Chapter 8

Reliability of IoT-Aware BPMN Healthcare Processes

Dulce Domingos
Universidade de Lisboa, Portugal

Ana Respício
Universidade de Lisboa, Portugal

Ricardo Martinho
Polytechnic Institute of Leiria, Portugal

ABSTRACT

BPMN (Business Process Model and Notation) has become the de-facto business process modelling language standard. Healthcare processes have been increasingly incorporating participants other than humans, including Internet of Things (IoT) physical devices such as biomedical sensors or patient electronic tags. Due to its critical requirements, IoT-aware healthcare processes justify the relevance of Quality of Services aspects, such as reliability, availability, and cost, among others. This chapter focuses on reliability and proposes to use the Stochastic Workflow Reduction (SWR) method to calculate the reliability of IoT-aware BPMN healthcare processes. In addition, the chapter proposes a BPMN language extension to provide processes with reliability information. This way, at design time, modellers can analyse alternatives and, at run time, reliability information can be used to select participants, execute services, or monitor process executions. The proposal is applied to an Ambient Assisted Living system use case, a rich example of an IoT-aware healthcare process.

DOI: 10.4018/978-1-5225-1820-4.ch008
INTRODUCTION

Business Process Management has been applied to the healthcare domain, improving several practical aspects regarding the quality of care services provided to patients (Reichert, 2011; Russo & Mecella, 2013). These aspects include, from a healthcare professional perspective, reduced number of procedures, cost optimizations, increased information availability in critical situations and better decision making, among others. From a patient perspective, they include reduced length of stay, decrease of evasiveness to treatments and a global care process-awareness.

BPMN (Business Process Model and Notation) (OMG, 2011) is becoming the leader and de-facto standard in business process modelling (Harmon & Wolf, 2014). Considering the healthcare domain, BPMN has been used to model and execute various processes, both administrative and medical processes (Svagård & Farshchian, 2009; Rojo, Calahorra, & Ruiz, 2010; Strasser, Pfeifer, Helm, Schuler, & Altmann, 2011; Scheuerlein et al., 2012; Cossu et al., 2012; Müller, Prüfer, & Stöhr, 2014; Braun, Schlieter, Burwitz, & Esswein, 2015).

In addition, the healthcare domain presents itself as an ideal playground for Internet of Things-related scenarios (Pang, 2013). Known applications include real-time location systems, patient flow management, remote health monitoring, fitness programs, chronic diseases, and elderly care. For this, there are several IoT-related solutions commonly based on smart devices, including mobile devices, sensors, imaging devices and electronic text tags. Together with communication gateways or through direct communication protocols, they can bring timely and up-to-date information to Information Systems and the Organization. IoT-based healthcare services are expected to reduce costs, enrich the user’s experience, increase the quality of life, and the number of patients served (Islam, Kwak, Kabir, Hossain, & Kwak, 2015).

However, healthcare processes are highly time sensitive and critical due to the impact that an error may have regarding, for instance, patient safety or information security and confidentiality. In Islam et al. (2015) the authors identify several challenges, signalling the Quality of Service (QoS) as an important requirement that must be assured in the application of IoT in healthcare. In this context, measuring reliability of a certain healthcare process that uses smart devices, such as sensors, can prevent a number of issues. These can range from a simple medical appointment delay or absence, to a serious hazard involving medical prescriptions of wrongly identified patients, or inappropriate emergency assistance with potential fatal consequences.

Calculating reliability of sensors has already been proposed (see, for instance, Parente et al., 2011; Siewiorek & Swarz, 2014). Nevertheless, these proposals focus on a particular device or type of devices, lacking on the evaluation of a global reli-