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D2.5.1. Formative Evaluation and User-Centred Design

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Glossary of Acronyms

| Acronym | Definition |
|---------|-------------------------------------|
| D | Deliverable |
| EC | European Commission |
| WP | Work Package |
| M12 | Milestone 12 of the SOA4All project |
| M1 | Milestone 1 of the SOA4All project |
| QoS | Quality of Service |
| DL | Description Logic |
| IPs | Integrated Projects |

Executive summary

This document presents the overall evaluation plan for the evaluation of SOA4All, and the results from fulfilling the first stage of this plan in regards to the outputs of WP2. These results cover the following areas: usability evaluation of the first version of SOA4All Studio as of July 2009; the perceptions of our target group of end users regarding the benefits and drawbacks of their use of SOA4All. This allows us to both form conclusions about the likelihood of SOA4All being used, and to support its uptake through innovative features and platform models; and an in-depth study of how our target users understand three alternative representations of service composition.

The results of the expert based evaluations revealed different usability problems within the current version of SOA4All studio, especially related to navigation, composition editor, and annotation editor. The focus group based evaluations demonstrated end users' enthusiasm for user-driven service development ideas, with privacy issues and technical complexity being the most feared risks of such activities. In terms of composition design alternatives, users preferred the assisted composition approach due to its reduced complexity and efforts required to perform composition, but openness of the template library was highlighted as its main issue.

1. Introduction

1.1 Introductory explanation of the deliverable

This document presents the overall methodology that will be followed to evaluate the SOA4All project and its outcomes such as the software prototypes.

1.2 Purpose and Scope

This deliverable focuses on measuring if SOA4All results are valid contributions to technology and society, including end users. In addition, we describe the first evaluation step we have carried out during the first 18 months of the project, particularly: a usability evaluation of the SOA4All Studio and its components at two different levels:

- Expert-based Evaluation;
- Focus group based evaluation (focusing mainly on user perceptions of user-led service development).

1.3 Structure of the Document

The remainder of this deliverable is organised into five sections. Section 2 describes the evaluation plan we will follow to assess different aspects of SOA4All. In more details, we will focus on:

- Set of measurable performance indicators for SOA4All i.e., a set of different dimensions wherein the SOA4All project could be evaluated;
- Fit-for-purpose Evaluation i.e., Performance Indicators for Scalability with “Billions” of services, Increased Robustness, Context Awareness;
- Technical Evaluation i.e., a generic set of software quality factors;
- Usability Evaluation at three levels, tailored to inspect the usability of software prototypes.

Section 3 details the procedures of the first evaluation step undertaken. Section 4 reports the results of the expert-based evaluation and focus group based evaluation. Finally, Section 5 summarises the findings of this deliverable.

1.4 Methodology

In the first step of writing this deliverable, evaluation strategies at three levels (Fit-for-purpose, technical, and usability) alongside of their performance indicators were defined. Following this, the first phase of the usability evaluation, defined in table 6, was carried out. This evaluation involved an expert based evaluation of the SOA4All studio and focus group based evaluations of user perceptions of service development. In future steps, heuristics and user-based evaluations are planned to evaluate other outcomes of SOA4All.

2. Evaluation Plans of SOA4All

This section aims to define **measurable performance** indicators for measuring the progress of the project and the degree to which its objectives are fulfilled. This contrasts with WP14 – Project Management, which does contain an extensive set of indicators for measuring project quality, but these indicators are process-centred, and designed to evaluate if the consortium is doing the right things at the right time, for example the measuring the percentage of deliverables on time and the number of meetings attended by each partner. Instead, the evaluation plans outlined here *focus on establishing if project results are suitable for their purpose and if they are valid contributions to science, technology and society.*

Contributions to science cover all results of Activities 1 to 3 in SOA4All (respectively Fundamental & Integration, Core R&D and Use Case activities), and are measured using traditional impact metrics such as papers published, invited papers and talks, more aligned with WP12 Dissemination. In addition, the consortium has been asked to provide clear statements on how our “Hot Topics” excel over the State of the Art – these statements were part of many M1 deliverables but we may consider a unified summary map of these to be made available to reviewers and, if considered appropriate, put on the Web site as well.

2.1 Set of Measurable Performance Indicators for SOA4ALL

The evaluation of the outcome of SOA4ALL started from the project objectives stated in the Section 1.1.2 on page 11 of the DoW (5th Nov 2008). Each of the objectives was then related to its main beneficiaries as shown in Table 1. The three types of beneficiaries are envisioned:

- *the Society* (the impact of the project results exemplified by the *Use Cases*),
- *Service Technology* in general,
- *End Users*.

Arguably, other links can also be stated, the ones in the table have been chosen to allow the identification of the beneficiary who is in a position to evaluate the impact of achieving a particular objective.

| SOA4All Objective | Society / Use Cases | Technology | End Users |
|--|---------------------|------------|-----------|
| Scalability to master the very large and meeting the challenge of dealing with billions of services | √ | √ | |
| Usability to enable end-users not only to interact with services but also to create services | | | √ |
| Discovery to find the “right” service among the billions of services offered | √ | √ | |
| Dynamic composition to create the networks of services underpinning business networks and aggregating seamless solutions by orchestrating a network of services | | √ | |

| | | | |
|--|---|---|--|
| <p>Increased Robustness to respond to change. Services will appear, disappear, change location, adjust their usage model from free-use to pay-per-invocation, will be blocked, out of service, be inspected and commented upon – with dependent services being able to act quickly to changes</p> | √ | √ | |
| <p>Context Awareness to support collaboration across business networks in context of business processes and the personalization of services to individual preferences</p> | √ | √ | |

Table 1. SOA4All Objectives and their Potential Evaluators

Note that the latter tables (3, 4, and 5) provide further details in terms of metrics and indicate which WPs contribute towards the objective. Given the above table, we can determine the most appropriate evaluation mode against each objective. For example, if we need to evaluate the composition technique proposed by WP6 against the scalability objective, we need to judge this within the context of the Use Cases (what is the scalability implied by the particular use cases), and also on a technical level (we can run stress tests upon integrating in WP1).

Given the three main “beneficiaries” in Table 2 we can proceed to divide the evaluation strategy into the following types of evaluation:

| Beneficiary | Type of Evaluation |
|-------------|--|
| Use Cases | <i>Fit-for-purpose Evaluation:</i> the techniques and models developed in every WP will be tested against the requirements of the use cases (i.e. requirements validation). |
| Technology | <i>Technical Evaluation:</i> the performance of the software modules and algorithms/techniques developed by each WP will be tested upon integration in the main SOA4All Deliverables: <i>SOA4All Runtime</i> and <i>SOA4All Studio</i> . |
| End Users | <i>Usability Evaluation:</i> several techniques will be employed to evaluate the usability of the interfaces produced by the project, using representative samples of the target end users. |

Table 2. Evaluation Strategy

In addition, there is the overarching concern about contributions to the **scientific community**, the evaluation of which will be undertaken by the traditional metric of quality and number of publications in conferences and journals.

Figure 1 illustrates the proposed model for evaluation within SOA4All, relating the three main types of evaluation to the flow of results between work packages.

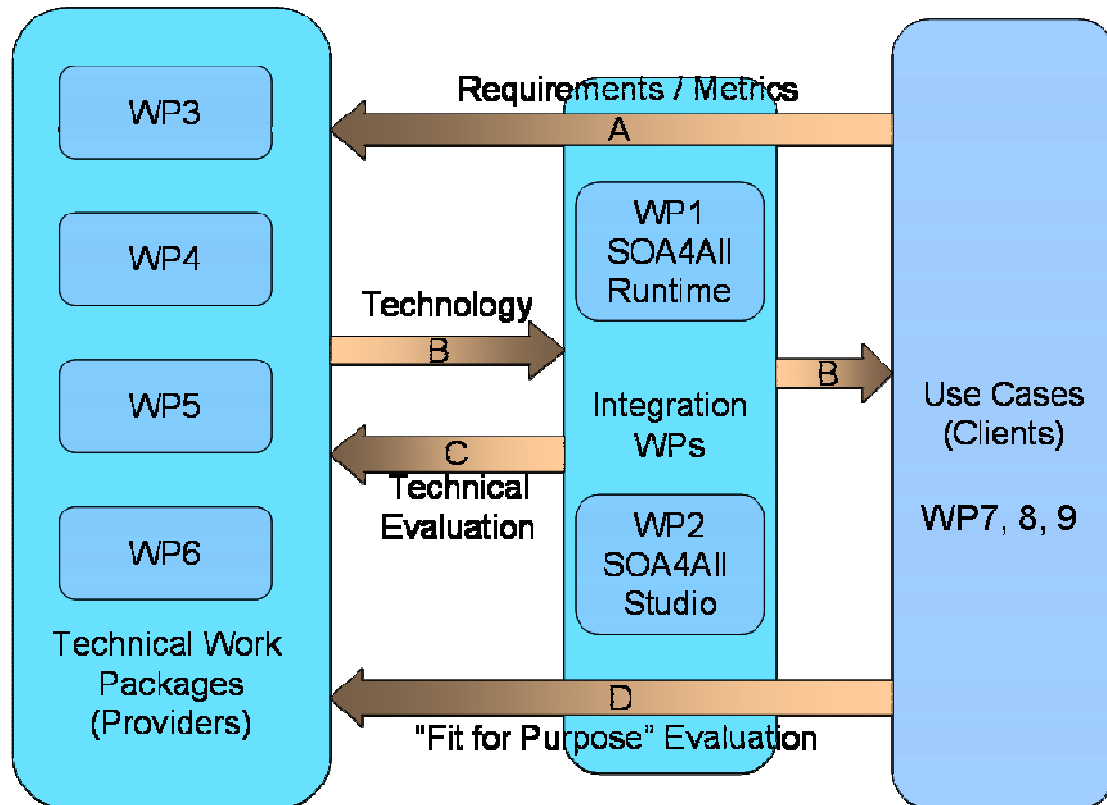


Figure 1 Internal Evaluation Model in SOA4All

The above figure shows the Use Case WPs as clients providing requirements and evaluation metrics to the core technical WPs (arrow 'A'). The 'Technology' results of these (arrow 'B') will be integrated in the two main results from SOA4All (SOA4All Runtime - WP1 and SOA4All Studio - WP2), who will provide Technical Evaluation (arrow 'C' in the Figure). The integrated 'Technology' results will be passed onto the Use Case modules, which will evaluate their suitability against the requirements and metrics provided early on under arrow 'A'. The results of this 'Fit for Purpose' evaluation (arrow 'D') will be fed back into the follow-up stages of developing technology by the technical work packages.

A list of metrics, which can be used to evaluate and validate SOA4All objectives, is proposed in Tables 3, 4, and 5 in the remainder of this document. Each table is accompanied by clarification and/or evaluation plans as appropriate. The choice of metrics is guided by reviewers' recommendations (see recommendations from 1 to 10 in the Progress Review Report page 4), together with some additional metrics (e.g. Coverage of Scenarios, Standardisation Effort).

2.2 Fit-for-purpose Evaluation

| Objective | Metric | Measure | Method of measuring | Reviewers' Recomm. (Progress, review report, Page 4) |
|---|--|---|---|--|
| Scalability with "Billions" of services | Performance of SOA4All studio and its modules under a maximum number of services implicated by each use case | Expressed as a 5-point Likert scale (1...5) for each technical WP | Report by the WP7, 8 and 9 leaders on the scalability of the technical WP results to the scale implicated by their Use Cases | 4 |
| Increased Robustness | Availability of the use case-specific services and verification of their status (i.e. physical access: updated or not). Each use case should assess whether the necessary services are available for consumption by their target users | Expressed as a 5 point Likert scale (1...5) per technical WP | Report by the WP7, 8 and 9 leaders on the robustness of the techniques used in the Use Case deliverables | 4 |
| | Completeness and consistency of the annotated services implicated by the use cases | | | |
| Context Awareness | Coverage of context adaptation and dimensions | Percentage of context dimensions and adaptation elements handled | Report by the WP7, 8 and 9 leaders in the Use Case deliverables on what percentage of all scenario elements which involved context adaptation were handled by the system. | |
| | Coverage of Scenarios | Percentage of requirements covered | Report by the WP7, 8 and 9 leaders in the Use Case deliverables | |

Table 3: Performance Indicators of the Fit for purpose Evaluation

Scalability with "Billions" of services: Results of the SOA4ALL project should be demonstrated to scale to an environment "billions of services". WP leaders for the use case

work packages will act as “clients” to the technologies developed by the technical work packages, and should be able to provide impartial evaluations to value the scalability of approaches developed by SOA4ALL within the context of the scenarios introduced in their respective work package - WP7, 8 and 9. The evaluation will be expressed as a number (1..5) measuring the suitability of an approach for the expected scale of real-world service deployment envisaged by a particular scenario.

Coverage of Scenarios: WP leaders will be asked to estimate what percentage of WP7, 8 and 9 requirements relevant to their WPs can be addressed by the results of these WPs. Such requirements are key input for the technical WP (from 1 to 6).

2.3 Technical Evaluation

Table 4 below lists the main metrics to be used in the technical evaluation of different project results. The metrics are informed by a generic set of software quality factors found in the literature [6, 7, 8]; however, the complete application of this set is not considered appropriate for a proof-of-concept software development such as the one envisioned for SOA4All.

| Objective | Metric | Definition |
|-------------|---|--|
| Scalability | Performance of module or subsystem under stress-test conditions. | Stress-test conditions should be defined by the scientific work packages (WP3-6) as the upper boundary of the presumed system size within which the technology is meant to function. The appropriate stress-tests should then be implemented. |
| | Performance of SOA4All Runtime and Studio under stress-test conditions. | Stress-test conditions for SOA4All Runtime and Studio should be defined within WP1 and WP2, based on the Stress-test conditions identified in WP3-6 but also taking into account the limitations imposed by the architecture. These should then be used upon integration of modules. |
| | “TestBed” | Preparation of a testbed infrastructure where services can be easily created from templates (generation of a suitable amount of services (semi-) automatically) [WP1.5], i.e. specifying a default behaviour and a certain range of (QoS) parameters using a statistical model, and then generating services from that. The individual components will of course have to use that infrastructure to verify their scalability - T1.5 will collect the evaluation results as discussed. (This is mentioned in D1.5.1). Nevertheless, true Internet scalability probably still cannot be proven by using the testbed. |
| Discovery | Non functional quality of retrieved services | This metric considers the non functional quality of services which have been retrieved (e.g., in terms of their Response time, Price, Reliability) |

| | | |
|-----------------------------------|--|--|
| | Cover/Rest rate of each service | <p>The cover rate [11] considers the number of DL descriptions covered by the service and the query.</p> <p>The rest rate [11] considers the number of DL descriptions required by the query but not provided by the service.</p> <p>The miss rate [11] considers the number of DL descriptions provided by the service but useless for the query.</p> |
| | Precision/Recall of each service | <p>The precision rate considers the number of relevant services retrieved by a search divided by the total number of services retrieved [18].</p> <p>The recall rate considers the number of relevant services retrieved by a search divided by the total number of existing relevant services (which should have been retrieved) [18].</p> |
| | Execution/Response Time and Scalability of the Discovery process | <p>This metric signifies the time spent to discover services</p> |
| Dynamic composition | Non functional quality of Composition | <p>This metric consider quality of services (i.e., QoS such as Response time, Price, Reliability) of each service involved in the composition. For this a set of aggregation rules have been introduced in [9]</p> |
| | Semantic fit of composition | <p>This metric consider the semantic quality of connections between services [10], This evaluates the data flow of any composition by considering their semantics.</p> |
| | Execution Time of the composition process | <p>This metric signifies the time spent to compose services</p> |
| Increased Robustness ¹ | Service Availability | <p>This metric is used to evaluate the availability of services and verify their status (for instance in term of semantic description, physical access: updated or not)</p> |
| | Consistency/Completeness of semantic annotations | <p>Completeness [12] is achieved when all the parts of a service are annotated. Consistency [12] on the other hand is achieved when the annotations are not contradictory, e.g., transformation and ontological annotations are consistent.</p> |

¹ by using some periodic check over services

| | | |
|------------------------|---|---|
| Context Awareness | Context diversity | This metric considers the diversity of context aspects (i.e., Informational, Organizational, Behavioural, Operational, Causal, Chronological and Environmental aspects) supported in SOA4ALL. |
| | Context adaptability | Percentage of the context dimensions above for which adaptation mechanisms have been implemented. |
| Standardisation Effort | Expressed as tuple of two subjective ratings on a 1..5 scale – the impact of the project and the average impact of the peer projects. | Submission to standardization groups for further evaluation will be recorded and compared with the standardisation impact of peer projects. The evaluation will be expressed as a scale (1...5). Suggested definition of peer group is the set of other IPs in the same Cluster of EC activities. |

Table 4: Performance Indicators of the Technical Evaluation

2.4 Usability Evaluation

The overall usability metrics are listed in Table 5. Summative evaluation is carried out when the interface has been completely implemented to assess whether it meets the required standards whereas formative evaluation is performed during the design phase to identify the usability problems and improve the current interface.

| Objective | Metric | Measure | Method of measuring | Reviewers' recomm. (Progress review report, Page 4 and 6) |
|-----------|---|---|--|---|
| Usability | Ease-of-use per target group | Expressed as a 5-point Likert scale (1...5) or report of potential usability problems | User feedback from focus groups, also heuristics evaluation (Nielsen Heuristics) - formative evaluation-, and user testing – summative evaluation- | 4, 6 |
| | “For All” Metric – degree of adaptation to target groups (specialist and non-specialist users). | Expressed as a tuple: (ease-of-use, features coverage) | User feedback obtained during testing, based on end users profiles and skills (in particular novice and expert users) – | 4, 6 |

| | | | | |
|--|--|--|-----------------------|--|
| | | | summative evaluation- | |
|--|--|--|-----------------------|--|

Table 5: Performance Indicators of the Usability Evaluation

Ease-of-use: The “ease-of-use” is an important criterion to evaluate results of SOA4ALL. End-users with very limited programming skills are targeted through this metric. In this direction the valuation will be performed by means of user feedback, heuristics evaluation techniques, and user testing. The evaluation will be expressed as a scale (e.g. a 5-point Likert scale) or a report of the number of problems.

“For All” Metric: Degree of adaptation to target groups of users (specialist and non-specialist users): Results of the SOA4ALL project should be a tool “for all”. To this end, evaluation will be implemented by target groups of end-users through appropriate experiments and feedback sessions. These tests will consider different classes of end-user to validate the “for all” dimension of the project. Specifically, we will address two main categories: novice (e.g. students) and expert users (e.g. professional users / Town hall administrators). Such an evaluation will be expressed as a tuple of two measures: the value of the “ease-of-use” metric and the percentage of target features covered at that skill level.

2.4.1 Usability Evaluation Techniques for Use Case WPs and SOA4All Studio

The evaluation techniques which will be employed in the SOA4All for the purpose of gathering requirements, feeding the design process, and evaluating the end products involve the following approaches:

- Focus groups;
- Expert based evaluation;
- User based evaluation.

2.4.1.1 Focus Group-based Evaluation

Although this formative evaluation method within a participatory design process is mainly based on data gathering techniques, it can be tailored for evaluation purposes. In focus groups, a group of people (developers or users) is asked about their attitudes towards an idea / product [5]. Focus groups capture information about the users’ needs and the issues related to a particular system. Usually 6 to 10 users participate in a focus group and the session lasts for 1 – 2 hours. A moderator who encourages the free flow of ideas guides the discussion of the users. The moderator has few specific questions to initiate open-ended discussions, which are recorded for later analysis.

2.4.1.2 Expert-based Evaluation

Expert based evaluation is often guided by heuristics (e.g. usability principles / guidelines) endeavouring to identify usability problems in an interface design. For instance, a widely used set of heuristics for usability problems discovery was developed by Jacob Nielsen 1990 from an empirical analysis of 249 usability problems [2], as reported in section 3.1.2. Discount evaluation, which uses five evaluators who can identify up to 80% of the potential usability problems, can be used to maximise the benefits.

The evaluators are usually supplied with a typical scenario containing a set of realistic tasks that need to be performed by a typical user. The scenario should be based on a task analysis of real end users carrying out their daily job. At the end of the evaluation, a list of usability problems and associations to the relevant usability guidelines will be produced. Hence, evaluators should specify what they did not like about the current interface, explain why, and relate it to the appropriate principles.

2.4.1.3 User-based Evaluation

Task-based evaluation with users will be carried out to test the usability of the final products of SOA4All. Usually user testing involves measuring end users' performance while carrying out typical tasks. The evaluators analyse the number and type of problems users make, and record the time spent to perform these tasks. While performing the tasks, user interaction will be recorded via video and logging programs. At the end of the experiment, users' opinion is elicited using questionnaires and interviews. The results of the usability testing will be analysed using a usability post analysis process (i.e. Model Mismatch Analysis (MMA)) to gain a further understanding of the identified problems [13].

2.4.2 Usability Evaluation Plan

Table 6 summarises the usability evaluation steps in Use Case WPs: WP7, WP8, WP9, and SOA4All studio (WP2), and their appropriate evaluation techniques.

| Work Package | Target end users | First stage | Second stage | Third stage |
|--------------|--|---|--|-------------------|
| | | Initial mock-ups, low-fidelity prototypes, power point presentations, | Initial prototypes, high-fidelity prototypes | End-user products |
| WP7 | End users from public sector | Focus groups Heuristics evaluation | Heuristics evaluation | User testing |
| WP8 | BT customers | Focus groups Heuristics evaluation | Heuristics evaluation | User testing |
| WP9 | E-Commerce User (Buyers, Sellers, Resellers) | Strategic priorities interviews Analysis of existing user data | Heuristics evaluation | User testing |
| WP2 | General users (e.g. students) | Focus groups Heuristics evaluation | Heuristics evaluation | User testing |

| | | | |
|-------------------------------|-----------------------|-----------------------|-----------------------|
| Deadline of evaluation | M14: 05 / 2009 | M22: 01 / 2010 | M36: 03 / 2011 |
|-------------------------------|-----------------------|-----------------------|-----------------------|

Table 6: Usability Evaluation Plan

3. Phase 1 Evaluation Methodology

In the first stage of the usability evaluation, two techniques were employed, namely: (1) expert based evaluation to discover the existing design flaws within the SOA4All studio, and (2) focus group based evaluation to elicit end users’ opinions about general risks and benefits of end user development and the possible ways in which complex services can be created by wiring together simpler ones. Both evaluations aim to supply designers with valuable feedback to make further improvements in various aspects of the project. In the following subsections, we describe the procedures involved in performing these two evaluations. The results described in Section 4 are related to WP2.

3.1 Expert-based Evaluation of SOA4ALL Studio

This expert review aims to detect usability problems within the current design of SOA4All studio by checking its conformity to good design principles, provide quick and cheap feedback to designers, and generate recommendations to improve the user interface. The intended end users of SOA4All studio are general web users who frequently use web 2.0 applications such as: Facebook², Twitter³, and Wikis. The SOA4All studio will be used to create applications for general leisure, but also for business purposes to generate revenue (i.e. to resell services).

3.1.1 Evaluation Steps

In the evaluation of an early prototype of the SOA4All studio, 2 expert evaluators followed the evaluation steps outlined in table 7.

| Step | Completed |
|---|--------------------------------|
| Define the aim of the evaluation, the target end users, and the context of use for SOA4All studio | Yes |
| Select heuristics | Yes (see Usability Heuristics) |
| Brief the evaluators about SOA4All studio and how it is intended to be used | Yes (see Scenario description) |
| Each evaluator independently makes a first pass through the design to get an overall impression | Yes |
| Each evaluator independently examines the aspects | Yes |

² <http://www.facebook.com>

³ <http://www.twitter.com>

| | |
|--|---|
| of the design in detail, working through typical scenarios | |
| Produce a list of problems linked to their heuristics, rate their severity on a 1-3 rating scale (1 = not severe at all, 3 = very severe), and suggest solutions to these problems | Yes (see Usability Problems and Proposed Solutions) |

Table 7: Expert-based Evaluation Steps

3.1.2 Usability Heuristics

To perform a heuristics evaluation, we have selected the well-established and general purpose heuristics of Nielsen. Table 8 lists the relevant design principles.

| ID | Heuristic |
|-----|---|
| H1 | Visibility of system status: Is the system continuously informing the users what is going on using appropriate feedback? Are all things visible to the user? |
| H2 | Match between system and real world: does the system use familiar words, phrases, and concepts to the users? Is information presented in a natural and logical order? Are metaphors used effectively? |
| H3 | User control and freedom: Does the system support the undo and redo actions? Are there clearly marked exits in case of a mistake? Can the user easily go back to the initial stage? |
| H4 | Consistency and standards: Is the use of different components consistent throughout the system? Have the platform conventions been followed? |
| H5 | Error prevention: Does the system eliminate error-prone conditions? Does the system ask for confirmation before executing a dangerous action? |
| H6 | Recognition rather than recall: Are the objects, actions and options visible to the user? Does the system offer visible instructions of how to use the system? |
| H7 | Flexibility and efficiency of use: does the system support both novice and expert users? Does the system allow the users to skip unnecessary actions? |
| H8 | Aesthetic and minimalist design: does the system contain the relevant elements only? Is it free from distractive elements? |
| H9 | Help users recognize, diagnose, and recover from errors: does the system clearly describe the problem and suggest a way of recovery? |
| H10 | Help and documentation: Does the system provide clear and focused help and documentation? |

Table 8: Nielsen Usability Heuristics

3.1.3 Scenario Description

The evaluators of SOA4All studio have employed the scenario below, extracted from the “Overall Scenario SOA4All-Common Scenario One Stop Cloud Shop”) which is described in detail in deliverable D9.2.1, to carry out this expert-based evaluation. This example scenario is chosen because it embodies realistic tasks and covers many aspects of the SOA4All studio.

Nada visits the SOA4All Studio and creates a user profile with the SOA4All Profile Editor. Surprisingly, she notices that she can even reuse her OpenID for logging in which she uses on many other websites as well.

She then starts searching for suitable services using the SOA4All Discovery Platform and finds many services related to products and product catalogues such as a service from Amazon and other sellers.

She has the chance to refine her search and to filter the result set to those services related to the textile domain. Nada also has the chance to see comments and feedback left by other users who tried them before.

Anyway, she is still not sure about which services she really could use. But fortunately the SOA4All Recommendation System is capable of automatically recognizing her interests by analyzing her behaviour within the Consumption Platform. Because of this SOA4All is able to “recommend” to her services that users with a similar profile rated in a positive way.

She looks at the product service result list and gets an ordered list of four different services, in which the fourth one was rated not so positively while the first three have received good feedback. She finally decides to use the three different services coming from sellers Schahram, Theodore and Esteban.

Having selected some services or some goals she wants to achieve, Nada wants to connect them to her webshop. However some goals need to be concretized (actually as services). To do so she launches the SOA4All Composer and the SOA4All Composition optimizer. These allow her to create a single process which connects each of the product services (goals are concretized on the fly by the most appropriate services given some services’ price constraints and some User preferences) from Schahram, Theodore and Esteban to a filter service from her webshop which adds product specific data, price information and which aggregates the product list. Nada uses a pre-defined template from the SOA4All Template Generator which allows her to take advantage of existing process templates without having to start from scratch.

Once she has done so she uses the process editor again to create a second process which forwards an order from her webshop to the product manufacturer service as soon as an order arrives. She executes her process to test it and she can directly see the results of her execution.

3.2 Focus Group-based Evaluation of Design Approaches for Web Service Composition

In focus groups, a group of people (developers or users) is asked about their attitudes towards an idea / product [1]. Usually 6 to 10 users participate in a focus group and the session lasts for 1 – 2 hours. Focus groups enable capturing information about the users’ needs and the issues related to a particular system. The discussion of the users is guided by a moderator who encourages the free flow of ideas. The moderator has few specific questions to initiate open-ended discussions which are recorded using a camera for later analysis.

In the Phase 1 of evaluation, focus groups have been carried out with the aim of encouraging participants to share and discuss their thoughts, opinions, and feelings about the overall idea of end users developing service-based software, and about the specific design choices underpinning the *composition editor of the SOA4All studio*. The choice of the composition editor as a focus for these discussions is based on the general lack of consensus about effective representations in the literature and the cognitive difficulty of the task of assembling services and dealing with side-effects etc. In contrast, the cognitive principles of discovery and annotation are simpler and best practice has been identified in the literature. It is worthwhile to note that other aspects of the SOA4All studio have not been evaluated at this stage because they have not been implemented yet. Such aspects will be investigated in details, and results will be reported in future deliverables, particularly in D2.5.2.

The main idea of focus groups was to gather target users’ opinions about opening up software service development and making it as easy as creating a blog or a customized Facebook page. In the focus groups and materials, we refer to this idea as *service composition by users (SCU)*. The result of the focus group will be used as input to the design stage. In summary, the main objectives of these focus groups are to:

1. Obtain general opinions of the end-users about end user development of service-based software;
2. Evaluate and compare the current mock-ups (3 designs) of the composition editor within a participatory design process;
3. Capture as many composition editor requirements as possible.

We aimed to have at least 12 participants for each planned session, soliciting the participation of different target groups according to the target types of users identified by SOA4All work packages. Each session lasted for about 3 hours in a large seminar room, with a 15-minute break in the middle. A 30-minutes introductory talk was followed by a 30-minutes discussion on the perceptions about risks and benefits of end user development of service-based software, and on existing practices and proposed supporting actions. After the break, the discussion focused on alternative representations to help end users to create service software by composing web services.

The discussions were conducted in groups of 3 to 5 people, depending on the number of participants. Each group had a facilitator to steer the discussion. Questionnaires and audio tapes were used to record the participants’ responses for later analysis. The moderator of the group was tasked to encourage and facilitate free-flowing discussion, by avoiding any of the following problems:

- Some participants trying to dominate the discussion;
- Differences in opinions leading to personal confrontation;
- Some participants not getting involved in the discussion;
- Friends in the same groups supporting each other / forming cliques;
- The facilitator getting biased to a particular answer.

The structure of the focus group discussions is reported at the first page of Appendix I (the workbook), and visualised in Table 9 below.

| Step | Activity | Expected time |
|------|---------------------|---------------|
| 1 | Introduction script | 10 mins |

| | | | | |
|------------|---|---------------------------|--------------------------|----------|
| 2 | Presentation / Motivational Speech | | | 30 mins |
| 3 | presentation discussion | presentation discussion | presentation discussion | 20 mins |
| 4 | Notational study | | | 15 mins |
| 5 | Coffee break | | | 15 mins |
| | Group 1 | Group 2 | Group 3 | |
| 6 | Design 1 walkthrough, | Design 2 walkthrough. | Design 3 walkthrough, | 10 mins |
| 7 | Questionnaire filling | | | 10 mins |
| 8 | Design 2 walkthrough, | Design 3 walkthrough. | Design 1 walkthrough, | 10 mins |
| 9 | Questionnaire filling | | | 10 mins |
| 10 | Discussion, design 1 vs 2 | Discussion design 2 vs. 3 | Discussion design 3 vs 1 | 25 mins |
| 11 | Capstone session – overall discussion by all participants | | | 25 mins |
| Total time | | | | 180 mins |

Table 9: Web Service Composition Workshop Agenda

Once the focus group has been carried out, the participants’ responses were collected and analyzed. Recorded material and unstructured questionnaire responses were analyzed using the Thematic Analysis approach; quantitative questionnaire answers were analyzed using conventional statistical methods with SPSS.


4. Phase 1 Evaluation Results

4.1 Expert-based Usability Evaluation of SOA4All Studio

In this section, the potential usability problems with reference to Nielsen’s usability heuristics and a severity rating on a 3-point rating scale (where 1 = low severity, 3= high severity) are reported. Recommendations to remedy these problems are also suggested.

| Usability problem | [Heuristic ID, severity rating (1-3)] | Design recommendation |
|-------------------|---------------------------------------|-----------------------|
| | | |

| | | |
|--|-------------------------|---|
| <p>The SOA4All studio logo changes to SOA4All composer, SOA4All annotator ... etc upon selecting one of the options from the main page. This causes the main logo to disappear and being replaced by a sub logo.</p> | <p>[H4, H6, 1]</p> | <p>Sub logos can be introduced in their appropriate pages, but ensure that the main logo is always kept in all pages. Users usually use it as a reference point to go back to the main page.</p> |
| <p>In some pages of the studio, the logos totally disappear or are hard to see due to their low contrast (i.e. query page, Analyse page)</p> | <p>[H8 ,3]</p> | <p>The logo is an important feature in interactive systems and should always be presented. The remedy to this problem is to add the logo to the pages where it is missing and to ensure the visibility of the logo by employing a good colour contrast.</p> |
| <p>Once clicking on the top left logo, a pop-up menu appears; this is unusual and sometimes hides part of the view. In addition, it hinders information seeking.</p> | <p>[H4 H6 H8, 3]</p> | <p>The left hand menu should always be toggled on. Users frequently use it to access different areas of the studio.</p> |
| <p>Upon clicking the top left logo, a “select language” option appears prior to the appearance of the main menu</p> | <p>[H8, 1]</p> | <p>The “select language” option must appear as part of the menu not as a separate entity.</p> |
| <p>It is unclear how to go back to the main page or switch to other editors (e.g. composer, annotator, discovery ... etc). Navigating back to the main page is not intuitive and may take a long time.</p> | <p>[H1, H2 , H3, 3]</p> | <p>The SOA4All studio must employ a good navigation scheme to enable easy movement between its diverse sections. Users should also be able to go back to the main page easily.</p> |
| <p>In the main page, two options are labelled: annotate REST and annotate WSDL. This creates some sort of categorisation inconsistency.</p> | <p>[H2 ,1]</p> | <p>On this page, a more general navigational scheme could be used instead. Both options “annotate REST” and “annotate WSDL” could be replaced with “annotate”; these two options could be introduced in secondary pages, i.e. pages further down the hierarchy.</p> |
| <p>The main page of the studio has a horizontal scrolling bar, which makes the studio look unpleasant. Some menu options are also not visible.</p> | <p>[H8, H4, 3]</p> | <p>Remove the horizontal scrolling bar, and ensure that the studio is well represented in different resolution settings and in different browsers, showing all options.</p> |
| <p>The browser’s front and back arrows are not working properly. More than one click is required to go backward or forward.</p> | <p>[H3, H4, 3]</p> | <p>The studio is hosted within a web browser; it should therefore inherit the conventional properties of the browser, such as: the back and forward arrows, to comfortably navigate through the pages of the</p> |

| | | |
|--|-----------------|--|
| | | studio. |
| The main menu is mal-categorised and finding targets may take a long time. | [H1, H2, H3, 2] | The main menu should embody a good classification of its items to enable efficient and easy access to different information. |
| The items of the main menu, once expanded using  , show only a few navigational elements within a large space. | [H8, 1] | The menu should efficiently make use of the available space. Hence, we suggest removing the empty space. |
| Unexpectedly, in some platforms the right mouse click invokes the browser's options. Expert users usually use the right mouse click to quickly access various functionalities. | [H4, H7, 1] | The right mouse click should instead invoke the options of the studio to accommodate different users (i.e. novice and experts users). |
| In the profile overview, it is not possible to log-in the studio or register as a new user. | [H9, H7, 1] | Users should be able to create profiles which suit their interests. This gives them a feeling of ownership and control. |
| In the WSMO-Lite editor, clicking the open "Service Description" or "Ontology" option of the File menu, followed by "List" button lists all potential directories. The user is then required to navigate, depending on his knowledge, to the right directory and find the file she is looking for, which wastes time. The user may also mistakenly open a non-relevant file. | [H5, H7, H8, 2] | The system should show only the relevant directories. For instance: if the user clicks on open "ontology" option and clicks on "List" button, the system should report the available ontologies only, in this case the groundingSample and services directories should be made invisible. Constraining user options by omitting non relevant directories and files decreases the number of errors. |
| In the WSMO-Lite editor, the purpose of quick find option at the bottom of the Semantics Models section is unclear; it currently does not do anything. | [H2, H8, 2] | Ensure that the "quick find" option is operational and use a better labelling to convey its purpose. |
| In the WSMO-Lite editor, what functionality does the Ontologies Search section, at the left bottom of the page, offer to users? | [H8, 3] | This section should be removed as it serves no purpose. |
| In the WSMO-Lite editor, users have to drag the concepts, from the Semantic Models section, and over the service elements, in the WSMO-Lite Editor, to identify the valid connections. It is also not obvious how to determine which connections are meaningful, i.e. how to | [H5, H6, 3] | It is important to minimise users' actions by clearly highlighting the possible connections without the need to hover over the service elements. The system should also offer suggestions to users so that only meaningful connections are |

| | | |
|--|-----------------|---|
| connect the concepts to the appropriate service elements. | | established. |
| In the WSMO-Lite editor, the “close” menu option clears only the content of the main window. It is not possible for users to clear the content of the Semantic Models section. | [H3 , 3] | Add an option to empower users to delete/close the content of the Semantic Models section. |
| In the composition editor, two horizontal menus are presented, a top left menu and a top right menu. This is inconsistent and often creates confusion. | [H2, H4 ,2] | The two menus should be joined together to form a single menu placed at the top left. |
| In the composition editor, the top small icons to access the most frequently used features are all annotated with the word “compose”, which does not reflect their true functionality (i.e. undo, redo ... etc). | [H1, H6, H7 ,3] | The top icons should be annotated according to their functionality. |
| In the open process model dialog box of the composition editor, (1) text is hard to read, (2) the double mouse click does not open a file. | [H4, H8 ,3] | Use a good colour contrast and a readable font size. Enable the double mouse click to open a file. |
| In the composition editor, the favourite and console tabs are hidden from the user. | [H1, 2] | If these tabs are important and provide valuable information, ensure they are visible to users, otherwise they should be removed. |
| In the composition editor, it is unclear how to delete processes, activities, or services from the design area. | [H3, H4, H7, 3] | Enable users to delete unwanted activities and services via prominent navigational options as well as the mouse / keyboard. |
| In the composition editor, it is unclear how to connect processes and activities together, does the user have to select the start point then select the finish point, or select the start point and drag the mouse to the finish point ... etc | [H2, 3] | Clearly emphasise the connection aspect of the composition editor, for instance highlight, using a different colour, the start point and possible end points of the processes / activities. |
| In the composition editor, the names of processes and activities can not be edited. | [H3, H7 ,3] | Users should be allowed to edit the names of processes and activities within the design space. |
| In the composition editor, the undo and redo options in the edit menu are non-functional. | [H3, H7, 2] | Both options are necessary to support users’ actions; hence they should be operational. |
| In the composition editor, the design can not be saved. | [H5, 3] | The studio should be supplied with save options. |

| | | |
|---|--------------------|---|
| <p>Once exiting the composition editor, no “save message” is prompted to the user. This will result in losing current work.</p> | <p>[H5, 3]</p> | <p>The system must always ask the users whether they want to save their work or not.</p> |
| <p>In the consumption platform, duplicate services can be added to the design space. The system does not inform the user about duplicate services.</p> | <p>[H5, H9, 3]</p> | <p>The user should be notified about adding an already existing service to the canvas.</p> |
| <p>In the consumption platform, a single click on the favourite actions or recommended services adds a service to the canvas. Double click adds two services, triple click adds three services and so forth. This is unusual and may frustrate users.</p> | <p>[H4, 3]</p> | <p>A single click on an item should highlight/select it. Only a double click should be able to add a service to the design area.</p> |
| <p>In the consumption platform, when services are added to the design area, they are vertically aligned causing some of them to be invisible. This creates an unpleasant design and wastes space.</p> | <p>[H8, 3]</p> | <p>The system should automatically organise the added services in a more attractive way.</p> |
| <p>In the consumption platform, the search results are presented in the design space which is dedicated for something else (i.e. to design the application).</p> | <p>[H2, 1]</p> | <p>Report the results of the search in an appropriate place; the results could be presented below the search section. The design space should be always used to design the application.</p> |
| <p>Some windows are not fully viewable in the studio, for instance: related document IDs, document content in the discovery platform.</p> | <p>[H1, 1]</p> | <p>All sections of the studio should be viewable on the screen either by means of scrolling or clicking to expand.</p> |
| <p>Some terms are ambiguous such as: “structured-documents search” in the discovery platform, “editor” in the main menu. Does the word “editor” refer to the composition editor, annotation editor, or something else?</p> | <p>[H2, 2]</p> | <p>Use a more precise labelling and self-explanatory terms within the studio.</p> |
| <p>The functionality of the earth icon at the bottom right of the studio is unclear.</p> | <p>[H8, 1]</p> | <p>Remove the earth icon if it has no purpose or emphasise its job.</p> |
| <p>The template generator can not be found within the studio.</p> | <p>[H1, 3]</p> | <p>Ensure that the user can easily find the template generator. It should be visible and accessible via the navigational options.</p> |
| <p>The help menu and wizards are non-functional.</p> | <p>[H10, 3]</p> | <p>The studio must be supplemented with wizards to guide users and with a detailed help documentation in case of</p> |

| | | |
|--|------------|--|
| | | problems. |
| It is unclear how to execute the produced process. | [H1,H6, 2] | Upon finishing the design of the complex application, the system should clearly communicate the possibility of executing the produced application. |
| The system shows error messages at the bottom right of the studio which might not be easily noticeable by users. It is also hard to make associations to the occurring problems. | [H9, 3] | The system feedback should be associated to the place where a problem occurs. |

Table 10: Usability Problems within the SOA4All studio and their Corresponding Design Recommendations

4.2 Focus Group Discussions

This section of the deliverable reports the results of the focus groups and divides the users' responses into five sections as follows:

4.2.1 Background of Participants

We solicited participants who were not professional software developers. We had two workshops with students and one workshop with academic and research staff from Manchester Business School, a total of 35 participants.

The age of our participants ranged from 19 to 40, with an average of 26. The distribution is shown here:

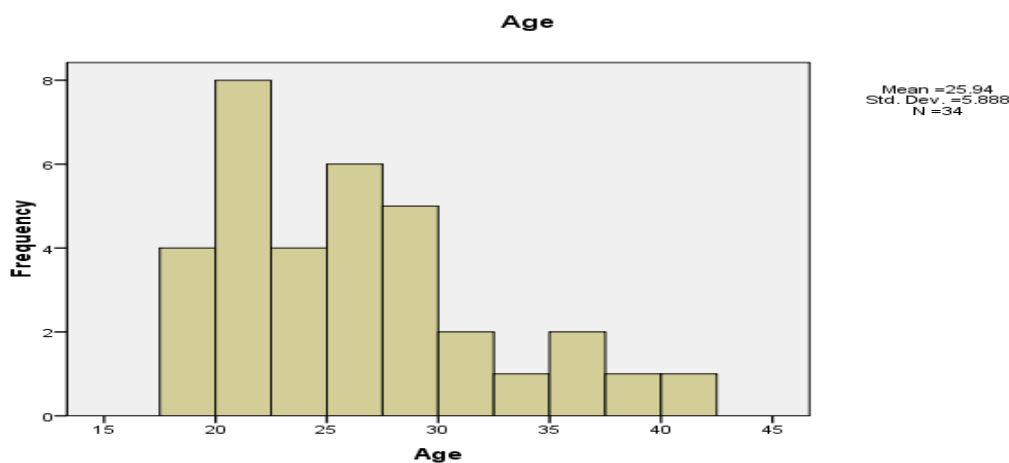


Figure 1. Age of Participants

The education level (highest degree completed) ranged from high school to PhD according to this chart:

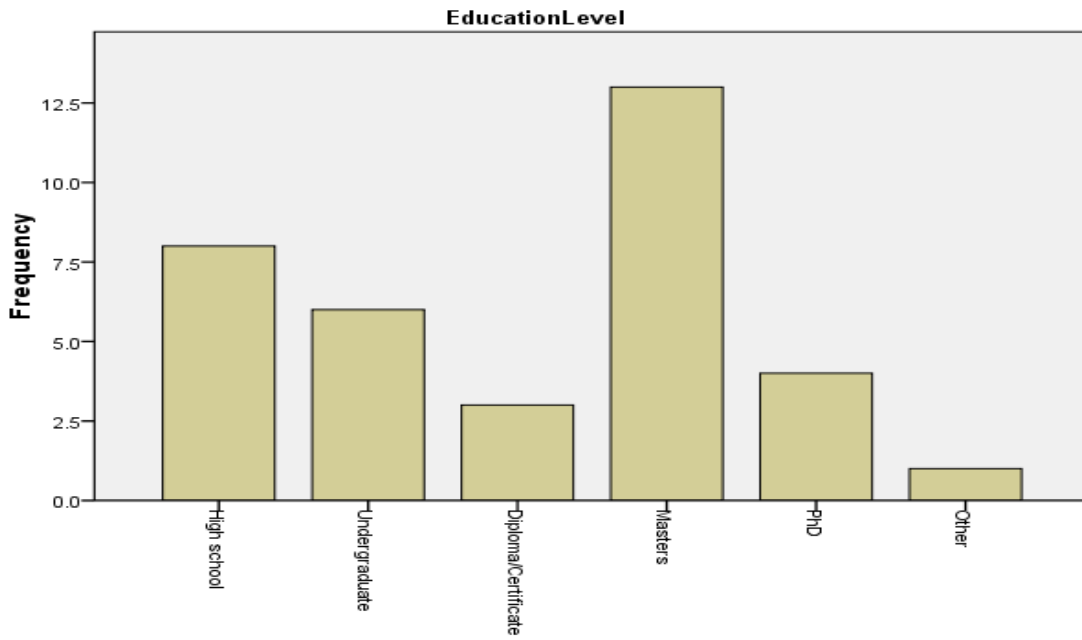


Figure 2. Education Level of Participants

The level of IT education has a bi-modal structure, accounting for the 14 participants who had IT-oriented degrees. This provided an interesting basis for comparative analysis of the two groups.

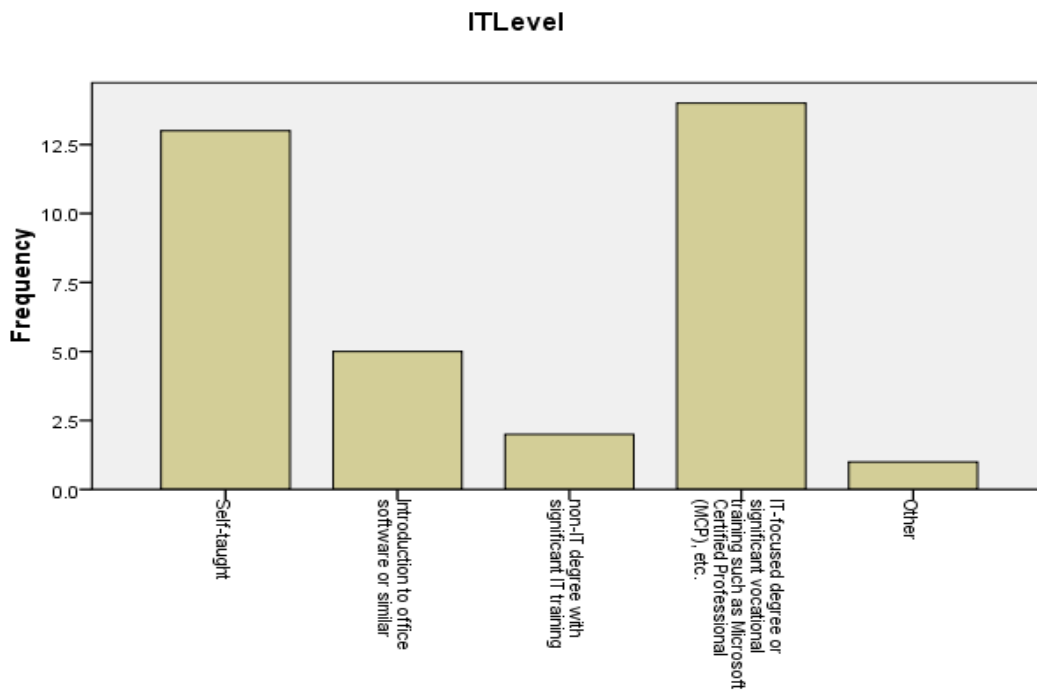


Figure 3. IT Level of Participants

In terms of Software Development experience, most participants were not experts:

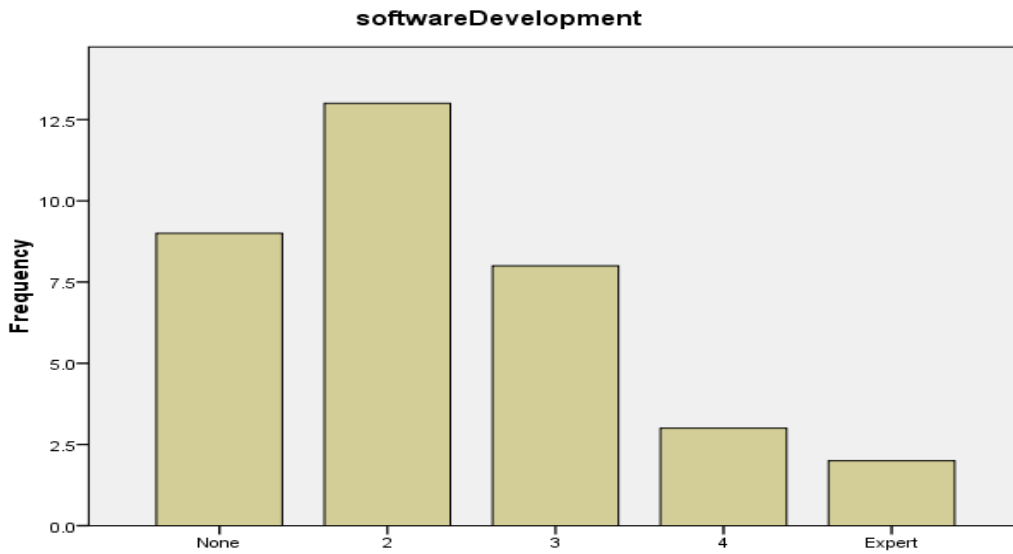


Figure 4. Software Development Experience of Participants

This was even more dramatically pronounced in the case of experience in developing software services:

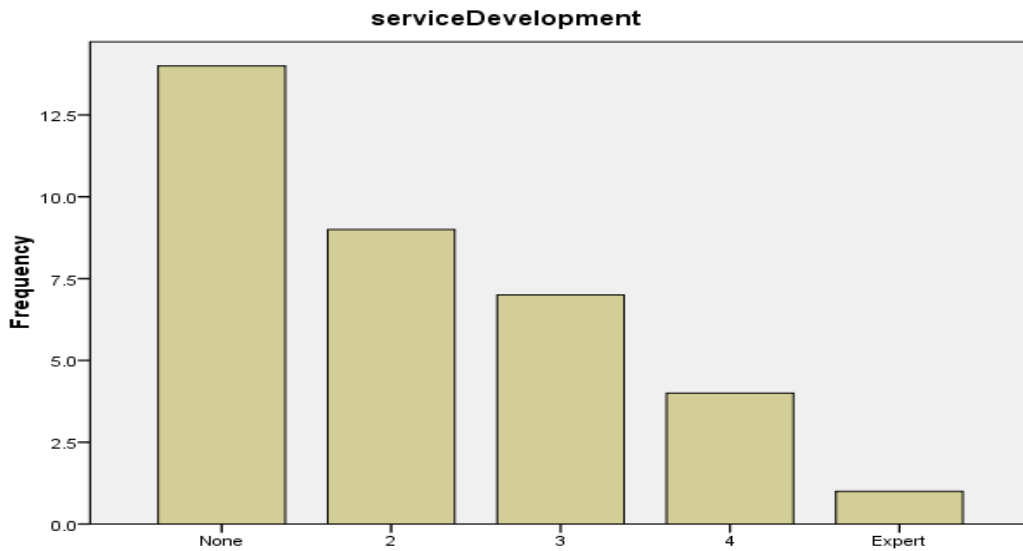


Figure 5. Service Development Experience of Participants

In terms of experience in analysis and design notations, participants were also not experts, although the general level of knowledge was higher:

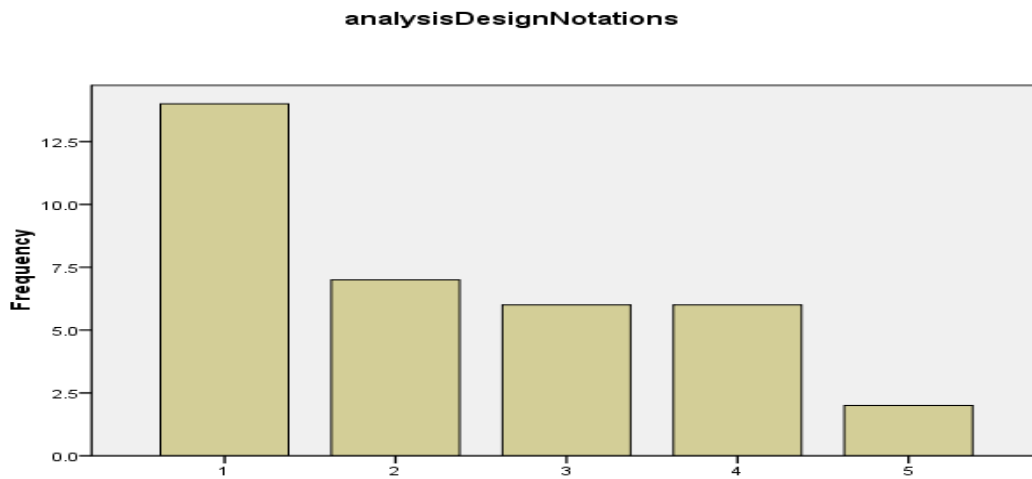


Figure 6. Analysis and Design Notations Experience of Participants

4.2.2 Users Understanding of Services

25 user comments related to service understanding emerged from the qualitative analysis of the responses gathered in the focus groups. The results demonstrated diverse user understanding/definition of services; these definitions varied between: features assisting users, solutions to issues, components of business process, offerings to customers, information provision, and execution of transactions. In general, users' definitions concentrated on two main aspects, (1) describing attributes/features of services such as: services are intangible and they have a back end, (2) describing specific interactions with users in the form of service consumption, such as: providing users with information, helping users, and delivering expertise.

To sum up, end users with no/little computing knowledge have no knowledge of the technical aspects of services, i.e. they could not provide a technical definition of services. Essentially, they perceive services as elements which deliver services (be it information, help, solutions ... etc) to accomplish specified users goals. This view emphasises that services need to be abstracted from their technical complexity and conveyed in a way that describes their purpose/functionality, especially for ordinary web users.

4.2.3 Risks, Benefits, and Support

The discussion about the balance between risks and benefits is based on work [14-17] explaining the uptake of software development by end users (known as End User Development) as a rational economic decision based on the balance of perceived costs and perceived benefits of each user. The ongoing programme of research in the area aims to analyse the factors which impact this perceived balance, and to discover organisational and technical strategies which aim to tip the balance in favour of the benefits, thus supporting the uptake of such technologies, including SOA4All.

From the quantitative questions, the first one was designed to gauge the general level of interest:

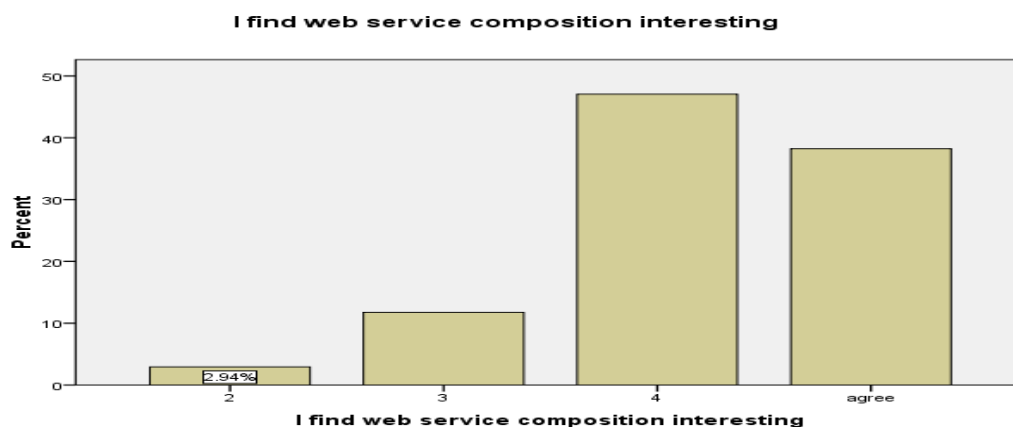


Figure 7. Level of Interest in Service Composition of Participants

Please note that no participants selected disagree (all answers were provided on a five-point

Likert scale from (1 – disagree) to (5 – agree).

Participants ranked highly the potential usefulness of service development.

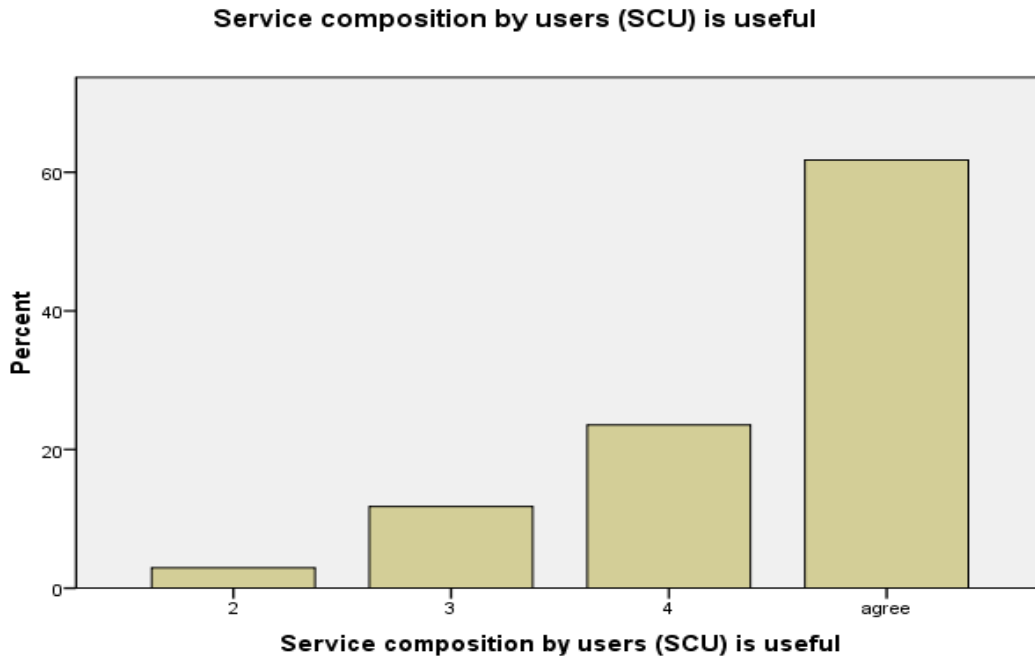


Figure 8. Usefulness of Service Composition by Participants

The opinions about the difficulty of user-based service development were more balanced as shown on the chart below:

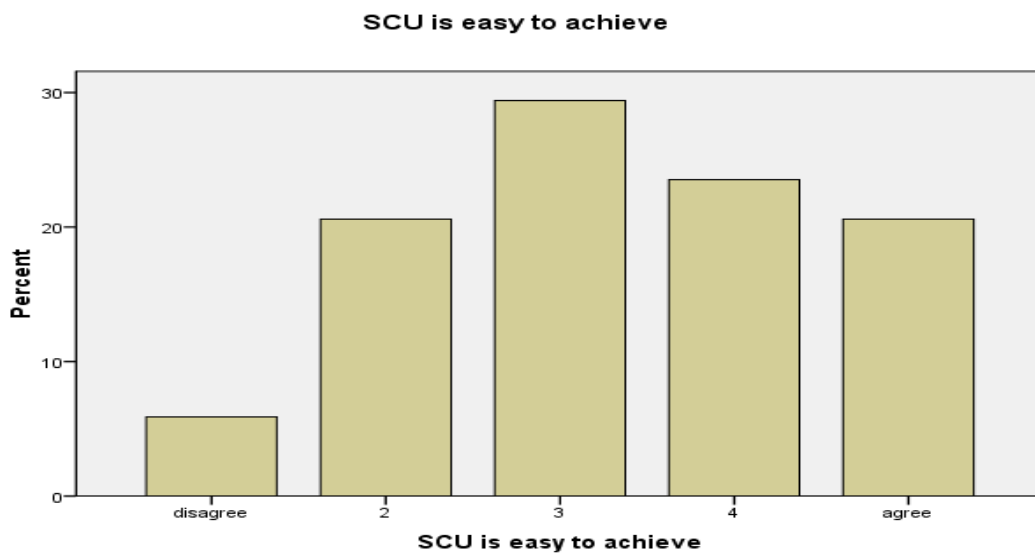


Figure 9. Ease of Achievability of Service Composition by Participants

The main perceived benefit of user-driven service development was the potential

effectiveness of the activity:

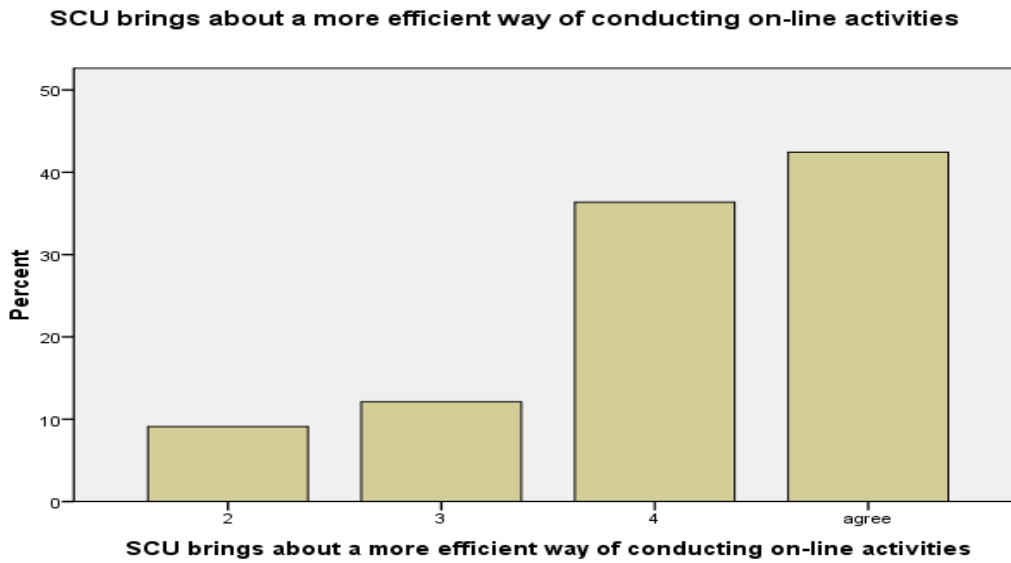


Figure 10. Effectiveness of Service Composition by Participants

In terms of perceived dangers of user-driven service our development, target users were worried about the potential for errors created by end users:

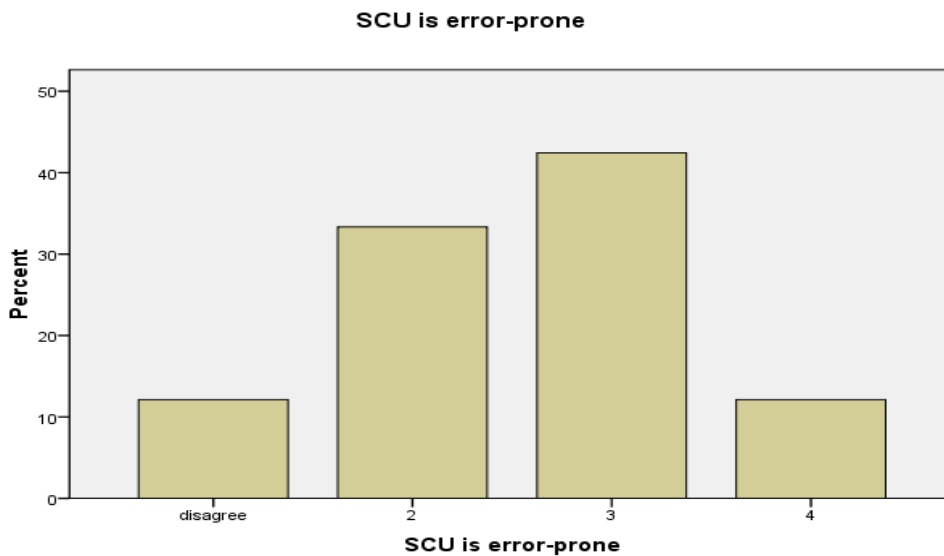


Figure 11. Error-Proneness of Service Composition by Participants

This is consistent with the findings of long-term studies of the most successful end user development tool, spreadsheets, which show that 6% of all spreadsheets in active use contain significant errors, and suggest some priority for testing and validation support in SOA4All Studio.

The potential disruptive use of service development in general and service composition in

specific was also ranked quite highly as shown on the chart below. This mirrors concerns in the focus group discussions presented below.

SCU can be used to break organisational rules and policies



Figure 12. Disruptive Use of Service Composition by Participants

Most users disagreed or remained neutral in regards to the statement that service composition by users is unfeasible, which mirrors their enthusiasm about the idea.

SCU is unfeasible

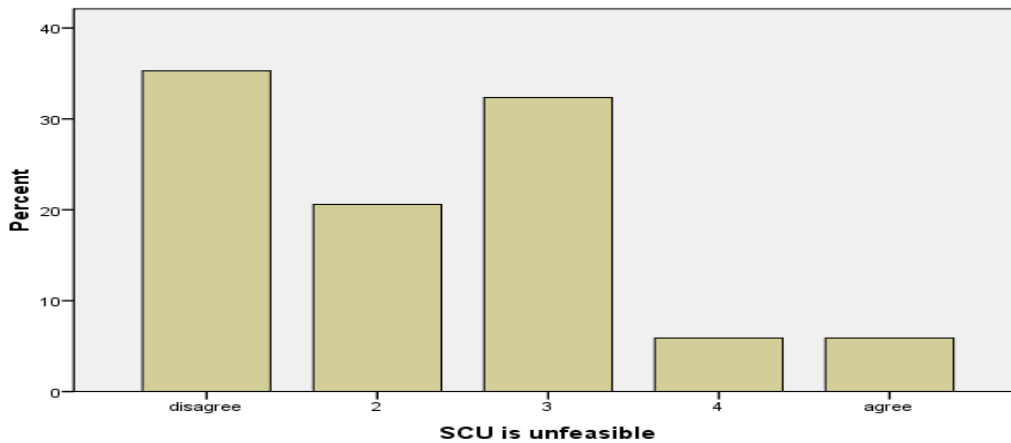


Figure 13. Feasibility of Service Composition by Participants

The focus group discussions about risks and benefits complement the questionnaire findings.

In terms of benefits, discussions focused on the usefulness of reusing composition knowledge, and the time users can save as a result of this. Giving users control over service composition would empower them to produce service applications which are tailored to their needs, such as meta-search engines, thus saving them time and allowing them to obtain better results.

In terms of risks, the biggest fear was about losing control over personal information, especially when the effect is mediated through the effect of social interactions (your friends providing information about you), or through the service provider (information aggregator), which may pass your phone number to other sub-contracting services, and those may or may not be bound to the data protection principles. Errors in putting information together were also possible, especially when the composition is done by inexperienced users and untrusted third parties.

Also, users felt that services may no longer be there when they need them, and that any recommendation support for services may be biased to a set of services.

In terms of technical risks, users touched on one topic of discussion, which was covered also in the focus groups with professional programmers – the technical complexity of connecting services from different vendors was felt to become a daunting obstacle to successful composition.

We also discussed what could be the social and organisational support for user-based service development. The following ideas emerged:

- “Go with the flow” – once everybody is doing it, people will join, mirroring success in other technologies;
- Non-trivial examples of successful use will also help (to sell benefits), this was felt quite strongly;
- Community-level control mechanisms such as feedback, etc. would ensure validation of services and, together with a validating body/watchdog may help to ensure the trust vital for uptake of user-driven service composition.

In terms of technical support which can be provided by the SOA4All platform, the following themes emerged:

- The difference between naïve and professional users was felt to be partially in the awareness of consequences of one’s actions – we should support this awareness;
- Full automation such as Google search results will frustrate due to lack of control by the end users, a balance should be maintained;
- Tools should offer clarity of process in respect to building and using;
 - Context and personalization;
 - Reuse of designs.

In terms of questionnaire answers, the effects of successful examples were ranked quite highly, with no respondents disagreeing with the statement.

Examples of successful SCU can stimulate one to try it.

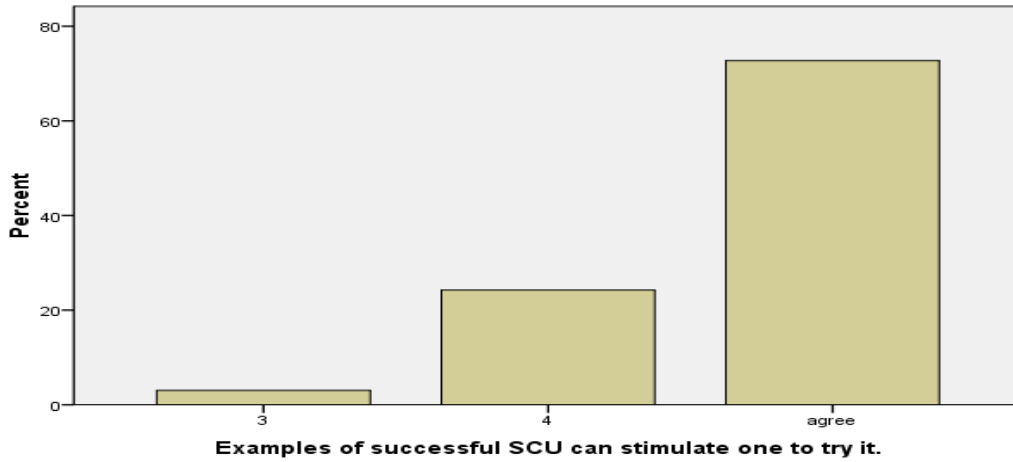


Figure 14. Effects of Successful Examples to Stimulate Service Composition by Participants

Measures for recognizing user effort when producing reusable compositions would also be judged to have potential positive effect.

Recognising and rewarding SCU effort will make people more willing to try it

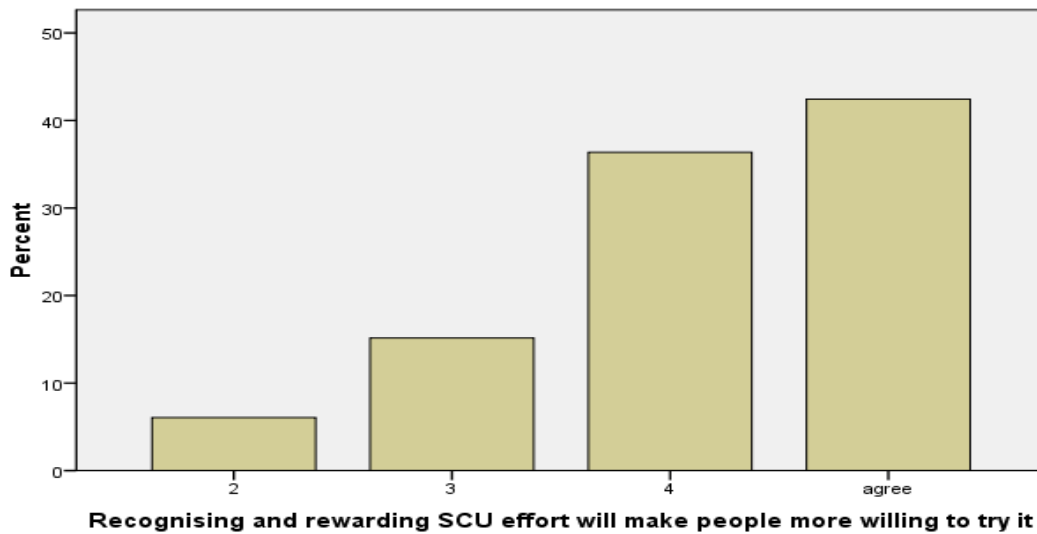
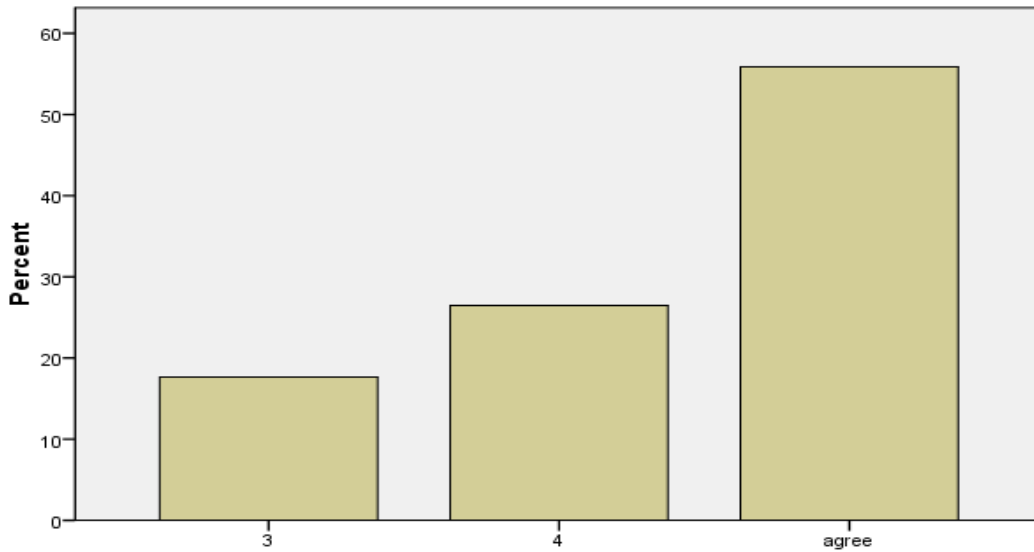


Figure 15. Effects of User Effort Recognition on Service Composition by Participants

Attending a training course was also considered positive.

Attending a training course could help people to start SCU.

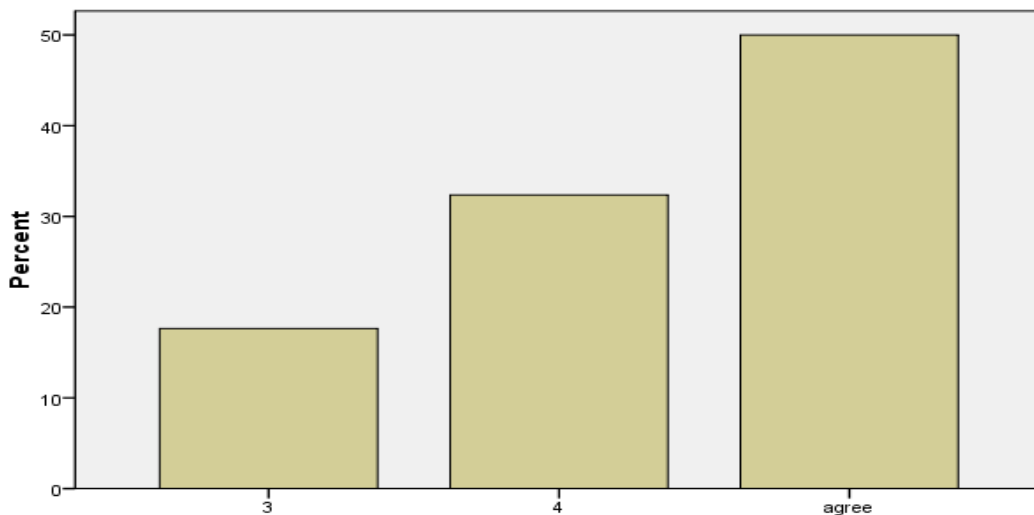


Attending a training course could help people to start SCU.

Figure 16. Helpfulness of Attending a SCU Training Course by Participants

Quality standards and testing were considered a positive way to reduce the risks associated with user-developed services.

SCU quality standards and testing will decrease risks



SCU quality standards and testing will decrease risks

Figure 17. Effects of Quality Standards and Testing on Risks of Service Composition by Participants

4.2.4 Platform

An important concern raised during the focus groups centred on competing with the existing service composition platforms. The participants discussed various service composition platforms and expressed their concerns about competing with the technologies offered by big companies such as Twitter⁴, BT Rapid⁵ and Apple⁶ (iPhone mash-ups). In this respect, the group made some suggestions to attract the users from other platforms e.g. rewards can be introduced for users to use the platform or certain services.

Whilst discussing about the competition with different platforms the group also expressed interest in the business model and revenue generation schemes for the proposed platform. The general perception was the use of advertising revenue for meeting the hardware and administrative expenditures. Another thread of discussion raised the issues related to the rapid availability and ways to manage new information. An important point raised during this discussion was about the need for data standards to validate and authenticate newly available information. In this respect, the group was concerned about the data standards that can be used to ensure that only valid data is transferred between different services in a mash-up.

4.2.5 Representations

4.2.5.1 Notational Studies

Here the workshop participants were asked to draw a service composition in their own style without any constraints on the way service elements are put together. The results were very interesting, with control flow and data flow –based thinking amongst most participants. Some mixed control flow and data flow even within the same diagram, and used data-flow terms to discuss a diagram, which was constructed as control flow.

One notable aspect is that nearly all participants considered their composition to process data sets (the set of all Facebook friends, for example), rather than to iterate through each data item in turn. This matches the way in which multiple element of the same type are treated in spreadsheets, and should be considered carefully in the design of any composition representation based on both data flow or control flow.

In the second and third task, users were shown a problem which was modelled to use the existing representation from the SOA4All Composer mockup, and asked to resolve a simple problem based on the way they understand the diagram. Again some users understood the diagram as control flow and others as data flow. The explanations and discussions suggested that simple representational embellishment may help users identify the type of diagram in a better way, but there is still a danger of misunderstanding, and the effectiveness of the embellished representations will be tested on further lab experiments.

⁴ <http://www.twitter.com>

⁵ <http://bt.com>

⁶ www.apple.com

4.2.5.2 Opinions of Representation Alternatives

The table below shows the opinions of our target users about the three alternative representations, with the answers on a 5-point Likert scale from 1=disagree to 5=agree.

| | Control Flow | Data Flow | Assisted Composition |
|--|--------------|-----------|----------------------|
| I find this composition approach easy to understand | 4.82 | 3.45 | 4.27 |
| I find this composition approach easy to use | 4.00 | 3.45 | 4.09 |
| I find this composition approach effective | 3.64 | 3.36 | 4.27 |
| I feel in control when using this composition approach | 3.91 | 3.45 | 3.64 |
| Overall Rating | 4.00 | 3.55 | 4.45 |

Figure 18. Opinions of Representation Alternatives

Notably, the data flow representation scores were worst on all aspects, whilst the assisted composition approach was ranked best overall. However, the control flow approach was ranked marginally easier to understand than the assisted composition approach. Discussions provided some further insight into these opinions, with the assisted composition favoured for users who are not programmers, whilst control flow considered providing more control for people who understand programming. Data flow was considered difficult to understand, with a possibility that changes can have a ripple effect spiralling out of control. This could be accounted for by data flow explicating the tricky issue of inter-service interoperability and data types, whilst control flow abstracts this away, and assisted composition abstracts away even the notion of having to order services.

5. Conclusions

It is worthwhile to note that the current evaluations were carried out using early prototypes of the SOA4All studio, which justifies the high number of usability problems discovered. In addition, many features of the studio have not been implemented yet. In the next implementation stages, these problems will be resolved.

From the expert-based evaluation of the SOA4All studio, several problems with varied severity emerged due to the early phase of the prototype implementation. The most critical issues evolved around identity of the studio, navigation within the studio, user support, error prevention and recovery, and other specific aspects that relate to the composition editor, annotation editor, and consumption platform. In the annotation editor, connecting ontology concepts to the appropriate service elements is not intuitive and novice users could easily create incorrect connections. In the composition editor, the composition process is not well supported due to the ambiguity of some critical features, such as: the update and delete options of services / actions from the design space.

All these aspects are important to the delivery of a highly usable tool and without which users may find it extremely difficult to accomplish their goals. For instance: navigating within the studio is a serious issue because users frequently use navigational options to find information, and if no effective navigational scheme is employed, there is a high risk that users will fail to find their targets. Other less aggravated issues in the studio relate to the general look and feel of the studio such as: use of space, labelling, symbols, and text readability.

The usability problems discovered in the current version of the SOA4All Studio will be addressed in the next iterations, based on the recommendations made in the table earlier. The major remedies to the aforementioned problems suggest to: (1) clearly define the identity of the studio by incorporating relevant and visible logos in all pages, (2) provide a good navigational scheme to enable users to find information more efficiently, (3) support user decisions via wizards and system recommendations, (4) prevent users from making mistakes by constraining what they can do and by informing them about dangerous actions, (5) provide a comprehensive help section on which users can reply in case of problems, (6) and finally highlight and clearly communicate the relevant aspects of composition, annotation, and consumption.

In terms of workshop discussions, the overall opinion indicated enthusiasm for user-driven service development ideas, with privacy issues and technical complexity being the most feared risks of such activities. A user-friendly representation for service composition will abstract the aspect of iterating over sets of data elements, and show this as a single flowchart. Control-flow-based representation was judged better than the data-flow-based one, since it abstracts the issues of data passing between services and the associated technical challenges. The Assisted Composition approach, which uses templates to minimise effort and technical complexity, and to abstract away not only data compatibility issues but also flow of control, was the overall favourite, yet discussions raised the issue of flexibility and openness of the template library. One approach proposed was to have a control-flow-based composition representation “under the bonnet” of the assistive composition one, to allow expert users to customise service composition templates whenever necessary.

Finally, it should be noted that this evaluation report is focusing on the dashboard and composition parts of the studio as well as the annotation. As mentioned before the reason is twofold: Firstly, the service composition represents an interesting and complex task and is therefore well suitable for users. Secondly, many other parts (e.g. consumption, user profile, etc) have not been implemented at the time of the evaluation as they are still in an early stage. As such, they will be focused in the next iterations of this document in order to give a holistic view.

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Appendix

Appendix A

| | | |
|----------------------|---------|--------|
| Date: 10 - 06 - 2009 | Group # | User # |
|----------------------|---------|--------|

WEB SERVICES WORKSHOP WORKBOOK

Participant Information Sheet

The aim of this workshop is to gather your opinions about opening up software service composition to people without specialist technical skills and making it as easy as creating a blog or a customised Facebook page. We call this *service composition by users (SCU)*.

The workshop consists of four parts and will take approximately 3 hours to complete. This handout will act as a workbook or a lab-book where you record your thoughts and answer stage-specific questions. Please do not read ahead since your opinions on early sections may be skewed by the material available in later ones.

PART A – Introduction presentation and initial discussions (~ 60 min)

1. Complete *Part A.1 Background* of this workbook
2. Introductory Presentations about web services
3. Complete *Part A.2 Service Composition* of this workbook
4. Split into three workgroups – your group is indicated on this workbook
5. Discuss your opinions about *Service Composition by Users (SCU)* in group¹.

PART B – Notational Study (~ 20 min)

1. Complete Part B of this workbook¹

Coffee Break – 15 mins

PART C – Alternative Service Composition Approaches (~ 60 min)

1. Introduction and Walkthrough for each of the three alternative approaches to service composition by users, you will be asked to record instant opinions about each of the three approaches
2. Group discussion of the different notations¹

PART D – Capstone session (~ 20 min)

1. Overall discussion and noting any further comments and ideas ¹
2. Complete final part of this workbook: Part D
3. Invite individual feedback on a summary “take home” message⁷

WORKBOOK PART A.1 BACKGROUND

Please provide the following information and tick (✓) where appropriate:

| | | | | | |
|---|--|--|-----------|--|--|
| <p><u>Personal Details:</u></p> <p>Age: _____ Gender: M <input type="checkbox"/> F <input type="checkbox"/></p> <p>Current job / Course of Studies: _____</p> | | | | | |
| <p><u>Background:</u></p> <p>Please indicate the highest level of education you have completed.</p> <p><input type="checkbox"/> High school <input type="checkbox"/> Undergraduate <input type="checkbox"/> Diploma/Certificate <input type="checkbox"/> Masters <input type="checkbox"/> PhD</p> <p>Others, please specify: _____</p> <p>Which of the options below best describes the level of your IT training?</p> <p><input type="checkbox"/> none <input type="checkbox"/> self-taught <input type="checkbox"/> Introduction to office software or similar</p> <p><input type="checkbox"/> non-IT degree with significant IT training</p> <p><input type="checkbox"/> IT-focused degree or significant vocational training such as Microsoft Certified Professional (MCP), etc.</p> <p><input type="checkbox"/> other</p> <p>Please rank your software experience according to the following criteria:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;"></td> <td style="text-align: center;">1 2 3 4 5</td> </tr> <tr> <td> <ul style="list-style-type: none"> • My experience in software or application </td> <td style="text-align: center;"> none <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> expert </td> </tr> </table> | | | 1 2 3 4 5 | <ul style="list-style-type: none"> • My experience in software or application | none <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> expert |
| | 1 2 3 4 5 | | | | |
| <ul style="list-style-type: none"> • My experience in software or application | none <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> expert | | | | |

⁷ your opinion will be voice-recorded for anonymous follow-up analysis

| | |
|---|---|
| <p>development (e.g. Access, Visual Basic, Java) is:</p> <ul style="list-style-type: none"> • My experience in web service development (e.g. Yahoo!Pipes) is: • My experience with analysis and design notations (e.g. UML) is: <p>Please list the software analysis and design notations you have experience with:</p> | <p>none <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> expert</p> <p>none <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> expert</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> |
| <p>What do you understand by <i>software service</i>?</p> | <p>.....</p> <p>.....</p> <p>.....</p> |

WORKBOOK PART A.2 SERVICE COMPOSITION

Service composition was described in the introductory presentation. Please tell us your opinion about the following aspects of service composition by ticking one of the boxes for each question:

| | 1 2 3 4 5 |
|--|---|
| My experience with Service Composition is | none <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> expert |
| Please list the Service Composition languages and systems you are familiar with (or circle these examples: iGoogle, Facebook, Yahoo!Pipes, BPEL4WS, BPML, BPSS, OWL-S, WSCI, WSCL, WSFL, Semantic Pipes) | |
| I find web service composition interesting | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |
| <i>Service composition by users (SCU)</i> | |
| ... is useful | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |
| ...is easy to achieve | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |
| ... brings about a more efficient way of conducting on-line activities | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |
| ... is unfeasible | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |
| ... is error-prone | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |
| ... can be used to break organisational rules and policies | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |
| <i>Please tell us your opinion about the following ways of encouraging and supporting Service composition by users (SCU)</i> | |
| Examples of successful SCU can stimulate one to try it. | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |
| Recognising and rewarding SCU effort will make people more willing to try it. | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |
| Attending a training course could help people to start SCU. | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |

SCU quality standards and testing will decrease risks.

disagree agree

How often do you compose services or build service-based applications?

daily weekly monthly less often never

What are your favourite service composition languages or systems?

1. _____
2. _____
3. _____

WORKBOOK PART B: NOTATIONAL STUDY

Please note there are no right or wrong answers in the tasks below – we are simply interested in the way you think about the problem and notations.

Task One

Imagine you have to express a service composition by sketching a drawing. Please sketch the solution in the box below. The only restriction is to use simple rectangles to represent services. The choice of notation / symbols is up to you. After you have finished the sketch, please annotate it to describe how you linked the services and any other aspects you feel you need to clarify to us. Descriptions have been left vague in purpose, please feel free to make your own assumptions, just state them clearly whilst annotating the solution.

Please do not spend more than 5 minutes on this, a simple sketch will do.

Problem description

You want to create a composite “Meet Friends” service that enables you to organise a meeting with a group of friends at a short notice. For this you need to:

- Get a list of your friends from your Facebook account
- Retrieve their phone numbers
- Find out information about the meeting venue (website, address, telephone)
- Send each friend an invite and meeting venue info using SMS

You can use the following services to sketch the composition of “Meet Friends”:

- Facebook service providing a list of friends
- A friends contacts service, providing telephone numbers
- “Yellow Pages” service providing information for a chosen venue
- An SMS service

Your
solution

Task Two

The diagram below shows a partial solution to the previous design problem, which is slightly modified to only invite friends who are near to the chosen venue. The services have the following functionality:

Set Location: allows the user to select a location for the meeting venue;

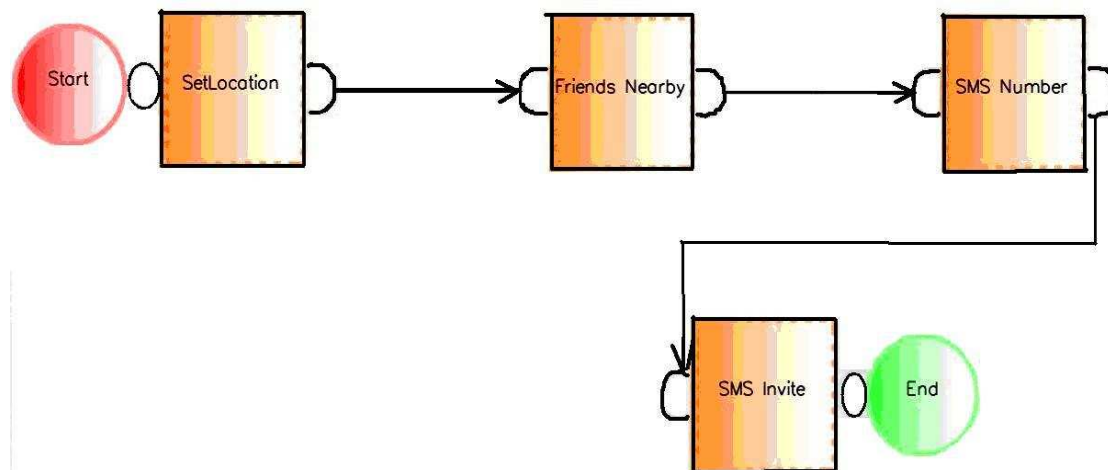
Friends Nearby: Given a location, this composite service retrieves those friends from say the Facebook list of friends which are in proximity of the meeting venue, and their locations;

SMS Number: given a list of friends, this service retrieves their SMS numbers;

SMS Invite: This service sends an SMS Message to a list of SMS numbers inviting people to the meeting.

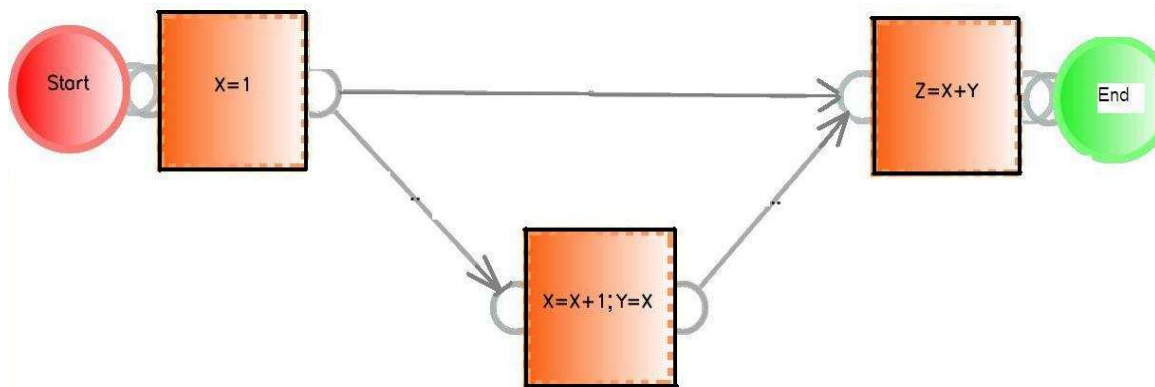
The task is to add a new service “Get travel route”, which provides travel information from the location of each friend to the location of the meeting venue. The instructions should be included in the outgoing SMS message.

Please include the new service and connect it with the rest of the diagram as you see fit. Please then annotate your sketch to explain what you did and why, and also any assumptions you made.



Task Three

Consider the following service composition which calculates mathematical sums.



1. What is the value of "Z"?

2. Please explain how did you get "Z"?

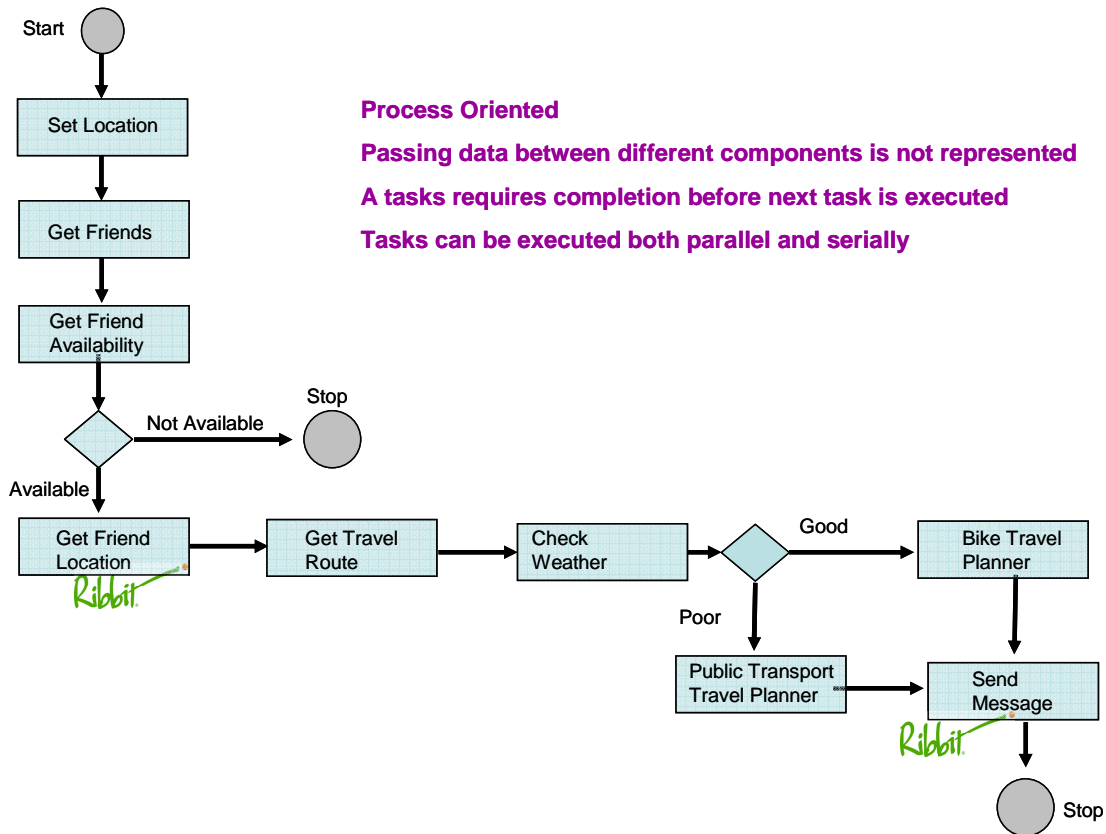
WORKBOOK PART C: SERVICE COMPOSITION

Complete this after the presentation of the **first** alternative for Service Composition.

Please answer the following questions and tick (✓) where appropriate:

CONTROL FLOW

Control Flow



1. Do you have experience using control flow-based service composition?

Yes No, if yes please specify for how long: _____

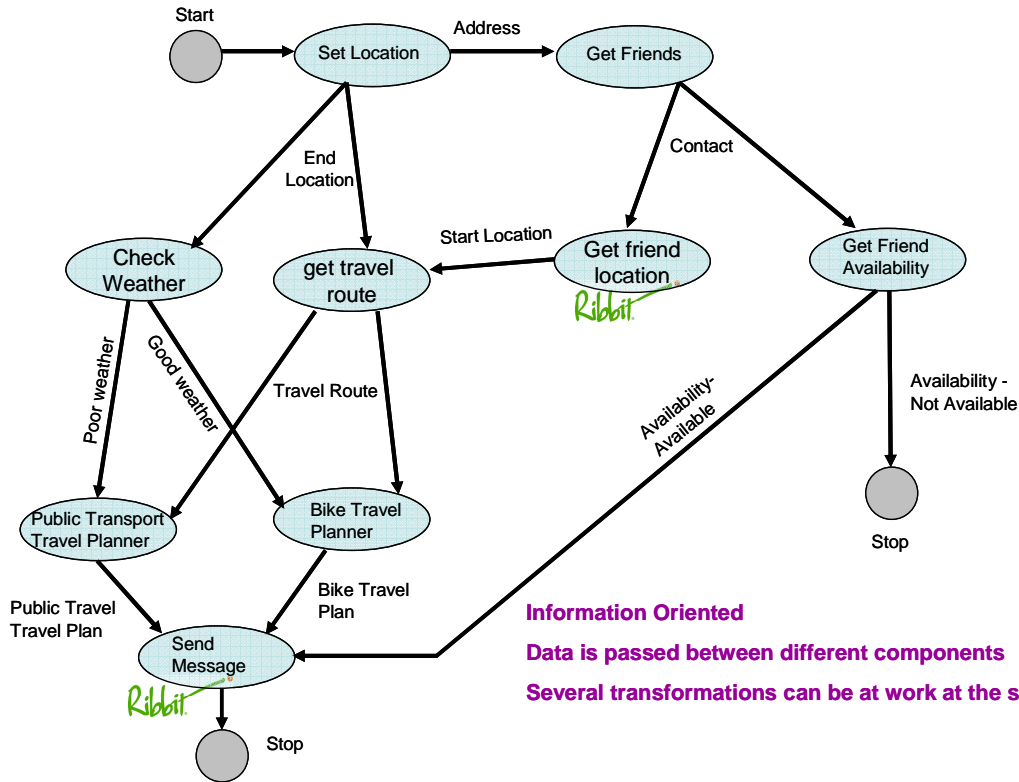
2. Please answer the following questions:

| | 1 | 2 | 3 | 4 | 5 |
|---|----------|--------------------------|--------------------------|--------------------------|--------------------------|
| I find this composition approach easy to understand | disagree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I find this composition approach easy to use | disagree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I find this composition approach effective | disagree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I feel in control when using this composition | disagree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

| | |
|--|--|
| <p>approach</p> | <p>agree</p> <p>disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p> <p>agree</p> |
| <p>Overall, I find this composition approach</p> | <p>1 2 3 4 5</p> <p>bad <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> good</p> |

DATA FLOW

Data Flow



Information Oriented
Data is passed between different components
Several transformations can be at work at the same time

1. Do you have experience using data flow-based service composition?

Yes No, if yes please specify for how long: _____

2. Please answer the following questions:

| | |
|--|--|
| | 1 2 3 4 5 |
| I find this composition approach easy to understand | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |
| I find this composition approach easy to use | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |
| I find this composition approach effective | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |
| I feel in control when using this composition approach | disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> agree |
| Overall, I find this composition approach | 1 2 3 4 5 bad <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> good |

ASSISTED COMPOSITION

Design Composition Three: Assisted Composition

| Templates | Set Location Task | Get Friends | Friends' Location Services | Travel Route Services | Weather Services | Messages Services |
|---|---------------------------|-------------------------------|-------------------------------|--------------------------|---------------------------------|---------------------------|
| Organise Enterprise Event Birthday Conference Movie Outing Wedding Family Food Travel | Enter Location amazon | Facebook Friends facebook | Address-based PostOffice | PlanRoute viamichelin | Weather Forecast BBC | Send SMS <i>Rabbit</i> |
| | Choose Venue letsParty | Outlook Contacts Microsoft | GSM-based <i>Rabbit</i> | TravelPlan theAA | Weather Tomorrow weather.com | Send e-mail Microsoft |
| | Set Place Google | SIM-card Contacts Nokia | GPS-based TomTom | Route Maps Google | | Send MMS 3G |
| | Choose Place visitNW | GMAIL Contacts Google | 3G based | GMTPE Manchester | | |
| | | | LinkedIn Contacts LinkedIn | | | |

1. Do you have experience using assisted-style service composition?

Yes No, if yes please specify for how long: _____

2. Please answer the following questions:

| | 1 | 2 | 3 | 4 | 5 | | |
|--|----------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------|
| I find this composition approach easy to understand | disagree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | agree |
| I find this composition approach easy to use | disagree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | agree |
| I find this composition approach effective | disagree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | agree |
| I feel in control when using this composition approach | disagree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | agree |
| Overall, I find this composition approach | bad | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | good |

WORKBOOK PART D: COMPARISON OF ALTERNATIVES

Please answer the following questions and tick (✓) where appropriate:

1. Which service composition approach did you like most?

- Control Flow Data Flow Assisted Composition Other

2. Please list the reasons of your choice in the previous question?

3. If you think you have an idea about a better alternative approach to user-oriented service composition (you have clicked “other” in Question 1 above), please explain your approach to us (sketch or words):

4. Please note any further comments or ideas

Appendix B

A Moderator Guideline for the Service Composition Workshop

1. General Discussion (After the initial presentation) –Time: 10 to 15 mins-

The aim of this section is to capture the participants' views regarding service composition. So questions should focus on the followings aspects:

- The concept of service composition
- The benefits of service composition
- The risks and dangers of service composition

You could also ask participants about their previous experience:

- Have you ever performed composition (or built applications / integrated pieces of software together) before?
- Ask for examples
- Encourage participants to narrate their experience regarding service composition? Report on problems ... etc

2. Notional Study –Time: 30 mins-

For each of the tasks (**task 1, 2, and 3**) invite the participants to briefly explain their solutions. Ask questions like:

- How did you arrive to this solution? What symbols have you used to represent services, relationships between services?
- Why do the symbols you used mean? Are they easy/ difficult to understand? Are they expressive?
- How did you create links between services?
- Ask participants to explain their solution

3. Discussion of the Design Alternatives –Time: 30 mins-

In this section, you can ask more specific questions about each design approach, such as:

1. Do you think this design approach is natural?
2. What do you like about this composition approach?
3. What do you dislike about this composition approach?
4. What do you think can go wrong with this composition approach?
5. What kind of problems do you expect to encounter when using the current composition approach?

General Hints

- Encourage all participants to participate
- Watch out for dominant participants
- Encourage the free-flow of ideas
- If you notice that the discussion is being steered to an irrelevant topic, redirect it to the appropriate track

** This is a general guideline only and the moderator does not have to follow it word by word. If you think you have good questions, then do not hesitate to ask them.