Chapter 3.12
Business Process Analysis

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INTRODUCTION

Business-process management (BPM) is nowadays a key technology for the automation and support of processes in medium-sized and large organizations. This technology has been successfully applied to business-to-consumer (B2C) and business-to-business (B2B) e-commerce since the '90s, and it is now being applied also in e-government for the management of administrative procedures. As stated in Aalst, Hofstede, and Weske (2003), the origins of BPM technologies can be found in the '70s with the research on office information systems. Research in this area was almost stopped in the '80s, but it rose again in the '90s under the name of work-flow management. Now it is evolving with a more integral approach and a new name: BPM. It is defined in Aalst, Hofstede, and Weske (2003, p. 4) as "supporting business processes using methods, techniques, and software to design, enact, control, and analyze operational processes involving humans, organizations, applications, documents

and other sources of information." The main functionalities provided by a BPM system are defining business processes, automatically enacting them, controlling their enactment, and analyzing them. This article is focused on the last functionality: business-process analysis (BPA).

BPA can be defined as a set of technologies that provide support for obtaining relevant properties of business-process models in order to reason about them, detect functional errors, or improve their performance.

BPA was a neglected area in the work-flow management systems developed in the '90s. Will van der Aalst (1998) was one of the first researchers in this field. He proposed the use of petri nets for modeling business processes and the application of the analysis theory developed for this formalism to demonstrate the correctness of the developed processes, analyze performance, and so forth. Since then, other approaches, based on formal methods, were proposed. BPA is important for BPM because it provides the technology for improving the reliability and efficiency of the

business process of organizations. Reliability considerably reduces expenses caused by errors in transactions. Efficiency reduces expenses caused by an inefficient use of resources and can improve the satisfaction of customers.

The next section provides a background on the most important analysis technologies: functional verification and performance measuring. Then, the discussion is focused on functional verification. An overview on how different authors applied functional verification to business processes is presented. Then these works are analyzed and an open, modular, and extensible architecture for the functional verification of business processes is presented. Later, the future trends on this topic are outlined. Finally, the conclusion highlights the main concepts introduced in this article.

BACKGROUND

BPA technologies help process designers to reason about process models in order to guarantee a desired level of quality. The objectives of BPA can be classified into two main groups: functional verification and performance measuring. Functional verification consists of checking if the process is consistent with its functional requirements; that is, the process does always what it is supposed to do. Results of this type of analysis are used to correct functional errors in process models. Performance measuring consists of obtaining statistics about the performance of the process from the point of view of the customer (response times) or from the point of view of the organization that performs it (usage of resources). Results of this type of analysis can be used to obtain statistics, or to identify parts of the models that should be reengineered in order to improve performance. Depending on the type of reasoning needed, different analysis techniques are used. They are normally adapted from other fields like computer science. This section provides an overview of some of these techniques and shows how they are being applied for analyzing business processes.

Functional verification is an active area of research that is being applied to different fields, such as software engineering, digital-circuits design, or protocol design. As stated in Clarke, Grumberg, and Peled (1999), the main techniques for functional verification are guided simulation, testing, deductive verification, and model checking.

Performance analysis is used, for example, for designing telecommunication networks, operating systems, or manufacturing processes. Techniques for performance analysis are normally based on queuing theory and simulation (Gross, 1998).

Guided simulation and testing are two traditional and widely used approaches for verification. Guided simulation is performed by executing the process model in a fictitious environment provided by a simulator. The designer can, for example, guide the simulation, view or modify the content of variables, or put break points into the process definition. Testing consists of checking the correct behavior of the process in the real business-process management system before its definitive deployment. Although they are very useful analysis techniques, simulation and testing cannot, in general, analyze the behavior of all the possible execution traces of a process. In addition, they require too much human intervention and cannot be automated.

Deductive verification and model checking are techniques based on formal methods. They can be used to prove that a given property is true (or false) for every possible evolution of a process model.

Deductive verification is based on the use of mathematical axioms and rules for proving properties of models with the assistance of semiautomatic theorem provers. Deductive verification can be used to prove properties even in infinite-state process models. However, its main disadvantages are that it must be performed by trained experts, it requires a large amount of time, and it is an

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