Evaluation of Cost Based Best Practices in Business Processes

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Abstract. Reducing the Cost of a Business Process is a challenge faced by organizations. Business Process researchers have recommended a host of best practices for Business Process design which leads to Cost effectiveness. However, these are theoretical and there is no real guideline for either implementation or the Cost reduction acheived by the implementation of these best practices. In this paper, we evaluate the most commonly recommended best practices available in literature for Cost reduction for their effectiveness. We implement a pattern based Cost calculation methodology which shows the impact of best practices on examples in a measurable way. Using this methodology we calculate the overall Cost, reliability and the Cost incurred to achieve one successful execution of the Business Process; the Business Cost of the process.

Keywords: Business Process, Cost, Best Practices.

1 Introduction

In general profitability is the primary goal of any Business enterprise. The success of a Business is dependent on high income and low and controlled expenses. Processes are implemented to either directly contribute or support this goal of an organization. Every organizations interest is to make these processes successful. In the years, as information technology has become industry oriented the factors that make a process successful have taken center stage. This is especially very visible in the service industry. The aim of achieving higher quality and at the same time keeping the Costs controlled or reduced are of high importance to the Business. Even though this is important, methodologies, frameworks and theories which have foundational reasoning to achieve this are not precise in their recommendations. This is especially the case when we come to the topic of financial evaluation and optimization of a Business processes at the operational level.

In this study we consider five commonly recommended best practices: Resequencing of Tasks, Knock-Out Order, Task Elimination, Order Type and Triage, and Parallelism, for Cost optimization in Business Processes and evaluate them for their impact on a Business Process. So as to calculate the Costs before and after implementing these best practices we base ourselves on a pattern based Cost

T. Halpin et al. (Eds.): BPMDS 2011 and EMMSAD 2011, LNBIP 81, pp. 61–74, 2011.

calculation methodology. We calculate, for each example, the Cost, Reliability and Business Cost i.e the Cost incurred in achieving one successful execution of the Business Process.

2 Pattern Based Cost Calculation

The methodology for Cost calculation of a Business Process based on repetitive patterns has been presented by Sampath and Wirsing [1]. The methodology considers each artifact within a Business Process which is represented as a Business Process Diagram and attaches a parameter for Cost and Reliability to the same. It then breaks the Business Process into repetitive patterns and the Cost. Further Reliability and Business Cost of each pattern is calculated. In turn the overall Cost, Reliability and Business Cost of the complete Business Process is generated. A single task with Cost C and Reliability R has the Business Cost as shown in equation 1.

$$BusinessCost = C/R \tag{1}$$

Four patterns are defined as basis for Cost calculations.

2.1 Pattern 1: n Tasks in a Sequential Order

This pattern considers n tasks, each having a Cost and reliability, in a sequential order as shown in the Fig. 1.

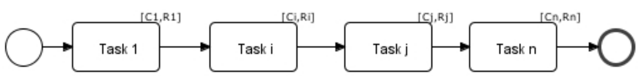

Fig. 1. n tasks in a sequential order

The calculation for Cost, Reliability and Business Cost is as shown here.

$$Cost = \sum Ci,\ where\ Ci\ is\ the\ cost\ of\ task\ i \tag{2}$$

$$Reliability = \prod Ri,\ where\ Ri\ is\ the\ reliability\ of\ task\ i \tag{3}$$

$$BusinessCost(1, n) = (Cn + BusinessCost(1, n-1))/Rn \tag{4}$$

2.2 Pattern 2: n Tasks in a Parallel Order

The pattern considers n tasks in a parallel order as shown in Fig. 2. The resulting cost and reliability of this parallel pattern then would be:

$$Cost = \Sigma Ci,\ (Ci\ is\ the\ cost\ of\ each\ flow\ in\ the\ parallel\ flow) \tag{5}$$

$$Reliability = Minimum(R) \tag{6}$$

$$BusinessCost = \Sigma BusinessCost(i)\ (i\ is\ the\ pattern) \tag{7}$$

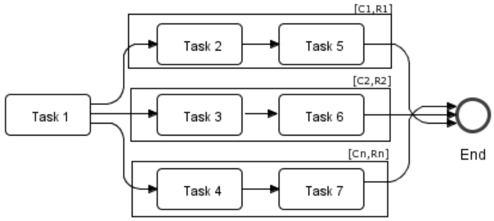

Fig. 2. n tasks in parallel order

2.3 Pattern 3: Conditional Branching

The pattern considers a conditional branching leading to different execution paths. The situation here is the same as mentioned in the case of sequential tasks in Pattern 1. Even though 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.

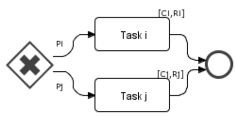

Fig. 3. BPD with conditional branching

$$Cost = \sum Pi * Cost(i), \ (Pi \ is \ the \ probability \ of \ taking \ path \ i) \tag{8}$$

$$Reliability = \sum PiRi, \ (Ri \ is \ the \ reliability \ of \ path \ i) \tag{9}$$

$$BusinessCost = \sum Pi * BusinessCost(i) \tag{10}$$

2.4 Pattern 4: "n" Successive Possibilities

The pattern considers n different services each performing the same function. The resultant parameters of Business Cost and reliability are dependent on the number of possibilities.

$$BusinessCost(1, Nn) = Cost(1, Nn)/Reliability(1, Nn) \tag{11}$$

$$Reliability(1, Rn) = 1 - ((1 - R1)(1 - R2)..(1 - Rn)) \tag{12}$$

3 Evaluation of Best Practices

In this section we consider five of the most commonly recommended best practices for Cost optimization. For each best practice, we take an example as an "Original Case", implement the recommended best practice on this example as a "Changed Case" and evaluate the impact of the same.

3.1 Resequencing of Tasks

This best practice is also called “Process Order Optimization”and is mentioned by Klein [2] and [3]. In a Business Process, the ordering of tasks does not reveal the logic behind the process and hence it could be that tasks in a process are executed even though it is not required at that moment. This best practice recommends that tasks such as these when resequenced in a Business Process help in Cost reductions. The logic is to execute a task only when the task is really needed to be executed.

Original Case. To evaluate this best practice, we consider a Business Process to book a flight. The corresponding BPD is as shown in the Fig. 4. The Business Process authenticates the customer, validates the inputs and finds the flights. If a flight is found then the flight is booked and confirmation is sent to the customer. We assume that the flight is available in 50 percent of the cases. Also, we make assumptions on the Cost and Reliability of the tasks in the Business Process.

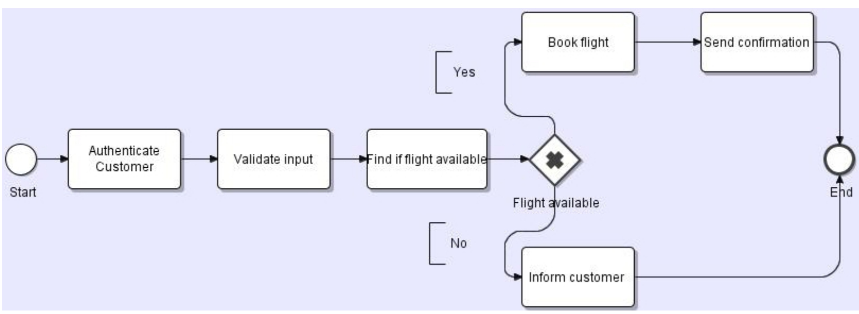

Fig. 4. Business Process Diagram to book a flight

Cost calculation: To calculate the Business Cost of this process, we divide the BPD in patterns which we combine by a decision (see Fig. 5). For each of the patterns, we make assumptions on the Cost and Reliability of all the tasks. In turn we calculate the Business Cost for each of the patterns.

The calculation at the level of the patterns is as shown in the table 1.

From the calculations in the table get the Business Cost of the patterns as:

$$Business\ Cost(Pattern\ 1) = 35.6$$
$$Business\ Cost(Pattern\ 2) = 48.1$$
$$Business\ Cost(Pattern\ 3) = 5.56$$

We assume that there is always a 50 percent chance of finding the flight according to the customer inputs. Hence the Business Cost of Pattern 2 and Pattern 3 would then be:

$$Business\ Cost(Pattern\ 2\ with\ Pattern\ 3) = 45.7 * 0.5 + 5.56 * 0.5 = 26.85$$

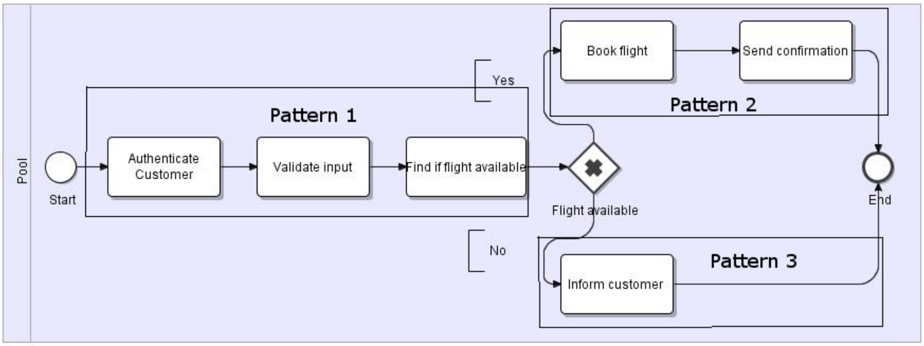

Fig. 5. Patterns in the Business Process Diagram

Table 1. Flight Booking - Pattern 1

Task	Cost	Reliability	Business Cost of the task	Business Cost
Pattern 1				
Authenticate	10	0.9	11.11	11.11
Validate input	10	0.9	11.11	23.5
Find if flight available	5	0.8	6.25	35.6
Pattern 2				
Book Flight	30	0.9	33.33	33.33
Send confirmation	10	0.9	11.11	48.1
Pattern 3				
Inform Customer	5	0.9	5.56	5.56

Table 2. Flight Booking - Pattern 1

Task	Cost	Reliability	Business Cost of the task	Business Cost
Validate input	10	0.9	11.11	11.11
Find if flight available	5	0.8	6.25	20.1

Hence the total Business Cost of the BPD would then be:

$$Business\ Cost(Pattern\ 1\ (Pattern\ 2\ with\ Pattern\ 3)) = 35.6 + 26.85 = 62.4$$

Changed Case with Tasks Resequencing. In the BPD in Fig. 4 we resequence the tasks in such a way that a task is executed only when it is required. The task "Authenticate Customer" is moved to the part where flight has already been found. This change is shown in Fig. 6 which is also shown in the patterns.

Tables 2 3 4 show the Cost and Reliability of the tasks and the patterns together.

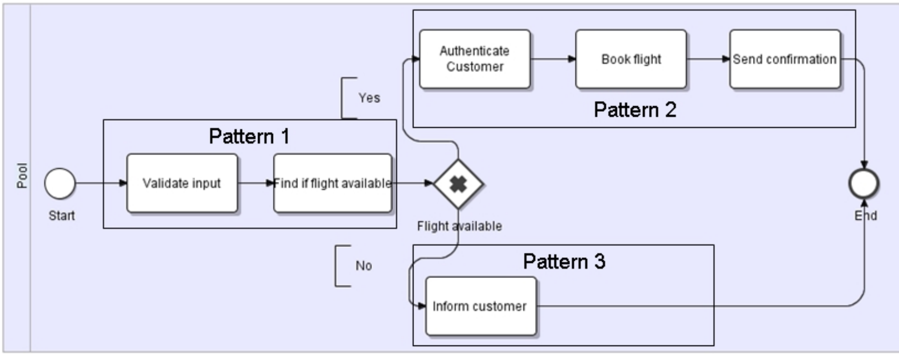

Fig. 6. Business Process Diagram to book a flight

Table 3. Flight Booking - Pattern 2

Task	Cost	Reliability	Business Cost of the task	Business Cost
Authenticate Customer	10	0.9	11.11	11.11
Book Flight	30	0.9	33.33	45.7
Send confirmation	10	0.9	11.11	61.9

Table 4. Flight Booking - Pattern 3

Task	Cost	Reliability	Business Cost of the task	Business Cost
Inform Customer	5	0.9	5.56	5.56

From the calculations in the tables we calculate the Business Cost as:

$$Business\ Cost(Pattern\ 1) = 20.1$$
$$Business\ Cost(Pattern\ 2) = 61.9$$
$$Business\ Cost(Pattern\ 3) = 5.56$$

We assume that there is always a 50 percent chance of finding the flight according to the customer inputs. Hence the Business Cost of Pattern 2 and Pattern 3 would then be:

$$Business\ Cost(Pattern\ 2\ with\ Pattern\ 3) = 61.9 * 0.5 + 5.56 * 0.5 = 33.71$$

Hence the total Business Cost of the BPD would then be:

$$Business\ Cost(Pattern\ 1\ (Pattern\ 2\ with\ Pattern\ 3)) = 20.1 + 33.71 = 53.8$$

Impact of Resequencing of Tasks. We see from the calculations that the change in the sequence leads to a change in the Business Cost. Nevertheless the rest of the parameters i.e Cost and Reliability of the process do not change.

3.2 Knock Out Order: 'Knock-Out in an Increasing Order of Effort and a Decreasing Order of Termination Probability

Every Business Process has conditions that need to be checked. If the conditions are not fulfilled then the execution of the process is terminated. This best practice recommends that conditions that have the highest probability to terminate the process should be executed right at the begining, followed by the condition having the next highest probability to terminate the process and continue. In such a case the reasons why a Business Process needs to be terminated is accomplished at the very begining and the rest of the Business Process is executed with a high probability of achieving the Business value. The knock-out best practice is a variant of the resequencing best practice. Van der Aalst [4], [5], [6], [7] mentions this best practice and also gives quantitative support for its optimality.

We believe that every task in the Business Process has a certain Reliability with which it performs. Hence the interpretation of this best practice in our case would mean that the Business Cost of the process will be lower in case the initial part of the process has a lower Reliability than the latter. To evaluate this we consider the Business Process to book a flight, nevertheless we will assume that all the flights are available. Hence there is no condition involved to check for the availability of the flight. This is shown in the Fig. 7.

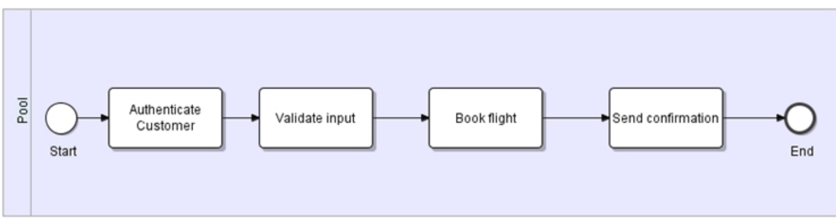

Fig. 7. Business Process Diagram to book a flight

Original Case - Task Order with Descending Reliability. We make assumptions on the Cost and Reliability such that the Reliability of the tasks have a descending order. We assume the Costs are the same on each of the tasks. The calculation of the Business Cost is as shown in the table 5.

Table 5. Flight Booking - Task Order with Descending Reliability

Task	Cost	Reliability	Business Cost of the task	Business Cost
Authenticate Customer	10	0.9	11.11	11 .11
Validate Input	10	0.8	12.50	26.4
Book Flight	10	0.7	14.29	52.0
Send Confirmation	10	0.6	16.67	103.3

Hence the Business Cost with descending order of Reliability would be:

$$Business\ Cost(Descending\ Reliability) = 103.3 \tag{13}$$

Changed Case - Task Order with Ascending Reliability. We make assumptions on the Cost and Reliability such that the Reliability of the tasks now have an ascending order. The calculation of the Business Cost is as shown in the table 6:

Table 6. Flight Booking - Task Order with Ascending Reliability

Task	Cost	Reliability	Business Cost of the task	Business Cost
Authenticate Customer	10	0.6	16.67	16.67
Validate Input	10	0.7	14.29	38.1
Book Flight	10	0.8	12.50	60.1
Send Confirmation	10	0.9	11.11	77.9

Hence the Business Cost with ascending order of Reliability would be:

$$Business\ Cost(Ascending\ Reliability) = 77.9 \tag{14}$$

Impact of Knock-Out Order: The example shows that the Knock-out Order brings the Business Cost of the Business Process down. The Knock-out sequence push the tasks which have the highest probability of terminating the process to the front and in turn makes sure that the rest of the process is executed only when all the conditions are met. The best practice does not change the overall Reliability and Cost of the process.

3.3 Task Elimination: Eliminate Unnecessary Tasks from a Business Process

This best practice recommends that the tasks which are having no value or tasks which are redundant should be eliminated. A task in a Business Process when eliminated reduces the Business Cost of the process. In case tasks in a Business Process are eliminated from the optimization perspective, this will then lead to a compromise on the quality of the process. There are different ways in which an evaluation can be done so as to find if tasks are unnecessary or redundant. One way is to look into tasks which consider iterations. Iterations indicate that a certain task is done "n" number of times because it has not achieved the Business value at once. Tasks redundancy can also be considered as a specific case of task elimination. In order to identify redundant tasks, Castano et al [8] have developed entity-based similarity coefficients.

We consider an example to book a hotel to evaluate this best practice. Consider a Business Process where an agency tries to find a room in a hotel according to the inputs given by the customer. Finding a room in a hotel is an iterative process. The travel agency nevertheless would like to try in every hotel possible to find a room until a room is found. Hence this task would be executed iteratively until the Business objective is met. In case every loop in this iteration Costs some money, the travel agency will need to decide on the number of hotels that they are willing to contact to find a room. The Cost of a task in a Business Process which has a looping to provide for Business Reliability varies according to the order in which each of the providers is called for. We use the BPD from the hotel booking process (see Fig. 8) in this case. Let's assume that there are six hotels with which the process interacts in a sequential order.

To check for the variations it could bring in the Cost we make assumptions here such as: the hotel which provides the highest Reliability also has the highest service charges or Costs.

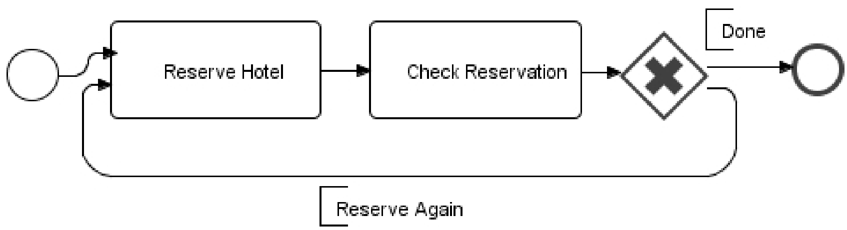

Fig. 8. Detailed BPD for booking a hotel

We execute this iteration in two scenarios:

Scenario 1: Highest Reliability - Highest Cost In this scenario we lay highest priority on the Reliability of the called service. Table 7 shows the hotels, there Reliability, Costs etc. due to the iterative condition every new hotel which is on the list increases the reliability. This increase in the reliability in case of n iterations is calculated as following:

$$Reliability(R1, Rn) = 1 - ((1 - R1) * (1 - R2)...(1 - Rn))$$

We call this reliability as the cumulative reliability and this is shown in the table.

Scenario 2: Achieve minimum increase in actual Cost with increase in Reliability In this scenario we start with the least reliable hotel and then select hotels with ascending order of Reliability. Table 8 shows the hotels with the development of Cost, Reliability, etc.

Impact of Task Elimination. From the calculation as shown in the table 7, for Scenario 1 adding the sixth hotel on the list increases the Reliability of the Business objective to find a room in the hotel from 0.998 to 0.999. Similarly in Scenario 2 the Reliability increases by very small percentage between the 5th and 6th hotel. Also, in scenario 1 we see that we check only the first hotel to reach a reliability of 0.9 whereas in the scenario 2 four hotels need to be checked

Table 7. Sample values

Option	Cost	Reliability	Cumulative-Rel	Actual Cost	Business Cost
Hotel 1	6	0.9	0.9000	6.00	6.67
Hotel 2	5	0.8	0.9800	6.500	6.633
Hotel 3	4	0.7	0.9940	6.580	6.620
Hotel 4	3	0.6	0.9976	6.598	6.614
Hotel 5	2	0.5	0.9988	6.603	6.611
Hotel 6	1	0.4	0.9992	6.604	6.609

Table 8. Sample values

Option	Cost	Reliability	Cumulative-Rel	Actual Cost	Business Cost
Hotel 6	1	0.4	0.4000	1.000	2.500
Hotel 5	2	0.5	0.7000	2.200	3.143
Hotel 4	3	0.6	0.8800	3.100	3,523
Hotel 3	4	0.7	0.9640	3580	3,714
Hotel 2	5	0.8	0.9928	3.760	3,787
Hotel 1	6	0.9	0.9992	3.803	3,806

before a reliability of 0.9 is achieved. Nevertheless, in both the cases the Business Cost does not increase by a huge margin and hence this could be an option to keep the iteration. But this situation could also be because the Cost for each of the iteration is coming down in comparison to the previous iteration. This leads to the situation where it might be that the last iteration need not be executed at all. In other words this redundancy can be eliminated and in turn there will be no or very less impact on the Business Process or the Costs that are involved.

3.4 Order Type and Triage

The best practice “Order type” says: determine whether tasks are related to the same type of order and, if necessary, distinguish new Business processes and the best practice “Triage” says consider the division of a general task into two or more alternative tasks or consider the integration of two or more alternative tasks into one general task. Both these best practices are similar to each other, at least in their intentions. Both of them are recommended so as to improve quality and in turn reduce Costs by either breaking tasks into many or by grouping certain tasks together.

Both these best practices are mentioned by a host of researchers which includes [9], [2], etc.

Original Case. To evaluate this Business Process we use the process for booking a flight which is shown in Fig. 7. The Business Cost of the process on a sample set of Cost and Reliability values is as shown in the table 6.

Changed Case. For the evaluation process we execute the tasks "Book Flight" and "Send Confirmation" together as one task assuming that the Cost of the new task is a summation of the Costs of both the tasks and the Reliability is the product of the reliabilities of the two tasks. In such a case the corresponding Business Cost is as shown in the table 9.

Table 9. Flight Booking

Task	Cost	Reliability	Bus.Cost of task	Business Cost
Authenticate Customer	10	0.6	16.67	16.67
Validate Input	10	0.7	14.29	38.1
Book Flight and Send Confirmation	20	0.72	27.78	80.7

Impact of Order type and Triage. We see that the Business Cost has increased when we put the tasks together. This is because the combined Reliability of the task is less than the two individual tasks. Combining two tasks might increase the quality and increase optimization, nevertheless this doesn't necessarily mean that the Cost of the process decreases. The combined task will produce a reduction in the Business Cost when:

$$Cost(New\ task)\ <=\ Cost(A)\ +\ Cost(B) \tag{15}$$

$$Rel(New\ task)\ >=\ Rel(A)\ *\ Rel(B) \tag{16}$$

3.5 Parallelism: Consider Whether Tasks May Be Executed in Parallel

This best practice recommends execution of tasks parallely rather than in sequential order. By doing this there is an effect on the Business Cost, probably bringing it down. At the same time the quality and co-ordination efforts increase due to the parallel execution of the tasks.

Original Case. In order to evaluate this best practice we take the Business Process to book a hotel and a flight depending upon customer inputs. We execute this process in sequential order to evaluate the impact on the Business Costs. The process is as shown in Fig. 9.

We make assumptions on Cost and Reliability. The table 10 shows the the calculation of the Business Cost on these assumptions.

From our calculations, the Business Cost of doing this process in a sequential order is 169.9.

Changed Case. Now we consider the same process in parallel order, we do the tasks "Book Hotel" and "Book Flight" in parallel to each other. This is shown in the Fig. 10. The pattern division is also as shown in the figure.

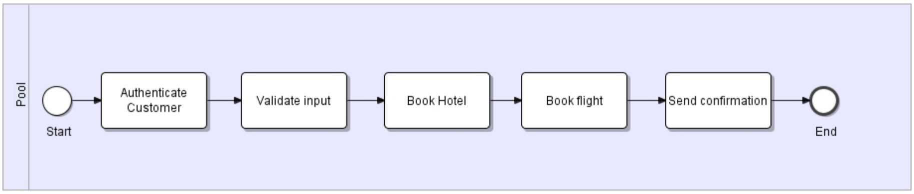

Fig. 9. Hotel and Flight Booking in Sequential Order

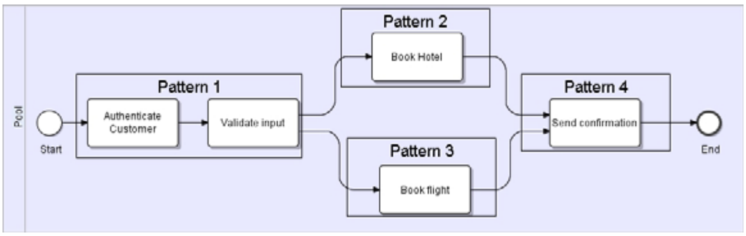

Fig. 10. Hotel and Flight Booking in Sequential Order

Table 10. Hotel and Flight Booking in Sequential Order

Task	Cost	Reliability	Business Cost of the task	Business Cost
Authenticate	10	0.9	11.11	11.11
Validate input	15	0.9	16.67	29
Book Hotel	20	0.7	28.57	70
Book Flight	30	0.7	42.86	142.9
Send confirmation	10	0.9	11.11	169.9

Table 11. Hotel and Flight Booking in Parallel Order - Pattern 1

Task	Cost	Reliability	Business Cost of the task	Business Cost
Authenticate	10	0.9	11.11	11.11
Validate input	15	0.9	16.67	29

Table 12. Hotel and Flight Booking in Parallel Order - Pattern 2

Task	Cost	Reliability	Business Cost of the task	Business Cost
Book Hotel	20	0.7	28.57	28.57

The tables 11 12 13 14 shows the calculation of the Business Cost according to the patterns.

Table 13. Hotel and Flight Booking in Parallel Order - Pattern 3

Task	Cost	Reliability	Business Cost of the task	Business Cost
Book Flight	30	0.7	42.86	42.86

Table 14. Hotel and Flight Booking in Parallel Order - Pattern 4

Task	Cost	Reliability	Business Cost of the task	Business Cost
Send confirmation	10	0.9	11.11	11.11

As Pattern 2 and Pattern 3 are in parallel, the Business Cost for both together is as shown in table 15:

Table 15. Hotel and Flight Booking in Parallel Order - Pattern 2 —— Pattern 3

Task	Cost	Reliability	Business Cost of the task	Business Cost
Pattern 2 —— 3	50	0.49	71.43	71.43

The total Business Cost by breaking the process in parallel is as shown in table 16:

Table 16. Hotel and Flight Booking in Parallel Order

Task	Cost	Reliability	Business Cost of the task	Business Cost
Pattern 1	20	0.81	24.69	24.69
Pattern 2 —— 3	50	0.49	102.04	152.4
Pattern 4	10	0.9	11.11	180.5

Impact of Parallelism. We see from the calculations that the Business Cost of the process increases by doing a process in parallel than by doing it in a sequential order. Execution of processes in parallel requires more tasks to make the process reach a logical end including compensation tasks. For example, in the Business Process that we considered, we will need a compensation task in case only the flight or only the hotel is booked. in this case the compensation will have to cancel the other booking. These situations do not arise when tasks are done in a sequential order.

3.6 Conclusion

In this paper we have evaluated the most commonly recommended best practices on Business Processes so as to determine their impact on Cost, Business Cost and Reliability before and after implementing the best practice. We see through this evaluation that these best practices achieve financial optimization, nevertheless the variation and the impact on the parameters cannot be generalized. These are dependent on the process and the complexity that the process is handling. We also see that in certain cases the implementation of the best practice does not lead to any financial gains, instead it Costs more to control the process and keep the quality high. In this paper, we have shown these effects on simple Business cases. Nevertheless, to elaborate the effects of these best practices, we will have to consider realistic business cases which include conditions such as failure and compensation mechanisms.

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