

Chapter X

Design of Repairable Processes

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ABSTRACT

This chapter illustrates the concept of repairable processes and self-healing functionalities and discusses about their design requirements. Self-healing processes are able to monitor themselves, to diagnose the causes of a failure and to recover from the failure, where a failure can be either the inability to provide a given service, or a loss in the service quality. Defining the process as a composition of services, the aim of this chapter is also to provide guidelines for designing services in such a way that they can be easily recovered during their execution. Repair mechanisms are thoroughly described by distinguishing between mechanisms applicable at design time and at run time.

INTRODUCTION

New technologies, such as Web services and the semantic Web, are currently available for the development of information systems, where processes may be defined as a composition of services which can be selected dynamically to provide advanced personalized value added services and reactive/proactive systems. In order to employ the full potential of Web services, appropriate models and

methods for service-based information systems and for workflows are being developed.

When considering service design and development, first of all the goals of designing a service need to be clarified, as several alternatives are possible [Pernici 2005]:

- **Integration (EAI):** In this case the goal is to integrate different information systems in order to create new cooperative applications. It is important to define the granularity

at which services are considered, and how existing systems are wrapped to offer their functionalities in a cooperative information system through a service-oriented approach [Papazoglou and Van den Heuvel 2006].

- **Redesign (e.g., in mobile, multi-channel applications):** The goal is to modify existing functionalities in order to offer them in a variable environment setting, for instance allowing users to interact with the system from a variety of different devices and from different places. To provide the requested functionality, redesign has to take into consideration quality of service parameters and their variability and to manage the services dynamic selection and binding.
- **New added-value services:** New services are created as a composition of existing services. Composition allows reusing services in several contexts and for different applications. Composition may be performed following a fixed process schema, or designing the composition structure dynamically.

The service oriented approach introduces some new issues in the process design strategies in comparison with the traditional software design. For example, the granularity of the service has to be defined and the interface of the service should clearly state all the functional and non functional properties. Possible solutions to some design problems have been proposed by using reference models and ontologies. Regarding models, the need for models with a rich set of elements as a basis for the design process is a clear prerequisite for all design methodologies. Models should include a variety of aspects, and in particular:

- Business services modeling
- Service composition and coordination
- Interaction between clients and providers
- Service modeling with its Quality of Service (QoS) properties

- Transactional properties
- Self description (metadata).

For each model element, a modelling language should be defined. Existing background in the area, which can be a basis for modelling Web services include the WS-stack, UML2, BPMN, EPC, Aris, and so on. No clear and unique background still emerges.

In order to better understand the complexity of Web services design and of the corresponding processes design, the classical life cycle is represented in Figure 1 [Pernici 2005]. Here, the typical phases are:

- **Analysis:** This phase aims at defining the process goals in order to guide the composition of existing services and to base design (or redesign) on QoS requirements.
- **Logical design:** It should define functionalities and behaviour of the single services that compose the business process and in particular, it is necessary to describe:
 - interface
 - composition of services
 - selection of components
 - coordination design (and possibly distributed orchestration)
 - interaction paradigms
 - adaptivity
- **Physical design:** There is some debate on whether physical design should be a specific issue of service design. Relevant topics are optimization, aimed at improving service performance, and selective reuse.
- **Deployment:** For the deployment phase, deployment criteria should be specified during the design of services.
- **Monitoring:** The issue of this phase is to design the right level of information for monitoring by providing selective visibility of QoS for a given service (depending on consumer, context, costs involved, . . .) and identifying observable elements in order

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