	-
References	http://bibadmin.s-cube-network.eu/show.php?id=252
Glossary	-
Keywords	-

Name	On Analyzing Evolutionary Changes of Web Services
Synopsis	What is the anatomy of Web Service changes? What are the stakeholders, what are the dependencies, what are the affected parts of Web Service changes?
Authors	Martin Treiber, Hong-Linh Truong, Schahram Dustdar
Type	Methodology
Description	The identified triggers for Web Service changes include changes of requirements. If new functionality is needed the changing requirements can affect the service implementation, interface, SLAs and service pre- and postconditions. Changes at the interface usually require new implementations, affect QoS, service’s pre- and postconditions and finally the original usage. Implementation changes (issued by e.g. by optimizations) need to consider impacts on the interface, in QoS, pre- and postconditions and the usage. Finally, QoS variations are changes observed at runtime and most likely influence service usage and require changes on implementation.
Research questions	Lifecycle of service compositions
Related research results	-
References	Treiber, M. and Truong, H.L. and Dustdar, S.. On Analyzing Evolutionary Changes of Web Services. Lecture Notes In Computer Science, 2009.
Glossary	-
Keywords	-

Name	Exploiting Assumption-Based Verification for the Adaptation of Service-Based Applications
Synopsis	The assumptions about services and context are monitored and analyzed to identify the source of the problem and to trigger appropriate adaptation
Authors	Andreas Gehlert, Antonio Bucchiarone, Raman Kazhamiakin, Andreas Metzger, Marco Pistore, Klaus Pohl
Type	Method
Description	While typically monitoring is used to identify critical changes and to trigger an adaptation of the SBA, the existing monitoring approaches have critical limitation: they are not able to discover a real cause of the problem when the SBA requirement is violated. The approach presented in the work addresses that limitation by explicitly encoding assumptions that the constituent services of an SBA will perform as expected. Based on those assumptions, formal verification is used to assess whether the SBA requirements are satisfied and whether a violation of those assumptions during run-time leads to a violation of the SBA requirements. In this way the approach allows for pro-actively deciding whether the SBA requirements will be violated based on monitored failures, and identifying the specific root cause for the violated requirements.
Research questions	Cross-layer identification of adaptation needs Online QA approaches
Related research results	-
References	Gehlert, A. Bucchiarone, R. Kazhamiakin, A. Metzger, M. Pistore, and K. Pohl: “Exploiting Assumption-Based Verification for the Adaptation of Service-Based Applications”. In Proc. SOAP track at Symposium on Applied Computing (SOAP@SAC), 2010. To appear
Glossary	-
Keywords	-

Name	Towards Correctness Assurance in Adaptive Service-Based Applications
Synopsis	The work studies the problems with the SBA functioning specific to the adaptation process and identifies possible directions to deal with those problems.
Authors	Raman Kazhamiakin, Andreas Metzger and Marco Pistore
Type	Principle
Description	Research on SBAs thus has already produced a range of adaptation techniques and strategies. However, adaptive SBAs are prone to specific failures that would not occur in “static” applications. Examples are faulty adaptation behaviours due to changes not anticipated during design-time, or conflicting adaptations due to concurrently occurring events. For adaptive SBAs to become reliable and thus applicable in practice, novel

	techniques that ensure the correctness of adaptations are needed. To pave the way towards those novel techniques, this work identifies different kinds of adaptation-specific failures. Based on a classification of existing adaptation approaches and generic correctness assurance techniques, it discusses how adaptation-specific failures can be addressed and where new advanced techniques for correctness assurance of adaptations are required.
Research questions	Adaptation quality framework
Related research results	-
References	http://bibadmin.s-cube-network.eu/show.php?id=28
Glossary	-
Keywords	-

Name	Proactive SLA negotiation
Synopsis	This result argues about the necessity of proactive SLA negotiation to handle the violation of an agreed SLA and present a framework that supports proactive SLA negotiation.
Authors	George Spanoudakis and Khaled Mahbub (City)
Type	Technique
Description	In the proposed framework an alternative service provider is identified and SLA is negotiated by the participating parties prior to a foreseen problem in the existing SLA. When the existing SLA is violated the faulty service provider is replaced by the newly selected service provider. A monitor component monitors the existing SLA and detects the conditions that trigger the proactive SLA negotiation. A Service discovery component identifies a list of potential service providers by analyzing the structural and behavioural characteristics of the services and the published SLA templates (i.e., service levels advertised by providers, e.g. gold vs. silver vs. bronze “service pack”). The list of potential service providers is updated as soon as a new service is available or at regular interval to make sure that the services with the most up to date offers are considered for the SLA negotiation. The proactive SLA negotiation is achieved in two phases, namely i) pre-agreement and ii) agreement. In the pre-agreement phase the published SLAs of the potential service providers are negotiated and SLOs are agreed by the service provider and the service consumers. It should be noted that at this phase the SLA has not been put into force rather it may establish a time frame within which the pre-agreement can be automatically brought into force without further negotiation. If this time frame elapses without the SLA been putting into force, the SLA should be renegotiated and a new time frame should be established.
Research questions	Proactive SLA negotiation and agreement
Related research results	-
References	-
Glossary	-
Keywords	-

Name	A Dynamic Privacy Model for Web Services
Synopsis	The privacy agreement framework provides an SLA for handling non functional QoS that support the evolution of policies and violation of non functional QoS requirements.
Authors	Salima Benbernou, Hassina Meziane
Type	Technique
Description	We propose a privacy agreement model that spells out a set of requirements related to consumer's privacy rights in terms of how service provider must handle privacy information. We define two levels in the agreement (1) policy level (2) negotiation level. A formal privacy model is described in the policy level to provide upon it a reasoning mechanism for the evolution. The framework supports in the negotiation level of the agreement a lifecycle management which is an important deal of a dynamic environment that characterizes Web services. Hence, the privacy evolution is handled in this level. A negotiation protocol is proposed to enable ongoing privacy negotiation to be translated into a new privacy agreement.
Research questions	SLA Negotiation for non functional QoS
Related research results	-
References	CD JRA 1.3.2 (a journal paper is under revision)
Glossary	-
Keywords	-

Name	SoftConstraint based Approach for QoS-aware Service Selection
Synopsis	The framework describes the required artefacts and activities to determining, during run-time, the violation of requirements.
Authors	Salima Benbernou, Manuel Carro, Mohand-Said Hacid, Mohamed Zemini
Type	Technique
Description	The framework describes a soft constraint approach to handle the relaxation and penalties. In fact, with Soft CSPs, we can obtain a suitable solution for that problem by allowing degrading the solution quality in accordance with customer preferences of the SLA. Moreover, SLA should include penalties in this case. Effectively, we have to distinguish two types of penalties: behavioral ones which concern the behavior of the customer or the service provider and arithmetical.
Research questions	Run-time Verification for Quality Prediction
Related research results	-
References	Salima Benbernou, Manuel Carro, Mohand-Said Hacid, Mohamed Zemini (under submission)
Glossary	-
Keywords	-

Name	Towards Data-Aware Cost-Driven Adaptation for Service Orchestrations
Synopsis	Several activities in service oriented computing, such as automatic composition, monitoring, and adaptation, can benefit from

	knowing properties of a given service composition before executing them. Among these properties we will focus on those related to execution cost and resource usage, in a wide sense, as they can be linked to QoS characteristics.
Authors	Dragan Ivanovic, Manuel Carro (UPM) and Manuel Hermenegildo (UPM/IMDEA Software)
Type	method
Description	In order to attain more accuracy, we formulate execution costs / resource usage as functions on input data (or appropriate abstractions thereof) and show how these functions can be used to make better, more informed decisions when performing composition, adaptation, and proactive monitoring. We present an approach to, on one hand, synthesizing these functions in an automatic fashion from the definition of the different orchestrations taking part in a system and, on the other hand, to effectively using them to reduce the overall costs of non-trivial service-based systems featuring sensitivity to data and possibility of failure. The approach is validated by means of simulations of scenarios needing runtime selection of services and adaptation due to service failure. A number of rebinding strategies, including the use of cost functions, are compared.
Research questions	How can cost-based derivation of data-aware QoS for a service composition be used to drive adaptation?
Related research results	-
References	-
Glossary	-
Keywords	Adaptation, QoS, composition, analysis, resource usage

Name	An Initial Proposal for Data-Aware Resource Analysis of Orchestrations with Applications to Proactive Monitoring
Synopsis	We focus on how statically inferred cost functions on input data, which represent safe upper and lower bounds for different cost measures, can be used to predict some runtime QoS-related values (to, e.g., validate compositions at design time) and to compare actual and predicted resource usage at run-time in order to take adaptive actions if needed.
Authors	Dragan Ivanovic, Manuel Carro (UPM) and Manuel Hermenegildo (UPM/IMDEA Software)
Type	method
Description	In our approach a BPEL-like orchestration is expressed in an intermediate language which is in turn automatically translated into a logic program. Cost and resource analysis tools are applied to infer functions which, depending on the contents of some initial incoming message, return safe upper and lower bounds of some resource usage measure.
Research questions	How can cost-based derivation of data-aware QoS for a service composition be used for predictive monitoring?
Related research results	-
References	-
Glossary	-

Keywords	Monitoring, QoS, composition, analysis, resource usage

2.3.4. Results from JRA-2.1

Name	Understanding about design-time concepts, mechanisms and languages for specifying, analyzing, and simulating end-to-end processes in agile service networks
Synopsis	Service networks realize various end-to-end processes, some of which are transactional in nature (see below). There is an acute need to develop better understanding of their design, possibly fuelled by simulation techniques. Design time concepts, mechanims and languages for specifying, analyzing and simulation of end-to-end processes–including the protocols that govern them- are still ill understood
Authors	Work-package team
Type	Exploratory study/Design Science
Description	ASNs essentially provide much more functionality and flexibility when compared to traditional BPM, enabling organizations to innovate new value delivery systems that transcend the enterprise and extend to every external partner. Given the emphasis of existing BPM concepts, techniques and tools on single enterprise processes, they cannot be simply applied to agile service networks. In particular, end-to-end business processes in ASNs span organization boundaries posing a number of significant business and technology challenges. First, network partners in the ASNs need to agree upon explicit and unambiguous standards that specify precisely the data and common business documents, such as purchase orders and invoices, which the disparate systems can exchange. Second, and, more importantly, they require loose coupling on the basis of precise business interaction protocols. Such business protocols are by necessity message-centric: they specify the flow of messages representing business activities among trading partners (without requiring any specific implementation mechanism). Collectively, business process protocols and associated data format and message exchange standards provide the means for automated, system-to system exchange of data and messages between network partners.
Research questions	-
Related research results	-
References	See deliverable PO-JRA-2.1.1/PO-JRA-2.1.2
Glossary	-
Keywords	Business protocols, agile service networks, service analysis and design

Name	Understanding of IT-enabled business process management and SNA theory and their potential use within the agri-food sector.
Synopsis	Our research activities to date have highlighted a significant level of uncertainty within the agri-food sector. We have also identified that there are unique properties within this sector which differentiates it from other economic sectors. We have noted that SNA theory is a potential area for further investigation with relation to this sector.
Authors	Noel Carroll, Eoin Whelan, Ita Richardson

Type	Exploratory study
Description	We need to explore how we can visualise, monitor, and report (qualitatively and quantitatively) on the relationships which exist within agile service networks. Flynn & Flynn (1999), report that the evaluation of IT-enabled processes in human resources, communication and managerial studies can contribute more by reducing organisational complexity than IT. To exasperate this, van Oosterhout et al. (2007), report that despite the history of the concept of agility, there is by far no consensus yet as to what exactly it is which emphasises our lack of understanding on how we could assess and achieve agility. Although many organisations assume they exercise agile practices, they often struggle to monitor this to analyse the „level" of agility. Thus, we need a new lens to gain a more holistic initial viewpoint with the aim to build on theoretically sound and tested models within BPM. This model should incorporate dynamic measures of agile KPIs across service networks. Our thesis is that social network analysis (SNA) can provide us with the methodology to monitor agile service networks (ASN) across virtual organisations.
Research questions	-
Related research results	-
References	- Flynn, B. B., & Flynn, E. J., (1999), Information-Processing Alternatives for Coping with Manufacturing Environment Complexity, Decision Sciences, Volume 30, Issue 4, pp.1021–1052. - Van Oosterhout, M., Waarts, E., van Heck, E., and van Hillegersberg, J., (2007). Business Agility: Need, Readiness and Alignment with IT Strategies, Chapter 5, pp. 52-69. In Desouza, K. C., (2002). Agile Information Systems: Conceptualization, Construction and Management. Butterworth/Heinemann: London.
Glossary	-
Keywords	-

Name	Understanding about concepts, mechanism and languages for run-time monitoring of business transactions.
Synopsis	Service based applications that support end-to-end processes in service networks typically involve well-defined process fragments such as payment processing, shipping and tracking, determining new product offerings, granting/extending credit, managing market risk and so on. These reflect standard process fragments that apply to a variety of application scenarios. Although such process fragments drive transactional applications between service network partners, they are completely external to current Web services transaction mechanisms and are only expressed as part of application logic. To remedy this situation, this we need to investigate a business-aware transaction model and business transaction language, which is driven by 'transactional' process fragments, and which treats transactional fragments as first class citizens. The model allows emphasises transactional process fragments such as payment and credit conditions, delivery conditions, business agreements stipulated in SLAs, liabilities

	and dispute resolution policies. It allows blending these fragments with QoS criteria such as security support to guarantee integrity of information, confidentiality, and non-repudiation.
Authors	Workpackage team
Type	Exploratory study/Design Science
Description	Conventional approaches to business transactions, such as Open EDI, the UN/CFACT Modeling Methodology (UMM) and ebXML, merely focus on the documents exchanged between partners, rather than coupling their application interfaces, which inevitably differ. In fact, the basic idea behind existing approaches is to define a library of standard electronic XML business documents such as invoices, purchase orders, and ship notices - possibly described in the Universal Business Language (UBL) to provide an intuitive framework for specifying the business logic and computations that take place on each end of a document exchange. For example, if a customer sends a purchase order to manufacturer, which the manufacturer can fulfill, it will then respond with an invoice and a shipping notice. How such documents are produced and what (service) operations result when they are consumed is strictly up to the business at each end of the document exchange. Existing approaches to system-level transactions on the other hand, revolve around a triad of Web-services standards: BPEL, WS-Coordination and WS-Transaction. Unfortunately however, business transactions are largely external to current Web services transaction concepts and mechanisms, and are typically hard-coded in application logic, severely hindering maintenance and adaptation, which are essential in ASNs. Accommodating business-aware transactions invokes many new, and very challeging, cross-cutting research challenges and questions (see below).
Research questions	-
Related research results	-
References	See deliverable PO-JRA-2.1.1/PO-JRA-2.1.2/PO-JRA-2.1.3
Glossary	-
Keywords	Business transactions, long-running transactions, QoS aware processes, end-to-end processes, transactional process fragments

Name	A formal model for business transaction using temporal logic, B method and StAC
Synopsis	As the most advanced business transaction system model, our preliminary model is built on a temporal logic specification of business transaction. Then, given a specification other transactional properties should be deduced as in a classical business rules engine. Finally we use a program refinement theory in order to propose the corresponding executable specification of the declarative business transaction language specification.
Authors	Francois Hantry and Rafiq Haque
Type	Technique-design
Description	As the most advanced business transaction system model, our

	preliminary model is built on a temporal logic specification of business transaction. Two models are proposed: a weak and a strong model. The weak model corresponds to the flexible intuition of business transaction atomicity, but the strong model corresponds to a strict business transaction atomicity. In our framework, given a specification other transactional properties should be deduced as in a classical business rules engine. Finally we use B method and Stac specification in order to propose the corresponding executable specification of a declarative business transaction language. This proposition is built on refinement method from the distributed software engineering community.
Research questions	-
Related research results	-
References	JRA-2.1.3 paper to be submitted (R.Haque and F.Hantry)
Glossary	-
Keywords	business transaction, vitality, atomicity

2.3.5. Results from JRA-2.2

Name	Monitoring and Analyzing Influential Factors of Business Process Performance
Synopsis	An approach to analyzing influential factors (QoS and process metrics) of KPIs of service compositions based on decision trees
Authors	Branimir Wetzstein, Philipp Leitner, Florian Rosenberg, Ivona Brandic, Schahram Dustdar, Frank Leymann
Type	technique
Description	We provide a framework for performance monitoring and analysis of WS-BPEL processes, which consolidates process events and Quality of Service measurements. The framework uses data mining techniques in order to construct tree structures, which represent the dependencies of a KPI on process and QoS metrics. These dependency trees allow business analysts to analyze how the process KPIs depend on lower-level process metrics and QoS characteristics of the IT infrastructure. Deeper knowledge about the structure of dependencies can be gained by drill-down analysis of single factors of influence.
Research questions	Analysis of Influential Factors of KPIs and SLA Violations Based on Machine Learning techniques
Related research results	Runtime Prediction of Service Level Agreement Violations for Composite Services
References	http://bibadmin.s-cube-network.eu/show.php?id=127
Glossary	-
Keywords	-

Name	Adaptation of Service-Based Applications Based on Process Quality Factor Analysis
Synopsis	An approach to identification of adaptation strategies based on process quality factor analysis using decision trees
Authors	Raman Kazhamiakin, Branimir Wetzstein, Dimka Karastoyanova,

	Marco Pistore, Frank Leymann
Type	technique
Description	We present an adaptation approach for service-based applications (SBAs) based on a process quality factor analysis. It is based on an existing analysis approach that uses decision trees for showing the dependencies of KPIs on process quality factors from different functional levels of an SBA. We extend the monitoring and analysis approach and show how the analysis results may be used to come up with an adaptation strategy leading to an SBA that satisfies KPI values. The approach includes creation of a model which associates adaptation actions to process quality metrics, extraction of adaptation requirements based on analysis results, and identification of an adaptation strategy which can consist of several adaptation actions on different functional levels of an SBA.
Research questions	Adaptation of QoS-aware Service Compositions based on Influential Factor Analysis and Prediction
Related research results	Monitoring and Analyzing Influential Factors of Business Process Performance
References	Kazhamiakin, Raman; Wetzstein, Branimir; Karastoyanova, Dimka; Pistore, Marco; Leymann, Frank: Adaptation of Service-Based Applications Based on Process Quality Factor Analysis. In: Proceedings of the 2nd Workshop on Monitoring, Adaptation and Beyond (MONA+), co-located with ICSOC/ServiceWave 2009.
Glossary	-
Keywords	-

2.3.6. Results from JRA-2.3

Name	Dynamic adaptation of services on Grids
Synopsis	Dynamic optimization of resource usage and SLA conformance
Authors	INRIA
Type	Technique
Description	We are studying how to apply dynamic adaptation principles at the level of one single service running on a Grid infrastructure. We are building a prototype based on the OSGi component framework, the XtreemOS (XO SAGA) interface and the Wildcat monitoring tool. We intend to define explicit links between the QoS of OSGi services and Grid resource utilization in order to be able to optimize resource usage while conforming to a given SLA.
Research questions	Self-optimization and self-healing of a single service
Related research results	-
References	-
Glossary	-
Keywords	GRID, self-*, adaptation

Name	Mechanisms for distributed and coordinated decision making (work in progress)
Synopsis	Design of decision algorithms
Authors	INRIA

Type	mechanism
Description	-
Research questions	Supporting adaptation of service-based applications
Related research results	Planning algorithms for distributed adaptation
References	-
Glossary	-
Keywords	-

Name	Planning algorithms for distributed adaptation (work in progress)
Synopsis	Planning of distributed and parallel adaptation actions using specific algorithms
Authors	INRIA
Type	mechanism
Description	-
Research questions	Supporting adaptation of service-based applications
Related research results	Mechanisms for distributed and coordinated decision making
References	-
Glossary	-
Keywords	-

Name	A chemical metaphor to model service selection for composition of services
Synopsis	An attempt to create a framework for self-evolving, dynamic, self-adapting service composition base don the chemical paradigm
Authors	SZTAKI, CNR
Type	Methodology
Description	Service-based applications are composed of a number of possibly independent services that are available in a network and provided by many actors under different conditions (like price, time to deliver, and so on). Service provision conditions may change in time depending on provider policies, and as such they cannot be statically advertised together with the service description. Propose and investigate the possibility to use the chemical computational model to finding compositions of services that satisfy time constraints coming from the structure of an abstract workflow against the time availability associated to each service component.
Research questions	Supporting adaptation of service-based applications
Related research results	Chemical distributed infrastructure model for services
References	C. Di Napoli, M. Giordano, Zs. Németh, N. Tonellotto: A chemical metaphor to model service selection for composition of services. Proceedings of the Second International Workshop on Parallel, Architectures and Bioinspired Algorithms (held in conjunction with PACT'09), ISBN 978-84-692-3675-8, pp. 11-19.
Glossary	Self-*, self-adaptation
Keywords	Nature inspired models, adaptation, self-organization

Name	Chemical distributed infrastructure model for services

Synopsis	Use of the Chemical model for service oriented computing
Authors	INRIA
Type	Model
Description	Definition of the representation of services, interaction between services and workflows in the chemical model
Research questions	Supporting adaptation of service-based applications
Related research results	Chemical self-* services Chemical distributed infrastructure A chemical metaphor to model service selection for composition of services
References	Jean-Pierre Banatre and Thierry Priol : Chemical Programming of Future Service-oriented Architectures. JOURNAL OF SOFTWARE, VOL. 4, NO. 7, SEPTEMBER 2009
Glossary	-
Keywords	Chemical programming

Name	Chemical distributed infrastructure
Synopsis	Implementation of a Distributed multiset for Chemical programming
Authors	INRIA
Type	Mechanism
Description	Definition and implementation of a distributed multiset allowing distributed interactions between chemical programs implementing a service oriented architecture.
Research questions	Scalable and fault tolerant techniques for service discovery Supporting adaptation of service-based applications
Related research results	Chemical distributed infrastructure model for services Chemical self-* services
References	-
Glossary	-
Keywords	Chemical programming, adaptation, self-*

Name	Chemical self-* services
Synopsis	Using the chemical programming paradigm to provide services with self-* properties
Authors	INRIA
Type	Technique
Description	Techniques for supporting self-adaptation based on the chemical model. Implementation of an interface for standard Web services in the chemical programming environment. Representation of QoS and SLA for chemical services.
Research questions	Supporting adaptation of service-based applications
Related research results	Chemical distributed infrastructure model for services Chemical distributed infrastructure
References	Jean-Pierre Banatre and Thierry Priol : Chemical Programming of Future Service-oriented Architectures. JOURNAL OF SOFTWARE, VOL. 4, NO. 7, SEPTEMBER 2009
Glossary	-
Keywords	Chemical programming, adaptation, self-*

Name	SLA-based resource virtualization approach for on-demand service provision
Synopsis	The SLA-based resource virtualization (SRV) architecture provides a technique for on-demand service provision and quality assurance for service execution in Clouds and Grids
Authors	SZTAKI, TUW
Type	Technique
Description	The SLA-based resource virtualization architecture provides an extensive solution for executing user applications in Cloud-like environments. This solution combines SLA-based resource negotiations with resource virtualization in terms of on-demand service provision. The architecture description focuses on three topics: agreement negotiation, service brokering and deployment using virtualization.
Research questions	On-demand, dynamic service provisioning
Related research results	-
References	http://bibadmin.s-cube-network.eu/show.php?id=135
Glossary	Self-*, self-adaptation, service deployment, service level agreement, SLA negotiation, brokering
Keywords	Negotiation, brokering, deployment, dynamic provisioning

Name	An approach for selecting Web Services based on structured and unstructured user feedback
Synopsis	An approach for supporting users in the Internet of Services to select good services from a large number of alternatives. The approach makes use of structured and unstructured feedback from previous service users, and is demonstrated based on a travel case study.
Authors	TUW
Type	Technique
Description	Since the Internet of Services (IoS) is becoming reality, there is an inherent need for novel service selection mechanisms, which work in spite of large numbers of alternative services and take the user-centric nature of services in the IoS into account. One way to do this is to incorporate feedback from previous service users. However, practical issues such as trust aspects, interaction contexts or synonymous feedbacks have to be taken into account. This research result involves a service selection mechanism that makes use of structured and unstructured feedback to capture the Quality of Experience that services have provided in the past. We have implemented our approach within the SOA runtime VRESCo, where we use freeform tags for unstructured and numerical ratings for structured user feedback. We have performed a case study and analysed the results.
Research questions	Selecting Web Services Based on Structured and Unstructured User Feedback
Related research results	-
References	http://bibadmin.s-cube-network.eu/show.php?id=254
Glossary	-
Keywords	-

Name	Preventing runtime SLA violations in Windows Workflows
Synopsis	Provide techniques to automatically adapt Windows Workflows based on predictions of SLA violations. Adaptation can happen either through data manipulation, service rebinding or by applying AOP-like modifications to workflows.
Authors	TUW, University of Stuttgart
Type	Technique
Description	This result involves using predictions of SLA violations as covered in “Runtime Prediction of KPIs and SLA Violations Based on Machine Learning Techniques” to automatically adapt Windows Workflows (i.e., service compositions implemented using the Windows Workflow technology), with the goal of ultimately preventing SLA violations. Adaptation is done on instance or composition level, and can be: (a) simple data manipulation, (b) service rebinding, or (c) structural adaptation of the composition. For the latter, techniques similar to aspect-oriented programming (AOP) can be used, as this approach has been demonstrated before for WS-BPEL based service compositions (and can arguably also be applied to Windows Workflows.
Research questions	Runtime SLA Violation Prevention
Related research results	-
References	-
Glossary	-
Keywords	-