Chapter 19
Simulation Based Evaluation of Service Science Productivity for Solution Providers

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ABSTRACT

Many companies offer customized solutions by integrating services into their product portfolio. In this regard, a systematic planning for solution providers is crucial, otherwise, task sequences or the assignment of resources to achieve the business objectives can be incorrect. In order to evaluate and to raise the service productivity, service models and simulation techniques have been used to determine the sequence of activities and to assign actors and resources to tasks. In this paper, the authors demonstrate that service solutions can be prospectively modeled, simulated, and optimized. To achieve improved service productivity, the concepts for service productivity are reviewed and a Petri net based simulation approach is introduced. Tests confirm that the simulation approach is capable of calculating a number of service performance metrics that focus on the effect of a stochastic makespan for tasks and the variable assignment of actors and iterations to activities. In the validation study, a service solution process for a power plant construction is considered to analyze the external validity of the simulation model, as well as the structural validity of the corresponding computational models. Simulation results demonstrate the approach providing a convergence to a global optimal service solution.

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INTRODUCTION

The successful integration of innovative services and products in one solution and bringing it to market is an important source of gaining competitive advantages in the mechanical engineering industry. In particular, the developed products and services are unique among engineering artefacts in that they are often capital cost intensive, operating expense intensive and designed for long lifetimes simultaneously (Eversheim, 2008). As a consequence, researchers in service science focus on studying the characteristics of service processes intending to simultaneously reduce service lead-times, reduce cost, and improve quality (Parasuraman et al., 1985). Several formal theories of service science have been published (Koumpis, 2010). While the relevant authors fail to agree on a single theory of service science for solution providers and corresponding best service processes as a benchmark, it seems to be generally agreed on four important facts in terms of planning service operations: (1) Uncertainties regarding the makespan of activities are a typical characteristic of service projects (Blackburn, 1991), (2) predecessor constraints of tasks within a (service) project are not strictly specified and are therefore often refined with respect to the situation and the person (Eppinger et al., 1994), (3) the assignment of actors and resources (tools, facilities) to tasks is a complex resource constraint scheduling problem whose solution determines the service lead-time (Hildum, 1994), (4) iterations are a characteristic of complex services as well as a major source of unexpected rework and budget overruns (Reijers, 2003). Due to these facts, both the prospective evaluation of uncertainty and the consideration of complexity have become central issues in developing a service organization for solution providers. Research in this field has shown that modeling provides an avenue to improved understanding and optimization of service operations (Barnard, 2006).

Optimization of a work organization and the underlying operations can be achieved in several ways: improving the sequence of tasks / activities to streamline the workflows, which directly determine the progression of complex services (Eppinger et al., 1994); developing new software tools to generate, describe and prospectively evaluate as well as minimize uncertainty within the service organization and adding actors and resources to bottle neck tasks (Yassine & Braha, 2003). Instability can be reduced by reordering tasks and considering alternative options so that the effects of delayed activity processing and feedback are minimized. An ideal work organization is defined as one with no iterations (Yassine et al., 2007) and which achieves the objectives. However, in real complex service projects, an optimal sequence of activities as well as assignment of actors and resources is unlikely to be uncovered.

Therefore, in this paper, three contributions are made to easily evaluate detailed service scenarios and service operations: First, prior to any simulation, the requirements of a simulation based measurement of service productivity for solution providers are formulated based on a comprehensive literature review. Second, these requirements are used to develop general mathematical descriptions of service processes for solution providers. Third, a Petri net based simulation approach to describe the system dynamics of a service organization is introduced. Thereby, we focus on factors of service productivity which are directly linked to the development of a conventional product of mechanical engineering. Initially, a Petri net based project structure model is enhanced with object-oriented Java functions to describe uncertainties and stochastic events within the service process. This hybridization required fewer necessary resources than the Petri net approach presented in earlier studies to obtain the same quality solution (Kausch et al., 2008).

In this paper, we review the requirements for modeling a service process and the heterogeneous parameters that have an impact on service