UDC 519.2

V. A. SHEKHOVTSOV, PhD, NTU «KhPI»

TOWARDS ASSESSING SIMULATED SERVICE QUALITIES BY BUSINESS STAKEHOLDERS OUTSIDE THE SYSTEM BOUNDARY

У роботі описана технологія збору думок реальних зацікавлених осіб (які не взаємодіють із системою на її границі) про якість сервіс-орієнтованих програмних систем. Ця технологія є розширенням методу ISAREAD-S, що реалізує збір таких думок на основі оцінювання характеристик якості програмних сервісів, поданих імітаційними моделями, на границі системи в контексті процесів їх використання. Це розширення полягає у реалізації спеціальної моделі залежності сервісів, що враховує залежності між показниками якості діяльностей процесів, доступних для реальних зацікавлених осіб і показниками якості діяльностей, визначених на границі системи, які представляють сервіси, що розроблюються.

В работе описана технология сбора мнений реальных заинтересованных лиц (которые не взаимодействуют с системой на ее границе) о качестве сервис-ориентированных программных систем. Данная технология является расширением метода ISAREAD-S, реализующего сбор таких мнений на основе оценивания характеристик качества программных сервисов, представленных имитационными моделями, на границе системы в контексте процессов их использования. Это расширение сводится к реализации специальной модели зависимости сервисов, учитывающей зависимости между показателями качества деятельностей процессов, доступных для реальных заинтересованных лиц и показателями качества деятельностей, определенных на границе системы, которые представляют разрабатываемые сервисы.

The paper describes an approach for collecting opinions on quality of service-oriented systems from the specific category of real business stakeholders (which do not interact with such systems directly on their boundary). This approach enhances the ISAREAD-S method for collecting assessments of simulated service qualities on the system boundary in context defined by the service usage process. We introduce special Service Dependency Model taking into account dependencies between usage process activities accessible by real stakeholders and boundary activities representing services under development.

1. Introduction. Software development process for service-oriented systems often relies on the assumption that every service under development can be directly assessed by stakeholders, i.e. every stakeholder is a *direct user* of the system under development (SUD) treated as a set of services. This is mostly true for the systems where all the service users are at the same time the business customers (i.e. all interactions with services happen at the system boundary) such as e-Business systems (online shops, auctions etc). However, for many systems this is not the case; to reflect this [5, 6] draw a line between such direct users and *real users* (customers of the system).

For example, in the system installed at the hotel reception desk, direct users are hotel receptionists whereas real users are its customers. Real users participate in system usage processes (e.g., the process of reserving a room) but do not interact directly with the system at its boundary (this is a work for the receptionists). Ignoring such users can lead to the biased treatment of the prospective system, missing important requirements, customer dissatisfaction, and the project failures.

Paper context. To facilitate development of the service-oriented systems, we proposed the ISAREAD-S framework (Interactive Simulation-Aided Requirements Engineering and Architectural Design for Services) [9, 13, 14] aimed at investigating the ways to support the stakeholder involvement in a form of assessing the perceived quality of the service-oriented SUD in its usage context. To implement such support we plan to elaborate a simulation-based method of making service quality assessment procedures accessible to the business stakeholders (without background in IT) and using their assessments as a driving force for software process activities related to requirements engineering and architectural design. This paper is devoted to integrating real users' assessments into this framework; it describes service-level mechanisms for assessing the system qualities outside its boundary and their integration into process-level mechanisms.

Paper structure. Section 2 describes the state of the art and formulates the problem statement, Section 3 shows the principles of the existing mechanisms for organizing the interaction with stakeholders on the system boundary, Section 4 outlines the proposed solution introducing specific service-level mechanisms for assessing derived service qualities outside the system boundary, Section 5 makes conclusions and describes the directions for future research.

2. State of the art and problem statement. To classify the existing methods for stakeholder involvement in the software process we follow the taxonomy of the methods to represent the quality of the prospective system proposed by Bosch [2]; it includes scenario-based techniques, prototyping, and simulation. In this paper, we restrict ourselves to methods belonging to the first category, see [14] for the review of methods belonging to other categories.

Human interaction with stakeholders. These methods directly address the problem of involving stakeholders into the software process by performing human interaction with them and collecting their opinions. We describe scenario-centered techniques of such involvement [3, 4, 7, 8, 11, 12] which organize scenarios of stakeholder interaction with a prospective system. In most cases stakeholders are requested to proceed through the scenarios in manual mode and express their opinions. There are shortcomings of these techniques as a means of addressing our problem: stakeholders cannot experience quality in a way that they perceive it as real; it is not possible to investigate the dependency between quality-influencing factors and the observed quality levels [2]; for reliability, the scenarios mostly cannot replace interaction with the real system or its executable model as they are able to express it only by example [1].

Real users and their involvement into the software process. The concept of real users which interact with the system outside its boundary was first introduced in [5]. In this book, these users were called customers, whereas direct users which interact with the system on its boundary were called participants. More extended treatment of this category of users was proposed in [6]. In this work the problem of gathering requirements from these users was investigated in detail. No attempts,

however, were made to make such customers experience qualities of the future system and assess these qualities in a way that these assessments become usable in a role of the software process' driving forces.

Problem statement. After analyzing the state of the art we can formulate both general and specific research questions which determine the problem statement.

The general question is: *How to involve business stakeholders into the development process for service-oriented software systems as a means of control for the performance and reliability of the produced artifacts?* We address this question by introducing ISAREAD-S framework [14] offering mechanisms for interactive assessment of simulated service performance and reliability on the system boundary; we present an outline of this framework in the next section.

The specific research question related to the topic of this paper is: *How to involve real users of the service-oriented system into the quality assessment process*? To answer this question, it is necessary to establish the necessary models and procedures which would allow qualities of the specific activities positioned outside the system boundary to be derived from the qualities of the services under development and to be proposed to the business stakeholders for assessment.

3. Assessment mechanisms on the system boundary. In [14] we described the proposed approach to establish service-level and process-level assessment mechanisms for the case when the services are directly accessible to stakeholders.

Service-level mechanisms. We elaborated IAS mechanisms (short for ***I***nteractive ***A***ssessment of ***S***ervices) aimed at an assessment of simulated service qualities at the level of the particular service. According to the model-driven methodology [10] it is necessary to have two mechanisms of this kind: IASC (for model composition) and IASE (for model execution). IASC inputs include the set of qualities of interest to be simulated and assessed and the set of factors influencing the simulation (simulation parameters [14]). To get the integrated quality simulation model, we compose simulation modules corresponding to the qualities of interest and the necessary parameters together with the base simulation structure. Also, we integrate into this model the set of user interaction models for the qualities of interest. The resulting service-level simulation and assessment model becomes the IASC output. It is transferred to IASE for standalone execution.

IASE is responsible for execution of both simulation and assessment interaction submodels of IASM. The input for every IASE run is the set of parameter values corresponding to the parameters used to build IASM. As a result of the run, the set of simulated values for the qualities of interest is obtained and presented to the service user for assessment via interaction processes described by interaction models integrated into IASM. The IASE outputs are this set of simulated qualities and the set of assessment results.

Process-level mechanisms. We elaborated IAP mechanisms (short for ***I***nteractive ***A***ssessment of ***P***rocesses) aiming at interactive assessment of simulated service qualities in context of usage processes at the level of the particular process, in particular: IAPC (for model composition) and IAPE (for model execution). They rely on IASC and IASE dealing with individual services.

IAPC forms the simulation model of the usage process making it ready for interactive assessment of service qualities. It combines the control flow model (CFM) for the usage process (conforming to the network BPM notation) with the role model for the usage process. The role model includes the set of roles defined for process participants (clerk, manager etc), the sets of interaction activities for different roles (they make participants affect the state of the process simulation), the sets of assessment activities for different roles (they correspond to the services of interest to be simulated and assessed by stakeholders) and the sets of qualities of interest and necessary parameters defined for every service of interest.

While composing the integrated model IAPM for the process, IASC creates the IASM model for every service of interest; this model later becomes integrated into IAPM. For every interaction activity, a mechanism for constructing the interaction model is invoked and the resulting interaction model is also integrated into IAPM. The resulting model will contain the simulation logic defined by CFM for the process and simulation submodels of different IASM models (for the services of interest); the assessment logic defined by interaction submodels of these IASM models; the interaction logic defined for all interaction activities.

The IAPM is executed by IAPE. Every run is presented to the stakeholder belonging to the particular role. During the run, the basic simulation flow is managed by the model derived from the CFM of the usage process; when the logic of the run requires invoking an activity representing the service of interest, the simulation of its qualities and the assessment interaction logic are handled by IASE invoked for its IASM. IASE inputs are parameter values for all the slots of this service; when this logic requires interacting with the simulation, the logic of this interaction is handled by the corresponding interaction mechanism. The outputs for IAPE run include the set of all simulated quality values for all the services of interest and the set of corresponding assessment results.

4. Outline of the proposed solution. We plan to address the above research question by extending the process-level mechanisms taking into account the dependencies between activities accessible by the real users and boundary activities representing services under development. We introduce two additional sets of business process activities to be defined for every role:

1. The set of derived activities accessible to the real users which could assess their qualities. They lie outside the system boundary and do not represent services so their qualities are not simulated directly;
2. The set of hidden activities representing services not accessible to the real users. Their qualities are simulated but not shown to stakeholders; they are used to derive the "visible" qualities of the derived activities. Such activity can be at the same time an assessment activity for the other role representing its direct user.

To take real users into account, we plan to introduce new service-level IAD mechanisms (interactive assessments of derived values) for handling real user interactions with the derived activities (IADC and IADE).

The additional input for IADC is the service dependency model SDM for a (derived) activity. It describes the dependencies between "visible" qualities of this activity and the simulated qualities of the services it depends on (its base services). Taking SDM into account (in addition to qualities of interest), IADC prepares the IADM model for an activity which describes how the presented values can be obtained from the simulated values. IADC gets the set of IAM from IAML and integrates them with the dependency model. To simplify SDM implementation, we plan to establish a library of basic dependency rules.

Executing IADM with IADE is shown on Fig.1a. IADE obtains the simulated values for all the qualities of the activity's base services. It then makes forward transformation of these values into the quality values for an activity. These values are shown to the real user to assess. In the simplest case the assessments obtained from this user form the output of IADE together with the simulated qualities of base services and the derived qualities and can be used to help in making informed decisions by analysts.

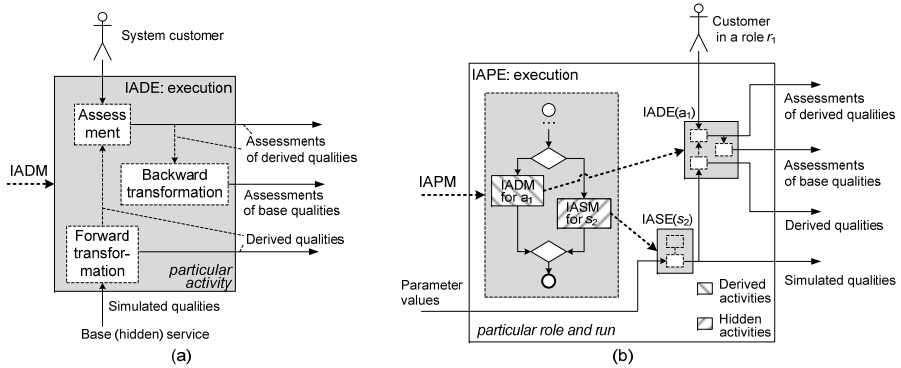

Fig.1. Service-level assessment by real users (a); its integration into the process-level mechanism (b)

In the "ideal" case, IADE makes backward transformation of such stakeholder assessments into the assessments of the base services' qualities. This way, IADE becomes output-compatible with IASE. This transformation is easier to implement if the activity has a single base service. If there are multiple base services, the situation is more complicated (we expect that varying input parameter values and, as a result, simulated qualities for different base services and observing resulting variations in real user assessments could help in such situations). We plan to investigate this issue in detail to find the dependency configurations making possible such transformations.

IADC and IADE are integrated into process-level mechanisms similarly to IASC and IASE. The execution of simulation model by IAPE with boundary and derived activities is shown on Fig.1b. For the "hidden" base service *s2*, IASE is invoked with disabled interaction subsystem, its simulated quality values become an input for the forward transformation module of IADE (*a1*).

5. Conclusions and future research directions. In this paper, we defined new service-level mechanisms for assessing the performance and reliability of the services under development by business stakeholders which take into account the dependencies between activities accessible by the real users and boundary activities representing services under development. These mechanisms can be integrated into the process-level mechanisms for assessing the service qualities in its usage contexts defined via process models. This integration allows us to cover all the types of stakeholder involvement.

In future, we plan to implement all the mentioned models and mechanisms in detail and investigate the possibility to perform backwards transformation of the assessments of derived activities into the assessments of its base services. The whole set of assessment mechanisms is to be the foundation for higher-level policies aimed at solving particular problems of requirements engineering and architectural design such as requirements elicitation and verification, aligning the requirements to the capabilities of the organization (architecture and requirements negotiation), software architecture assessment and, in general, the support of using stakeholder assessments as driving forces for the software process.

References: ***1.*** *Amyot, D., Eberlein, A.* An Evaluation of Scenario Notations and Construction Approaches for Telecommunication Systems Development // Telecommunication Systems. – 2003. – Vol. 24. – N 1. – P. 61-94. ***2.*** *Bosch, J.* Design and Use of Software Architectures. – Reading: Addison-Wesley. – 2000. ***3.*** *Carroll, J.M. (ed.)*. Scenario-Based Design. – Wiley. – 1995. ***4.*** *Drew, P., Raymond, G., Weinberg, D.* Talk and Interaction in Social Research Methods. – Sage Pubs. – 2006. ***5.*** *Dumas, M., Van der Aalst, W., ter Hofstede, A. (eds.)*. Process-Aware Information Systems. – Wiley-IEEE. – 2005. ***6.*** *Graham, I.* Requirements Modelling and Specification for Service Oriented Architecture. – Wiley. – 2009. ***7.*** *Gregoriades, A., Sutcliffe, A.* Scenario-Based Assessment of Nonfunctional Requirements // IEEE Trans. Software Eng. – 2005. – Vol. 31. – N 5. – P. 392-409. ***8.*** *Haumer, P., Heymans, P., Jarke, M., Pohl, K.* Bridging the Gap Between Past and Future in RE: A Scenario-Based Approach // In Proc. RE'99. – IEEE CS Press. – 1999. – P. 66-73. ***9.*** *Kaschek, R., Kop, C., Shekhovtsov, V.A., Mayr, H.C.* Towards Simulation-Based Quality Requirements Elicitation: A Position Paper // In REFSQ 2008. – LNCS, Vol. 5025. – Springer. – 2008. – P. 135-140. ***10.*** *Pastor, O., Molina, J.C.* Model-Driven Architecture in Practice. – Springer. – 2007. ***11.*** *Rolland, C., Achour, C.B., Cauvet, C., et al.* A proposal for a scenario classification framework // Requirements Engineering. – 1998. – Vol. 3. – N 1. – P. 23–47. ***12.*** *Seybold, C., Meier, S., Glinz, M.* Scenario-Driven Modeling and Validation of Requirements Models // In Proc. SCESM'06. – ACM Press. – 2006. – P. 83-89. ***13.*** *Shekhovtsov, V., Kaschek, R., Zlatkin, S.* Constructing POSE: a Tool for Eliciting Quality Requirements // In Proc. ISTA 2007. – LNI, Vol. P-107. – GI. – 2007. – P. 187–199. ***14.*** *Shekhovtsov, V.A.* Interactive assessment of simulated service qualities by business stakeholders: principles and research issues // Проблеми програмування. – 2010, у друку.

Надійшла до редколегії 18.12.09