Computing the Cost of Business Processes

Partha Sampath and Martin Wirsing

Institute of Computer Science,
Ludwig-Maximilians-University, Oettingenstr. 67, 80538 Munich, Germany
partha.sampath@capgemini-sdm.com,wirsing@lmu.de
http://www.pst.ifi.lmu.de/

Abstract. Computing the cost of a Business Process is a complicated and cumbersome process. Magnani and Montesi have proposed a concept of evaluating the cost by providing extensions to the Business Process Modelling Notation (BPMN). In this paper we propose a method by which the cost of a Business Process is calculated by considering the cost and reliability of each action or task in the process. This method breaks the Business Process, represented using BPMN, into repetitive patterns and a cost and reliability factor for each of these patterns is calculated. The method calculates the overall cost, reliability and the cost incurred to achieve one successful execution of the Business Process; the Business Cost of the process.

Keywords: BPMN, BPD, Cost, Reliability.

1 Introduction

BPMN, a standardized graphical notation for drawing Business Process Diagrams (BPD) in a workflow [2], concentrates mainly on representation and does not deal with the quantitative aspects such as cost and reliability of a Business Processes. The amount of money spent so as to execute a Business Process once is the cost of the process. Because a Business Process achieves its cost doesn't mean that the business value of the process has been achieved. To achieve business value we try to achieve higher reliability. Reliability can be interpreted from a technical perspective e.g. network availability and from a business perspective e.g. rate at which the business goal is achieved. There have been models by which the costs can be calculated from BPMN but they do not take reliability into account, especially from the business perspective. Magnani and Montesi [1] in their study have proposed a method for representing and calculating the cost of BPD's. We base ourselves on this study.

2 Representation of Cost and Reliability in BPD's

To calculate the Business cost of a process we only consider elements which fall under Flow Objects such as Activities and Gateways as these represent some action or job that needs to be done. The rest such as Swimlanes etc do not play

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a role in cost calculation. To each artefact, with a simple extension in the form of textual property, we assign cost and reliability as properties. We define these as:

$$Cost = C, where\ C >= 0 \tag{1}$$

$$Reliability = R, where\ 0 < R <= 1. \tag{2}$$

Constructs such as Gateways have cost = 0 and the reliability = 1. In the rest of this paper we elaborate on a method by which we calculate the Business Cost of a task and the whole BPD by patterns.

3 Calculation Method

We consider different patterns of Flow Objects and calculation of costs attached to them. We start with the most elementary combinations and move down to the patterns which have higher complexity. As a basis we consider two elementary scenarios:

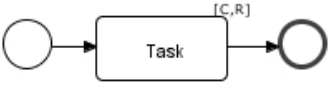

Fig. 1. BPD with one task

Scenario 1: BPD with one single task with no compensation having cost C and reliability R as shown in the Fig. 1. The Business Cost in this case is the result of dividing the cost by the reliability.

$$BusinessCost = C/R \tag{3}$$

We make the assumption that we always pay for a service to use it immaterial of its success or failure. Hence, the Business Cost is always going to be higher than the cost when the reliability of the task is less than 1.

$$BusinessCost = Cost,\ \ Reliability = 1 \tag{4}$$

$$BusinessCost > Cost,\ \ 0 < Reliability < 1 \tag{5}$$

Scenario 2: BPD with one single task having a cost C and reliability R and with an error flow as shown in the Fig. 2.

The error flow is invoked when the task fails and hence we consider the task together with its error flow. As a result the cost of the task will be the same as the Business Cost of this task which can be represented by the equation:

$$BusinessCost = C + ((1 - R) * (C + C(E)))/R \tag{6}$$

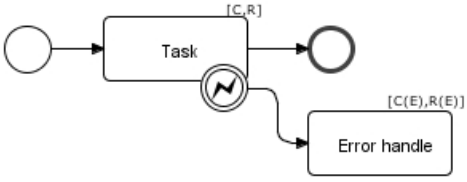

Fig. 2. BPD with one task and an error flow

4 Patterns for Cost Calculation

When we have BPD's with a number of tasks invoked in different manners, the cost, reliability and the Business Cost can be calculated by recognizing patterns which are repetitive. The values generated for each of these patterns put together gives the Business Cost of the overall Business Process. In this section we look at the four common patterns which we come across in Business Processes and derive the cost, reliability and Business Cost for each one.

4.1 Pattern 1: n Tasks in a Sequential Order

We are considering a pattern/process with n tasks (with no compensation) in a sequential order as shown in Fig. 3. The cost of the BPD is the summation of the costs and the reliability of the BPD is the product of the reliabilities of all the events. Equation (3) gives us the Business Cost for a single task. Business Processes contains tasks which are mutually inclusive i.e. the execution of a task is dependent on the successful completion of the tasks before it. Equation(3) can be used for patterns containing tasks which are mutually exclusive in nature. In case of a pattern where we have n tasks as the one shown in Fig. 3, the Business Cost is calculated by a recursive way, depending upon the number of tasks in the pattern. We consider n tasks where each task comes with a cost and reliability.

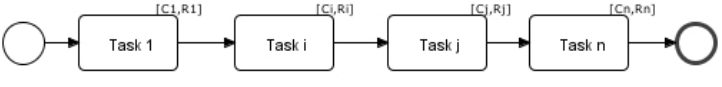

Fig. 3. n tasks in a sequential order

In case of one task in the pattern the Business Cost would be

$$BusinessCost(1,1) = C1/R1 \tag{7}$$

In case of two tasks

$$BusinessCost(1,2) = C2/R2 + (C1/R1)/R2 = (C2 + (C1/R1))/R2 \tag{8}$$

$$BusinessCost(1,2) = (C2 + BusinessCost(1,1))/R2 \tag{9}$$

Hence, in case of a sequential/serial pattern with n tasks:

$$BusinessCost(1,n) = (Cn + BusinessCost(1,n-1))/Rn \tag{10}$$

4.2 Pattern 2: n Tasks in a Parallel Order

We are considering a pattern/process with n tasks (with no compensation) in a parallel order as shown in Fig. 4. In a BPD with parallel tasks, each flow is a

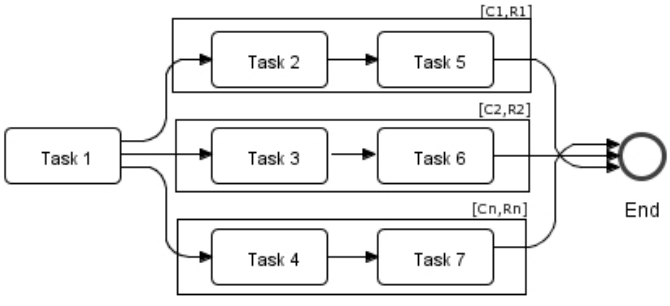

Fig. 4. n tasks in parallel order

sequential flow with one or more tasks. For each of the sequential patterns the cost, reliability and the Business Cost is calculated as shown in Pattern 1. The resulting cost and reliability of this parallel pattern then would be:

$$Cost = \Sigma Ci,\ (Ci\ is\ the\ cost\ of\ each\ flow\ in\ the\ parallel\ flow) \tag{11}$$

$$Reliability = Minimum(R) \tag{12}$$

$$BusinessCost = \Sigma BusinessCost(i)\ (i\ is\ the\ pattern) \tag{13}$$

4.3 Pattern 3: Conditional Branching

We consider a pattern/process with a conditional branching leading to different execution paths. This is same as in Pattern 1 with sequential tasks. Nevertheless a probability has to be attached to each flow out of the Gateway. The corresponding cost of the path is then multiplied by the probability which will lead to the cost of the whole branching.

$$Cost = \sum Pi * Cost(i),\ (Pi\ is\ the\ probability\ of\ taking\ path\ i) \tag{14}$$

$$Reliability = \sum PiRi,\ (Ri\ is\ the\ reliability\ of\ path\ i) \tag{15}$$

$$BusinessCost = \sum Pi * BusinessCost(i) \tag{16}$$

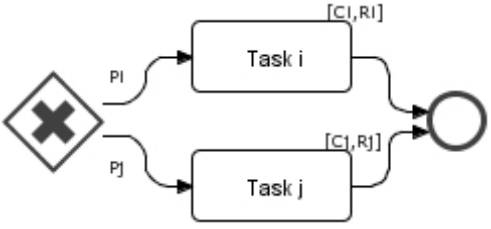

Fig. 5. BPD with conditional branching

4.4 Pattern 4: "n" Successive Possibilities

We are considering a pattern/process with n different services each performing the same function. Let us assume a BPD which tries to book a room in n hotels such that Cost(Hotel i) = Ci and Reliability (Hotel i) = Ri. The token first talks to the first hotel and then to the second and so on. The cost, Business Cost and reliability depend on the number of hotels and the order in which they are talked to. In this scenario we see that a hotel, Hotel i, is contacted when all i - 1 hotels before it have already been contacted. Hence the cost of talking to Hotel i is not just its cost but the accumulation of costs of the first i - 1 hotels. We call this cost the Actual Cost. In Table 1 we calculate the cost, Actual Cost, Business Cost and reliability in case of 1 hotel, 2 hotels and n hotels. The results can be represented with following equations:

Table 1. Actual and Business Cost

No. Hotels	Reliability	ActualCost (AC)	BusinessCost
Hotel(1,1)	1-(1-R1)	C1	C1/R1
Hotel(1,2)	1-(1-R1)*(1-R2)	AC(Hotel(1,1))+C2(1-R1)	AC(1,2)/Rel2
Hotel(1,n)	(1-((1-R1)*(1-R2)..*(1-Rn))	AC(Hotel(1,n-1))+Cn(1-R(n-1))	AC(1,n)/Reln

$$ActualCost(Ni, Nn) = ActualCost(Hotel(1, n-1)) + Cn(1 - R(n-1)) \quad (17)$$

$$BusinessCost(Ni, Nn) = ActualCost/Reliability \quad (18)$$

$$Reliability(R1, Rn) = 1 - ((1 - R1)(1 - R2)..(1 - Rn)) \quad (19)$$

5 Example: Breaking a BPD into Patterns

We consider a Business Process for booking a hotel, flight and taxi for a customer as an example as shown in Fig. 6. The tasks Authenticate customer and Validate input are tasks in sequential order and hence are in Pattern 1. The tasks Book Hotel, Book Flight and Book Taxi are in parallel and hence are in Pattern 2. The tasks Send confirmation and Send rejection are controlled through a Gateway

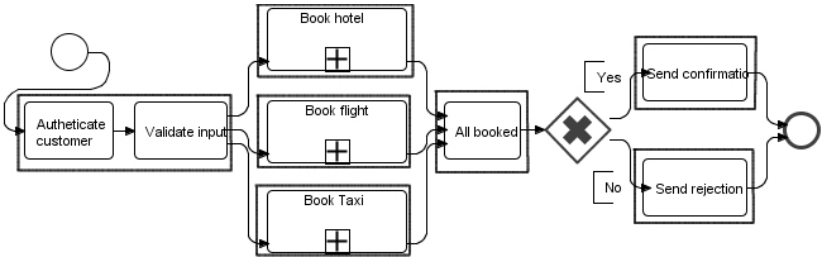

Fig. 6. Sample BPD

and are hence in Pattern 3. In the task Book Hotel, there could be n possible hotels with which a reservation can be done, hence this falls into Pattern 4. The Business Cost and cost of the BPD is the summation of the Business Cost and cost of the patterns whereas the reliability is the product of the patterns.

6 Further Work and Conclusion

The concept of compensation in BPMN doesn't match with the theoretical foundations for compensation such as Sagas [3] which deals with transaction compensations and hence has not been considered in this study. Calculating the impact of the cost of compensation on the Actual Cost or the Business Cost of the BPD deviates from the method represented here as it is dependent on the task that throws the trigger and its reliability. In this paper, we have presented a method by which the cost, Business Cost and reliability of a Business Process can be calculated considering the reliability of each of the artefacts. We are interested in having a standardised and parameterized approach towards cost calculation of BPD which would play a decision making role in designing and developing Business Processes.

References

1. Magnani, M., Montesi, D.: Computing the Cost of BPMN diagrams. Technical Report UBLCS-07-17 (2007)
2. OMG. Business process modeling notation specification (2006)
3. Bruni, R., Melgratti, H., Montanari, U.: Theoretical Foundations for Compensations in Flow Composition Languages. In: 32nd ACM SIGPLAN-SIGACT, pp. 209–220 (2005)
4. Clark, A., Gilmore, S.: Evaluating Quality of Service for Service Level Agreements. LNCS, pp. 181–194. Springer, Heidelberg (2007)
5. Vanhatalo, J., Völzer, H., Koehler, J.: The Refined Process Structure Tree. In: Dumas, M., Reichert, M., Shan, M.-C. (eds.) BPM 2008. LNCS, vol. 5240, pp. 100–115. Springer, Heidelberg (2008)