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Service portfolio management: A repository-based framework

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ABSTRACT

The paper discusses a framework for managing and evaluating ICT-enabled service portfolios along the service design phase. The framework adopts a service reuse perspective and it is made up of i) *a model* for the representation of a *repository* of services, ii) a model for the definition of a *service portfolio* representing current production lines of a service provider organization, iii) *a set of metrics* for service portfolio evaluation, and iv) *a tool* supporting managers in decision making for the achievement of design objectives. The proposed metrics and the tool are supposed to allow decision makers to get an improved view of the service design process. Furthermore, the framework supports managers in decision making for the achievement of production objectives as well as operational strategies, resulting in potential reuse initiatives, likewise. To provide evidence of the impacts of the proposed framework, experimental activities are discussed focusing on a real life case study, referring to an Italian small size service provider.

1. Introduction

At present, notwithstanding the multidisciplinary efforts in the growing area of Service Science (Ovum, 2010), the planning and design of services in digital ecosystems still see a focus on the technological perspective as the prevailing one, boosted by the service oriented computing (SOC) paradigm and service oriented design and development methodologies that support the realization of service-based ICT infrastructures (Papazoglou and Van Den Heuvel, 2006; Kohlmann et al., 2010; Papazoglou et al., 2008). As pointed out by Khadka et al. (2011), a service ecosystem is a marketplace for trading services that are developed, sold and used. Accordingly, design and evaluation frameworks are required, considering, e.g., socio-economic features of a service ecosystem apart from the technological ones. This paper adopts the state of the art concept of service portfolio, which is a core component of such kind of frameworks, supporting managers in decision making through all phases of the service lifecycle, i.e., service design, implementation, execution and monitoring.

In this paper we focus on the design phase, whose goal is to produce *abstract services* (Palmonari et al., 2008; Oberle et al., 2013), i.e., conceptual descriptions of services, expressed independently from their implementation. In particular, we propose a framework for ICT-enabled services portfolio evaluation with specific focus on service reuse. The framework is made up of i) *a model* for the representation of a *repository* of services, ii) a model for the definition of a *service portfolio* representing current production lines of a service provider organization, iii) *a set of metrics* for service portfolio evaluation, iv) *a tool* supporting managers in decision making for the achievement of service design objectives.

The framework has been developed in the context of the SMART (Services and MetA-services for smaRT e-Government) project, where a methodology for the service lifecycle is currently under development and experimentation. A central artifact in the methodology is the repository of services, which plays in the service lifecycle the role of a software applications repository in software engineering, and can be used, among others, for (i) aggregation of elementary services into composite services; (ii) identification of correspondences between services and events of life; (iii) assessment and improvement of the efficiency of the service lifecycle, and (iv) optimization of service value.

It is worth noting that in this paper we focus on the assessment and optimization of the lifecycle design phase. In order to make a repository of services an integrated representation of all services produced within an organization, we propose to model it with two different semantic relationships (namely, *is-a* and *part-of* relationships), originally proposed in the areas of knowledge representation and conceptual database design, highlighting similarities among services and part–whole relationships. Moreover, the repository, together with

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data on service design costs in production lines are the constituents of the resulting service portfolio. The knowledge generated from the implementation and adoption of the framework can be exploited for several usages that may improve design processes and operational strategies of the provider, enabling potential reuse in the design of services.

The paper is organized as follows. An analysis of the literature and related work is outlined in Section 2. In Sections 3 and 4 we describe the model for the definition of a. production lines and design process, b. the repository of services, c. the service portfolio and d. a set of metrics for service portfolio management and evaluation. In Section 5 we propose a tool supporting managers in decision making for the achievement of production objectives. Section 6 applies the framework to a real life case study referring to an Italian small size service provider. Finally, Section 7 discusses results of the experimental activities and outlines future work.

2. Background and motivations

The concept of portfolio management has been introduced by Markowitz (1952), proving that diversification of an investment portfolio is preferable to a homogenous portfolio based on the dimensions risk and return. These concepts led to the development of the Modern Portfolio Theory (MPT) (Elton et al., 2007), and to its former applications in the financial domain. However, over the years, portfolio management has been applied for the management of business objects such as business units, products, relationships, projects, or IT applications. Cooper et al. (2001) define three generic goals of portfolio management for new products based on empirical findings: *maximization of value* against one or more business objectives, *balancing*, in order to manage the overall risk of the portfolio; *strategic alignment* of the portfolio with the strategy. Accordingly, portfolio models can be clustered in seven different categories: financial or economic models; scoring models; probabilistic financial models; behavioral approaches; mathematical optimization procedures; decision support systems (Cooper et al., 2001; Henderson, 2006; Parkhe, 1991; Avlonitis and Papastathopoulou, 2006).

Thus, several applications have been investigated in the area of service portfolio management (SPM), and many models and algorithms have been developed to support IT executives. Accordingly, in literature authors have proposed frameworks for SPM adapting traditional goals of portfolio management, such as maximization of value against business, and shareholder financial objectives. In Kulkarny and Dwivedi (2008) an analysis is conducted over the current service portfolio of a provider to identify its suitability for layering and categorization at a later stage. The return on investment (ROI) of services is calculated by identifying various costs that incurred in building a service and its related benefits. As a second criterion, functional reusability is used to measure the ability of the services to produce a generalized set of services. Another application discussed in (Wei and Zhiqiang, 2011) provides a quantitative approach to analyze a service portfolio with multiple objectives under a given budget. Thus, SPM has been seen as an instrument for supporting decision making on service design, implementation, execution and monitoring (Janssen and Feenstra, 2006).

Besides the above issues, at the state of the art, a service portfolio perspective (Kohlborn et al., 2009) has received attention as a way for managing complexity in service asset management, in particular with regard to Service Oriented Architecture (SOA) based solutions for the service life cycle (Ponnalagu et al., 2011).

Thus, SPM in SOA has a role both in strategy design as well as in the development of services, covering different steps in their lifecycle. IBM, among others, has developed a method for the service life cycle called 'Service-Oriented Modeling and Architecture' (SOMA) (Arsanjani et al., 2008). It provides guidelines for three steps towards SOA systems: identification, specification, and realization of services, flows, and components. The approach of IBM further suggests organizing services in a hierarchy of services of different granularity to achieve modularity. Furthermore, in Dan et al. (2008) it is observed that reuse of services in supporting new business processes, is a key motivation in using SOA for developing business solutions. The three key benefits of service reuse are (i) improving agility of solutions, (ii) reducing costs, and (iii) reducing risks. Lee et al. (2010) propose a feature oriented approach to reuse, transferring to service composition the concept of 'design by contract' (Meyer, 1991). In Zhu (2005) the key idea is to split the overall lifecycle into two main phases: application engineering and family engineering. The method guides through the construction of a reuse infrastructure that consists of generic services optimized for the particular family of envisioned products. In reusing services and business processes repositories technologies play a relevant role (Weske, 2012; Sun Microsystems Inc. 2005), providing a structured representation of a given company services or business processes. Consequently, SPM ensures that "a sound method is used consistently to decide which services need to be developed and how the necessary investments are prioritized" (Schepers et al., 2008).

Considering now the design of a service portfolio, according to Sarno and Herdiyanti (2010) three levels of views are worth to be considered, which are the *conceptual view*, the *logical view*, and the *physical view*. The conceptual view supports the conceptualization of services and governance needs, while the logical view provides the architecture components for the conceptualized services; whereas the physical view identifies the physical implementation components of the services. In this paper we model the conceptual view. However, the latter has to take into account the two main parts identified in the literature for a service portfolio (Janssen and Feenstra, 2006): *catalog* and *pipeline*. The catalog services are composed of the active and retired services. The pipeline consists of services under development for a given market place. In this paper we focus only on pipeline services, considered in the service design process. Consequently, it is worth noting that a service portfolio can include services that are not yet developed, but only exist as service ideas (Janssen and Feenstra, 2006). As for the SOA specific domain, the terms registry, repository and catalogue are used often with similar meanings. Basically, as to technological perspective (Sun Microsystems Inc. 2005), they represent a middleware solution for managing the increasing SOA adoption in organizations. As to managerial perspective (Kohlborn et al., 2009), they represent a useful vehicle to support the decision-making process in regard to managing the service lifecycle in: (i) the introduction of new services, (ii) the improvement or change of existing services, (iii) the retirement of existing services, (iv) business decisions on the bundling of multiple services into one package.

As for service description and presentation also at business level, it is worth noting the emergence of structured and formal approaches to model the lifecycle of services: for example, languages such as, e.g., USDL (Oberle et al., 2013) and Linked USDL (Pedrinaci and Leidig, 2012) provide an abstract view on services as well as services networks (Cardoso, 2013) which can be used to develop generic solutions applicable for various service domains. These languages and modeling approaches can provide the building blocks to support portfolio management. However, they are oriented towards providing a somewhat high level perspective mainly on the development of services, thus, missing in their comprehensiveness a parsimonious set of relationships (i.e., level of development, effort spent and estimated effort to service development) for answering managerial queries to the portfolio at an even higher level of abstraction than the one they actually can reach. In particular, we consider the ones related to the modularity of the current service asset as made up of products of a given company; thus, questions related to the inter-firm product modularity, that is the configurations the service asset can have, e.g., when "merged" with other companies' asset.