Grant Agreement N° 215483

Title:	*Initial assessment of results of a separate mobility program for researchers and students*
Authors:	*UniDue, Tilburg, CITY, CNR, FBK, INRIA, Lero, POLIMI, SZTAKI, TUW, UCBL, UOC, UPM, USTUTT, UHH, VUA*
Editor:	*Branimir Wetzstein (USTUTT)*
Reviewers:	*Andreas Gehlert (UniDue)*
	Barbara Pernici (POLIMI)
	Mohand-Said Hacid (UCBL)
Identifier:	*Deliverable # CD-IA-2.1.3*
Type:	*Deliverable*
Version:	*1.0*
Date:	*14 December 2009*
Status:	*Final*
Class:	*External*

Management Summary

This deliverable provides a preliminary evaluation of the effectiveness and efficiency of the S-Cube mobility program. Based on the results of the mobility stays performed in the first 18 months of the project, we analyze the how the scientific subjects for mobility and the S-Cube integration framework elements have been covered. We further analyze the synergy of competencies between partners and perform a quantitative evaluation based on a set of performance indicators. For each of the analyzed aspects we identify gaps which will be addressed in future mobility exchanges.

The research leading to these results has received funding from the European Community's Seventh Framework Programme [FP7/2007-2013] under grant agreement n° 215483 (S-Cube).

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
The French National Institute for Research in Computer Science and Control	France
Lero - The Irish Software Engineering Research Centre	Ireland
Politecnico di Milano	Italy
MTA SZTAKI – Computer and Automation Research Institute	Hungary
Vienna University of Technology	Austria
Université Claude Bernard Lyon	France
University of Crete	Greece
Universidad Politécnica de Madrid	Spain
University of Stuttgart	Germany
University of Hamburg	Germany
Vrije Universiteit Amsterdam	Netherlands

Published S-Cube documents

All public S-Cube deliverables are available from the S-Cube Web Portal at the following URL:

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/

Table of Contents

List of Acronyms

A&M	Adaptation and Monitoring
ASN	Agile Service Network
BPEL	Business Process Execution Language
BPM	Business Process Management
CEP	Complex Event Processing
EAI	Enterprise Application Integration
GUI	Graphical User Interface
KPI	Key Performance Indicator
PPM	Process Performance Metric
QA	Quality Assurance
QoS	Quality of Service
SC	Service Composition
SC&C	Service Composition and Coordination
SI	Service Infrastructure
SLA	Service Level Agreement
SN	Service Network
SOA	Service Oriented Architecture

1 Introduction

The S-Cube mobility program supports young researchers in carrying out joint research through the reimbursement of travel and living expenses at the host institution. The goal of the mobility program is to support integration of knowledge and the alignment of research activities between different research groups and across S-Cube research domains.

In the previous deliverable CD-IA-2.1.2 “Identification of Scientific Subjects and Partners for Mobility”, we have identified scientific subjects for mobility and we have analyzed overlaps in the competencies of the S-Cube partner institutes thus pro-actively identifying suitable candidates for the mobility program. Based on that analysis, the goal of this deliverable is to perform a preliminary evaluation of the effectiveness and efficiency of the mobility program in the first 18 months of the project.

In this period 24 mobility stays took place. For each stay the results have been collected and summarized (see Appendix B). Based on that data, we have analyzed the results using different views. The objective of is to analyze results of the mobility program and use them to understand how we can proceed in the future to cover the identified gaps. We first analyze how the scientific subjects have been covered so far and how the competencies of the partners based on the knowledge model have been combined. Secondly, we analyze how the results have contributed to workpackages and how the integration framework baseline with its different views has been covered. We finally perform a quantitative analysis based on S-Cube KPIs and further indicators.

The results of the initial assessment in this deliverable will be used in the next deliverable CD-IA-2.1.4 “Mobility programme determined based on the S-Cube Convergence Knowledge Model and Optimisation of mobility policies and exchange scheme” for updating the pro-active mobility plan. The last two deliverables of the workpackage, PO-IA-2.1.6 and CD-IA-2.1.7 will then perform an intermediate assessment and concluding assessment, respectively.

The structure of the deliverable is as follows. In order to keep the deliverable compact, we have put the list of the mobility stays performed so far, which for each stay summarizes its main results and their relation to scientific subjects, workpackages, and integration framework views, into the Appendix B. Based on that data, we analyze different aspects in the Section 3, 4, 5 and 6. In Section 3 we analyze how scientific subjects for mobility have been considered and how competencies from different partners have been shared to accomplish common objectives to fulfill precise research subjects. Section 4 analyzes how the results have contributed to the different workpackages. In Section 5, the coverage of the integration framework baseline views is analyzed. Finally, in Section 6 we evaluate a set of performance indicators defined in the description of work. In Section 7, we summarize the analysis results and make suggestions for the next mobility period.

2 Scientific Subject Coverage and Synergy of Competencies

Based on the provided descriptions of the mobility stays by the visitors in Appendix B, we are able to establish the following table (Table 1). It gives, for each performed visit (in the rows), the covered scientific subjects for mobility as specified in the previous deliverable CD-IA-2.1.2. The table column numbers refer to the list of scientific subjects (Appendix A). (Note that these scientific subjects are not the same as the research challenges and research questions which will be specified as part of the first version of the integration framework in CD-IA-3.1.2. As that deliverable is due in M21 we cannot analyze the coverage of research challenges here.)

Table 1 shows that the following subjects have not been covered:

- Subject 5: Information quality
- Subject 6: Interaction
- Subject 7: Grid computing
- Subject 11: Quality assurance
- Subject 14: Service architectures
- Subject 15: Security
- Subject 22: User-centered requirements engineering[1]

Id	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
1		X																				
2		X							X			X				X			X			
3			X																			
4				X														X				
5		X						X								X		X				
6		X														X	X					
7										X							X					
8								X					X					X			X	
9			X																			
10	X								X											X		
11	X															X				X		
12	X															X			X			
13									X										X			
14		X														X						
15		X											X							X		
16	X	X							X			X				X			X			
17		X							X			X				X			X			
18													X							X		
19		X							X			X				X			X			
20	X	X														X	X		X			

[1] This subject is being covered by a collaboration between UniDue and City including visits, which have however not been financed by the mobility program.

21		X																			
22		X														X					

Table 1: Research Topics of Visits – Scientific Subjects for Mobility

Table 2 shows which competencies of the partners as declared in the knowledge model (glossary, see CD-IA-2.1.2) are concerned by the subjects/topics of the visits. For example, for the research topic "Service Systems and Business Process Management" UoC's expertise in service networks has been combined with Tilburg's competency in business processes and service composition in order to work on the integration of the corresponding two layers. Note that only the subset of partner competencies relevant for the topic has been listed here. The table clearly indicates a synergy of research at different institutions.

Id	Research topic	Partner 1	Competencies of partner 1	Partner 2	Competencies of partner 2
1	Service Systems and Business Process Management	UoC	Service networks	Tilburg	Business processes, service composition
2	Monitoring and Analysis of Influential Factors of Business Process Performance	USTUTT	Performance indicators Monitoring Process analysis	TUW	KPI Monitoring
3	Business Protocol Soundness	Tilburg	Business Process Languages Process execution	UPM	Business protocols Compatibility
4	Controlled Evolution of Services	Tilburg	Service choreography Service evolution	UCBL	Business protocol languages
5	Service Networks on top of the BPM layering stack	USTUTT	Business processes Modeling Performance indicators	UoC	Level of services Service specification
6	Internet of Services (IoS): bring human inside the workflow of software services	CNR	Grid workflow	TUW	Service Discovery, Service Architectures
7	Semantic based negotiation	POLIMI	Service negotiation	UoC	Ontologies for services Semantics
8	Configuration and deployment of SaaS applications using techniques from software product lines	USTUTT	Enterprise application integration ESB	UniDue	SBA
9	Replaceability and conformance analysis for business protocols	Tilburg	Formal specification Service analysis	UPM	Business protocols Compatibility
10	Exploiting codified human interaction (HCI) and context knowledge for engineering, monitoring and adapting service-based	UniDue	Requirements analysis	CITY	Human computer interaction Requirement analysis engineering

	applications				
11	Integrating requirements engineering, online testing and adaptation of workflows	UniDue	Requirements analysis/engineering Testing	USTUTT	Integration Adaptation mechanisms
12	Comparison between *SCENE* and BPEL'n'Aspects	POLIMI	Design for adaptation	USTUTT	Business processes
13	Calculating Service Fitness in Service Networks	TUW	KPI monitoring	Tilburg	QoS monitoring
14	Service Networks and Service Compositions	USTUTT	Service choreography Modeling Performance indicators	Tilburg	Service choreography Service specification Evolution
15	The interface between requirements engineering and workflows	UniDue	Requirement engineering	USTUTT	Workflow
16	Adaptation of SBAs based on process quality factor analysis	FBK	(Self) Adaptation SBA analysis	USTUTT	KPI BP analysis
17	Enhancing Service Network Analysis and Service Selection using Requirements-based Service Discovery	CITY	Service discovery	UoC	Quality of service Service discovery
18	The role of assumptions in the engineering and adaptation processes of service-based applications.	UniDue	Adaptation requirements Adaptation strategies	FBK	Adaptation mechanisms Business process modeling
19	Primary Research on Software Process for SBA Development	LERO	"Industrial expertise"	CITY	User-centered requirements engineering
20	Replacement policies for dynamic Adaptation of SBAs	INRIA	Adaptation requirements Adaptation mechanisms	CITY	Service composition
21	Paradigm of model management, refinement, consistency, model checker	UCBL	Business Process Languages	INRIA	Verification
22	Designing Adaptive Service-based Applications using Service Granularity	POLIMI	Adaptation requirements Design for adaptation	CITY	User-centered requirement engineering Requirements analysis

Table 2: Research subjects of the visits – competencies of the partners

Table 3 synthesizes the research visits by considering the couples (sending institution (lines), hosting institution (columns)). For example, there are two research visits from UniDue to USTUTT and one research visit from Tilburg to UCBL. Our analysis shows that SZTAKI, UPM, UniHH, and VUA didn't perform research visits yet, and CNR, LERO-UL, SZTAKI, POLIMI, UniHH and VUA have not acted as host institutions yet. Note that UniHH and VUA have not participated in the project from the beginning, but joined in 2009.

		Hosting Institutions															
Visiting Institutions		**UniDue**	**Tilburg**	**CITY**	**CNR**	**FBK**	**INRIA**	**Lero-UL**	**SZTAKI**	**POLIMI**	**TUW**	**UCBL**	**UoC**	**UPM**	**USTUTT**	**UniHH**	**VUA**
	UniDue			1		1									2		
	Tilburg											1		2			
	CITY												1				
	CNR										1						
	FBK														1		
	INRIA			1													
	LERO-UL			1													
	SZTAKI																
	POLIMI			1									2		1		
	TUW		1														
	UCBL						1										
	UoC		1														
	UPM																
	USTUTT	1	1								1		1				
	UniHH																
	VUA																

Table 3: Research exchanges between partners

3 Workpackage Coverage

Table 4 shows, for each performed visit, the covered research topic and the related workpackages in whose deliverables the results will be described. This information has been derived from the field "Related to S-Cube WPs/Deliverables" in the mobility stay descriptions (Appendix B). For example, the research stay regarding "Monitoring and Analysis of Influential Factors of Business Process Performance" is concerned with the work packages JRA-2.2 and JRA-1.2 and its results have been or will be described in corresponding deliverables in these workpackages.

Id	Research Topic	JRA-1.1	JRA-1.2	JRA-1.3	JRA-2.1	JRA-2.2	JRA-2.3
1	Service Systems and Business Process Management				X		
2	Monitoring and Analysis of Influential Factors of Business Process Performance		X			X	
3	Business Protocol Soundness				X	X	
4	Controlled Evolution of Services	X	X				
5	Service Networks on top of the BPM layering stack				X	X	
6	Internet of Services (IoS): bring human				X	X	X

	inside the workflow of software services						
7	Semantic based negotiation			X			
8	Configuration and deployment of SaaS applications using techniques from software product lines	X					
9	Replaceability and conformance analysis for business protocols				X	X	
10	Exploiting codified human interaction (HCI) and context knowledge for engineering, monitoring and adapting service-based applications	X					
11	Integrating requirements engineering, online testing and adaptation of workflows	X		X		X	
12	Comparison between *SCENE* and BPEL'n'Aspects		X		X	X	
13	Calculating Service Fitness in Service Networks			X	X	X	
14	Service Networks and Service Compositions				X	X	
15	The interface between requirements engineering and workflows	X				X	
16	Adaptation of SBAs based on process quality factor analysis		X			X	
17	Enhancing Service Network Analysis and Service Selection using Requirements-based Service Discovery		X	X			
18	The role of assumptions in the engineering and adaptation processes of service-based applications.	X	X				
19	Primary Research on Software Process for SBA Development	X		X			
20	Replacement policies for dynamic Adaptation of SBAs	X	X				
21	Paradigm of model management, refinement, consistency, model checker			X	X	X	
22	Designing Adaptive Service-based Applications using Service Granularity	X					

Table 4: Research subject of visits – S-Cube workpackages

From Table 4, we can note that workpackages are covered differently. The following figure synthesizes the percentages of research visits devoted to each workpackage. We calculate the percentage for a WP by counting how many visits have covered that WP (Table 4) and then dividing that number by the number of visits covering all the WPs (here 44 since some visits covered more than one WP). As a result, the Figure shows that WP-JRA-2.3 has been addressed much less often than the other WPs.

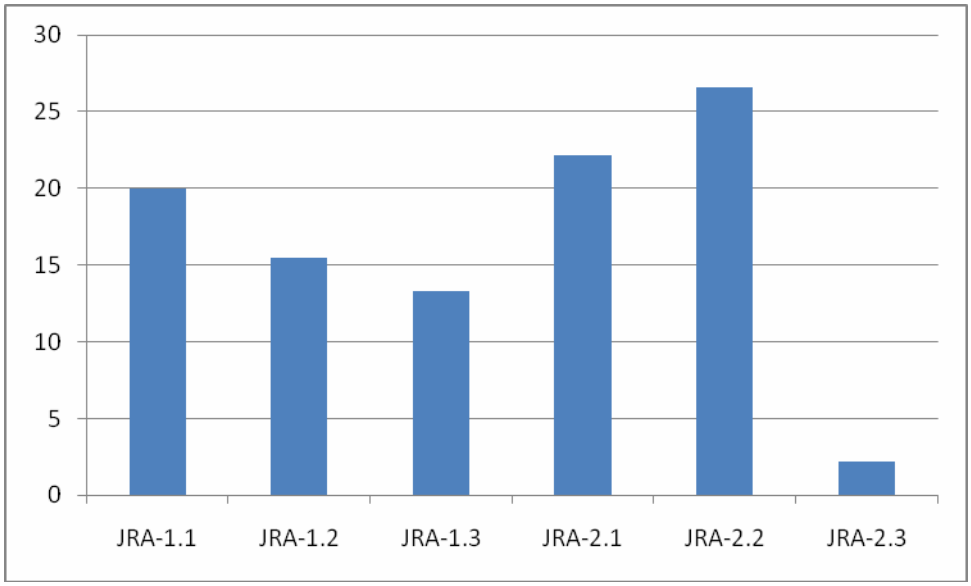

Figure 1: Percentage of research visits devoted to each workpackage

4 Integration Framework Coverage

The goal of this section is to perform a coverage analysis of mobility stays in respect to the S-Cube Integration Framework Baseline as defined in CD-IA-3.1.1. The section is divided into three subsections each covering one of the views on the framework: “Conceptual Research Framework”, “Lifecycle” and “Runtime Architecture”. We will use the figures from CD-IA-3.1.1 and annotate them with mobility stay IDs from Table 9 in Appendix B.

4.1 Coverage of the Conceptual Research Framework

Figure 2 shows how the conceptual research framework elements have been covered. Each of these elements is represented by a workpackage. Thus, here the result is similar as the one shown in Section 3 and in particular Figure 1. While the SC&C domain layer has most contributions (WP 2.2), the service infrastructure domain layer has the least (WP 2.3). The others are well-balanced. Most stays have covered more than one element of the framework. (Note that the difference of this view and the analysis in Section 3 is as follows: Section 3 analyzed to which WPs the results have been contributed covering some of the WP challenges, while here we analyze which aspects of the framework are in some way covered by the approach. The former aspect is thus more restricting. For example, the results of stay 2 on “monitoring and analysis of influential factors” have contributed to research challenges of WP-JRA-2.2 and WP-JRA-1.2 and thus have been described in corresponding deliverables. However, the corresponding approach covers also some engineering aspects on how to create monitoring solutions and uses monitoring mechanisms from the BPM and SI layer.)

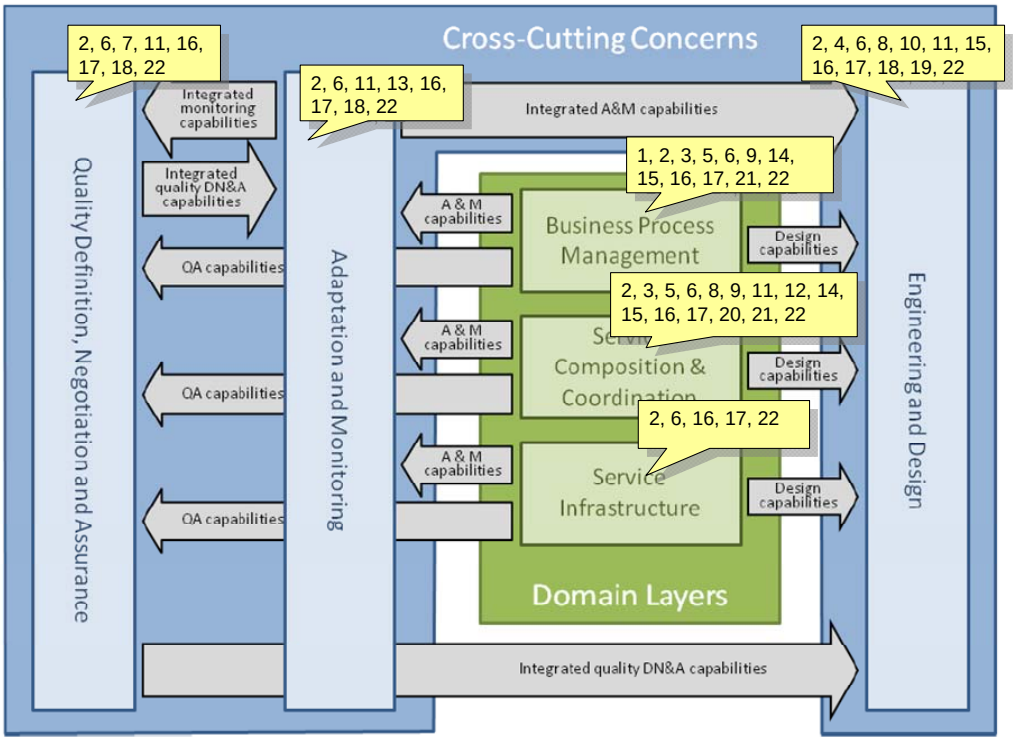

Figure 2: Coverage of the Conceptual Research Framework

4.2 Coverage of the Reference Lifecycle

Figure 3 shows how the Reference Lifecycle has been covered. Most results have addressed the "Requirements Engineering & Design" phase while "Early Requirements Engineering", "Identify Adaptation Strategy" and "Enact Adaptation" phases have clearly not been in the main focus yet.

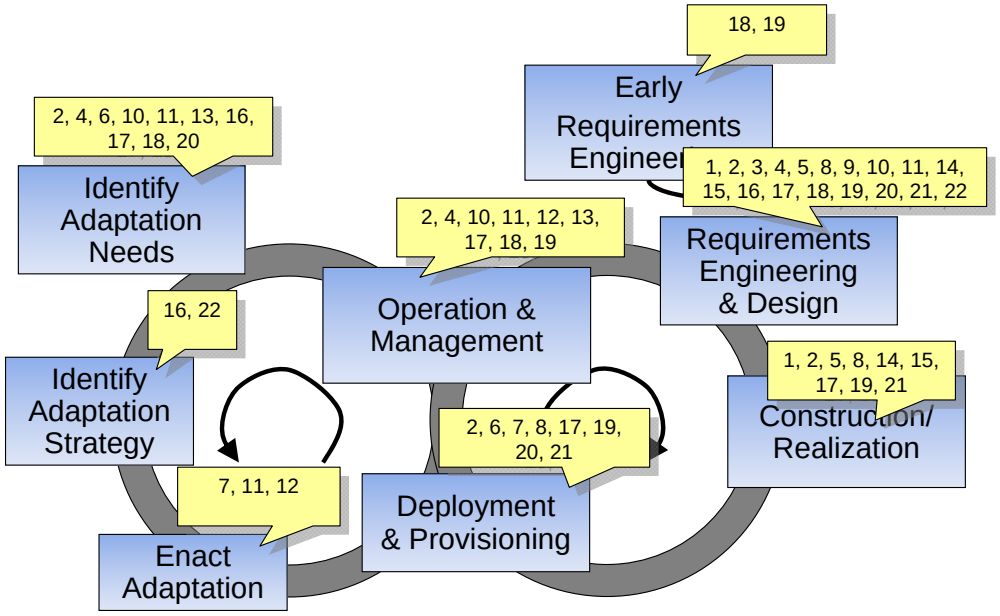

Figure 3: Coverage of the Reference Life Cycle

4.3 Coverage of the Runtime Architecture

Figure 4 shows how the Runtime Architecture has been covered. Most work has addressed monitoring and adaptation engines, and the service container, while the resource broker and human service interface have not yet been addressed. This can be explained by the fact that those two are part of WP-JRA-2.3 which has not been covered by many stays yet as shown in Sections 2 and 3.

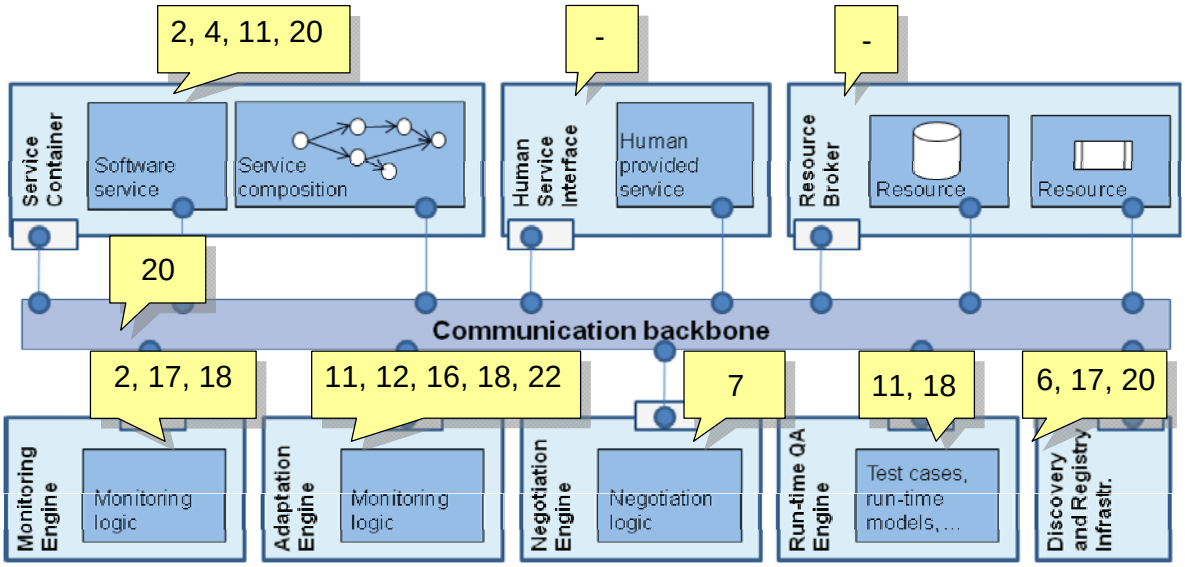

Figure 4: Coverage of the Runtime Architecture

4.4 Coverage of the Logical Design Environment

Figure 5 shows the coverage of the logical design environment. It shows that until now the main focus was on modeling for monitoring (KPIs, PPMs, QoS) with only few works focusing on adaptation and verification. This result is also consistent with the reference life-cycle above.

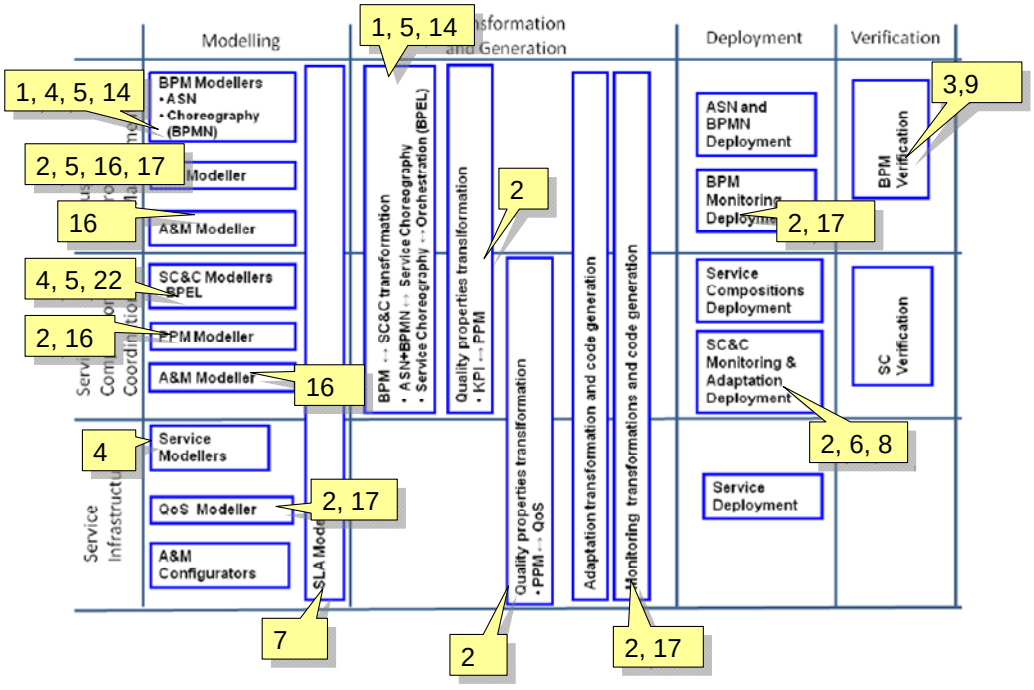

Figure 5: Coverage of the Logical Design Environment

5 Indicator Evaluation

In this section we analyze the mobility program based on a set of performance indicators. In particular we have included KPIs specified in the DoW as part of the S-Cube Key Objective (Obj-4) Bonding of Research Staff in our analysis. Table 5 shows the evaluated metrics, the evaluated periods and target values if specified in the DoW. We evaluate the indicators in six month periods in order to analyze trends.

Metric	M1-M6	M7-M12	M13-M18	Overall	Target
Number of research visits (KPI)	7	9	8	24	Should be increasing with time
Number of participating researchers (as visitors) (KPI)	7	8	7	19	-
Number of participating S-Cube beneficiaries as visitors (KPI)	4	5	7	12	All (16)
Number of participating S-Cube beneficiaries as hosts	5	6	5	10	-
Average Duration per visit (in days)	13	8	10	10	-
Number of co-authored publications resulting from mobility (KPI)	6	7	5	18	-
Number of reiterations (performed / planned)	1	1	0	2 / 4	-

Table 5: Performance Indicators

The Table 5 shows that the number of mobility stays has not increased with time but remained constant. As already shown in Section 2, Table 3 there are still partners who have not participated as visitors yet. Concerning the volume of visits, the DoW specifies the following: “each partner will have on the average two researchers visiting other institutes for a cumulative period extending on the average for up to four weeks (in total for both researchers) per annum…”. For a period of 1.5 years this translates to a target of 3 researchers (visits) and an overall duration of six weeks per partner. Table 6 shows the corresponding data for each partner and whether it meets the targets. The table shows that volume of research visits has clearly to be increased.

Visiting Partner	# of visits	Duration of all visits	# of visiting researchers	KPI fulfilled?	Actions
UniDue	4	14	2	o	Increase visit time
Tilburg	4	42	2	+	-
CITY	1	14	1	o	Increase # of visits
CNR	1	19	2	o	Increase # of visits
FBK	1	5	1	-	Increase volume
INRIA	1	14	1	o	Increase # of visits
LERO-UL	1	14	1	o	Increase # of visits
SZTAKI	0	0	0	-	Increase volume
POLIMI	3	37	3	+	-
TUW	1	15	1	o	Increase # of visits

UCBL	1	2	1	-	Increase volume
UoC	1	14	1	o	Increase # of visits
UPM	0	0	0	-	Increase volume
USTUTT	5	48	3	+	-
UniHH	0	0	0	-	Increase volume
VUA	0	0	0	-	Increase volume
Average	**1,5**	**14,9**	**1,2**	**o**	**Increase overall volume**

Table 6: Volume of visits after 18 months

6 Summary of Assessment Results and Conclusions

In the following we will summarize assessment results from the previous section and provide recommendations on how to deal with identified gaps in future mobility exchanges and on possible updates of the mobility plan in the next deliverable.

Analyzed Aspect	Main Results and Identified gaps	Recommendation
Scientific Subject Coverage	The following scientific subjects have not yet been covered (7 out of 22): Information quality, Interaction, Grid computing, Quality assurance, Service architectures, Security, User-centered requirements engineering	Uncritical, as those subjects are not the main focus of S-Cube research challenges which are being defined at the moment as part of the Integration Framework. In the next deliverable (update of mobility plan), the list of scientific subjects for mobility should be updated and aligned with research challenges and research questions.
Synergy of Competencies	Synergy of competencies has been clearly shown: In most cases there is a combination of competencies in a complementary way.	None
Workpackage Coverage	The workpackage coverage is well-balanced with the exception of WP-JRA-2.3.	Additional effort, in terms of joint research through visits is required in particular for WP-JRA-2.3.
Integration Framework Coverage	The integration framework is in general well covered. Some model elements are covered less in relation to the others, in particular: Conceptual Research Framework: - Service infrastructure layer Reference Lifecycle: - Early Requirements Engineering	The importance of not yet addressed elements should be evaluated based on research challenges and prioritized. The next version of the mobility plan should show which elements have already been covered well and which should be better addressed in the future.

	- Identify Adaptation Strategy - Enact Adaptation	
Indicator Evaluation	12 out of 16 partners have participated so far. Considering the trend, there is no increase in the volume of mobility visits in the first three 6-month periods. Only 3 partners have participated adequately considering the targeted volume of visits.	All partners should participate. The volume should be increased.

Table 7: Summary of Assessment Results

Appendix A

The following table lists the scientific subjects for mobility as described in CD-IA-2.1.2. This information is used for the coverage analysis in Section 2.

	Scientific Subject for Mobility	Common & Complementary Competencies
1	Adaptation	Self-Adaptation, Dynamic Adaptation of Parallel Programs, Engineering Adaptive Component-Based Systems, Adaptive Web Services, Adaptation in Business Protocols, Adaptation of Service Compositions, Engineering Adaptive Service-Based Systems, Self-Organising Systems, Self-Healing, Flexible & Self-Healing Web Services
2	Business Processes	Business Process Management, Distributed Business Processes Business Processes, Business Processes & Protocols, E-Business, Business Process Analysis, Monitoring & Auditing
3	Business Protocols	Business Processes & Protocols, Business Protocol Languages, Multi-Party Business Protocols, Adaptation in Business Protocols
4	Evolution	Service Evolution, Software Architecture Evolution, Dependable Evolvable Pervasive Service Engineering
5	Information Quality	Data & Information Related Quality, Data-Related Quality
6	Interaction	Interaction Design & Research, Personalisation
7	Grid Computing	Grid Scheduling, Grid Workflow, Grid Brokering, Load Balancing & Scheduling, Knowledge Sharing Networks
8	Model-Driven Engineering	Requirements & Model-Based Testing, Model-Driven Service Composition, Model-Driven Engineering
9	Monitoring	Monitoring, Service-Oriented Monitoring, Monitoring Design Principles & Monitoring Framework, Business Process Analysis, Monitoring & Auditing, Monitoring of QoS Metrics of Web Services, Monitoring of Key Performance Indicators
10	Negotiation & QoS Agreement	Service Level Agreement (SLA) Negotiation, Quality Assurance Negotiation & QoS Agreement, Estimation of the Quality of Service Providers
11	Quality Assurance	Software Quality Assurance, Quality Assurance, Static Analysis
12	Quality of Service	Quality Assurance, Quality of Service, Quality of Service in Component-Based Systems, Web Service Orchestration & QoS Optimisation, Monitoring QoS Metrics of Web Services
13	Requirements Engineering	Requirements Engineering, Requirements & Model-Based Testing, User-Centred Requirements Engineering
14	Service Architectures	Service Architecture, Service-Oriented Architecture, Service Orientation
15	Security	Security, Authorisation, Authentication
16	Service Composition	Model-Driven Service Composition, Service Composition, Web Service Orchestration & QoS Optimisation, Service Choreography & Orchestration, Service Networks
17	Service Discovery	Semantically-Enriched Service Discovery

		Mechanisms, Web Service Retrieval, Service Registries, Context-Aware Invocation of Web Services, Dynamic Binding & Invocation of Web Services, Discovery of Human-Based Services
18	Service Design & Modelling Methodologies	Service-Centric Systems Engineering, Service Design & Modelling Methodologies
19	Service-Oriented Computing	Service Orientation, Service-Oriented Computing, Service-Based Applications (SBAs), Service-Oriented Applications
20	Service Oriented Software Engineering	Dependable Evolvable Pervasive Service Engineering, Service-Oriented Software Engineering
21	Software Engineering Life-Cycle	Software Processes, Software Architecture, Software Engineering, Software Quality Assurance, Software Product-Line Engineering & Variability Management
22	User-Centred Requirements Engineering	User-Centred Requirements Engineering, User Centric Services

Table 8: Scientific subjects for mobility (see CD-IA-2.1.2)