CAptEvo: Context-Aware Adaptation and Evolution of Business Processes*

Antonio Bucchiarone, Annapaola Marconi, Marco Pistore, and Heorhi Raik

FBK-Irst, via Sommarive 18, 38123, Trento, Italy
{bucchiarone,marconi,pistore,raik}@fbk.eu

Abstract. CAptEvo is a framework for the adaptation and evolution of service-based business processes operating in dynamic execution environments. In this demonstration, we apply the CAptEvo to a case study from the logistics domain and show its advantages in handling highly complex dynamic real-world business applications.

1 The CAptEvo Framework

Adaptability is a key problem in dynamic business environments, where operational excellence requires to model and execute business processes taking into account a dynamic, open and non-deterministic execution context. These adaptation needs may be triggered by specific execution cases, dynamic service availability, non-controllable situations depending on environmental conditions, or changing requirements. Moreover, this need for continuous adaptation results in a system characterized by a huge set of process executions that, although instantiated on the same process model, strongly differ in terms of process structure. In such a dynamic environment, the *short-term* adaptations applied to process instances should be used to derive *long-term* changes that progressively improve the process models.

The CAptEvo Framework, developed within the ASTRO project [1], integrates sophisticated techniques for managing the execution, adaptation, and evolution of context-aware business processes. The framework exploits a modeling approach for Service Based Applications where adaptability and context-awareness are key embedded characteristics of the business application [2,3]. During the execution phase, process models are instantiated and the corresponding process instances are executed. The *Execution Manager* is responsible for keeping the system configuration up to date and for consistently aligning the status of context properties to the execution of the processes and to the context events. The system configuration is used by the Execution Manager to monitor context constraints associated to running process instances and to trigger adaptation in case of violation. The *Adaptation Manager* supports two types of AI-planning based dynamic adaptation: *vertical* and *horizontal*. The aim of vertical adaptation is to refine abstract activities of a process by automatically composing

* The research leading to these results has received funding from the European Community's Seventh Framework Programme FP7/2007-2013 under grant agreement 215483. (Network of Excellence S-Cube).

[1] www.astroproject.org

G. Pallis et al. (Eds.): ICSOC 2011, LNCS 7221, pp. 252–254, 2012.

available services and obtaining a concrete process that can be executed. Horizontal adaptation results in a structural modification of the process instance by adding, changing or removing process activities to retain the reachability of its original goals in case of a changing environment. The information about the system execution and adaptation is recorded in the *Execution Log*. Examples of stored information are the traces of process instances and of context properties execution and the adaptation history in terms of adaptation problems and adopted adaptation variant. The set of adapted process instances together with the information concerning their execution are used as training cases for evolution mechanisms in order to progressively improve process models that are then used to instantiate future process instances. The evolution need is triggered by a problem in the system performance with respect to the KPIs of the process models. Given the specific evolution need (KPI violation for a certain process model [5]), the Analyzer considers all the process instances that contributed to the KPI violation and looks for recurring adaptation needs examining their adaptation history. The *Evolution Manager* looks for adaptation variants that solve the same adaptation problem and that have good performance with respect to the KPI. The identified adaptation variants are then ranked according to execution performance (e.g., performance with respect to the other KPIs and confidence) and proposed as evolution variants to be plugged-in in the original process model. In our framework we adopt a man-in-the-loop approach, where evolution variants, together with their performance, are presented to the process designer that, through a set of *built-in adaptation tools* [4], can embed them in the evolved process.

2 Demonstration

To demonstrate the CAptEvo framework in action, we use a real-world scenario from the domain of logistics [1]. The scenario is based on business processes used in the terminal of the Bremerhaven sea port, where cars arriving by ship have to be delivered to retailers. Before the cars can be delivered, a series of activities needs to be completed such as customization procedures, car shipment and repair, etc. The management of car delivery is a highly complex process, as each car requires an individual treatment, and the process execution might be affected by changes in the execution context such as car damages. This requires sophisticated modeling that allows for run-time adaptation, and evolution of the application. In our demonstration, we illustrate the CAptEvo framework in action and present the outcome of our algorithms to the end users. We have created a visualization environment enabling interaction between the framework and the user and simulating execution, adaptation and evolution of business processes in our case study. In particular, it can:

- Run the reference "Car Logistics" scenario and simulate the execution and adaptation of each business process attached to each car.
- View the different adaptation strategies supported by our framework (i.e., vertical and horizontal) and how they are used during the scenario execution.

- Inspect the behavior of the system in terms of process performance and adaptation history.
- View the process evolution results and choose the process variants to be embedded in the system.

The goal of this demonstration is to show the novel concepts and advantages of the CAptEvo Framework when applied to a real and complex pervasive system.

References

1. Böse, F., Piotrowski, J.: Autonomously controlled storage management in vehicle logistics - applications of RFID and mobile computing systems. International Journal of RT Technologies: Research an Application 1(1), 57–76 (2009)
2. Bucchiarone, A., Kazhamiakin, R., Pistore, M., Raik, H.: Adaptation of Service-based Business Processes by Context-Aware Replanning. In: SOCA 2011 (2011) (submitted)
3. Bucchiarone, A., Marconi, A., Pistore, M., Sirbu, A.: A context-aware framework for business processes evolution. In: EVL-BP Workshop of EDOC 2011 (2011)
4. Marconi, A., Pistore, M., Sirbu, A., Eberle, H., Leymann, F., Unger, T.: Enabling Adaptation of Pervasive Flows: Built-in Contextual Adaptation. In: Baresi, L., Chi, C.-H., Suzuki, J. (eds.) ICSOC-ServiceWave 2009. LNCS, vol. 5900, pp. 445–454. Springer, Heidelberg (2009)
5. Wetzstein, B., Leitner, P., Rosenberg, F., Dustdar, S., Leymann, F.: Identifying influential factors of business process performance using dependency analysis. Enterprise IS 5(1), 79–98 (2011)