

Business Process Optimization

whitepaper

Executive Summary

This whitepaper presents an optimization technology for business processes. The purpose of the plugin is to generate the optimal schedule of business processes, i.e. to deliver the concrete execution order of activities defined in the business process.

The main advantage of the solution is that alternative paths can be evaluated beside exclusive decisions and parallel paths. In addition, since all processes may use the same exclusive resources, the resulted optimal scheduling can define the start times for activities of multiple process instances.

The plugin provides the following analysis options. The user can choose either **cost** or **time optimization** according to a **deadline** or a **cost limit** if it is needed, i.e. the optimal scheduling by cost minimization at a given deadline or time minimization at a given cost limit.

In the first case the plugin retrieves a scheduling that is cost-optimal and the overall execution of all processes is finished within the given deadline.

In the latter case the solution of the optimization delivers a scheduling with minimal time with respect to a cost limit, i.e. the execution cost of the schedule is not greater than the given cost limit.

Since the result is the optimal scheduling also simple processes (i.e. where no alternative ways are given) can be scheduled by the technique

1. Optimization

The management of business processes is a core problem in several fields of information technology and business life. Business process management aims at reengineering the process to gain much more efficiency, to decrease costs, to eliminate unnecessary tasks, etc.

In other words, business process optimization enables the rethinking of the processes or even the organization according to the available resources. On the one hand, one possible solution is the generation of an optimal scheduling of the workflow taking into account the alternative execution paths. On the other hand, resource allocation can be calculated in order to guarantee the efficient operation of the organization.

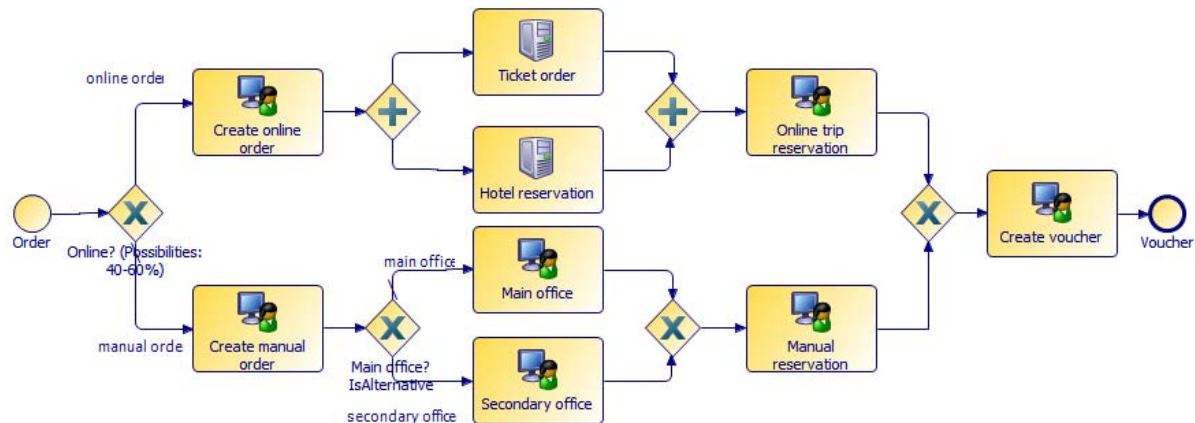
In order to keep the competitiveness, cost and time aspects are considered during optimization. Thus cost and time parameters are assigned to the execution of a certain activity or task (usually defined by the cost of the involved participant and the duration of the activity) and the goal is either the minimization of the overall cost or the execution time of the business process.

Although business process modeling tools and also workflow management systems usually give the facility to optimize business processes, this optimization is carried out **by simulation** whose evaluation needs human interaction to point out the crucial part of the workflow.

At the same time, the **generation of the mathematical model** of a business process enables the 'automatic' calculation of the optimal scheduling of a given workflow. Although the structure of the process is restricted in this case (e.g. no runtime information can be used), this solution may reduce the human interaction in the business process reengineering and can give answer for optimization problems like scheduling or the number of requested resources.

The main benefit of this solution is that the use of the mathematical model for optimization purposes complements the simulation based solutions which need several iterations and represents exact solutions. In addition, scheduling problems can be answered.

As a motivating example a simple **Order process** of a travel agency is considered. This example contains parallel paths, data-based exclusive paths and alternative paths. Although simulation could give intuitively a solution, no optimality in terms of time and cost is not guaranteed. Using the plugin, the optimal scheduling is generated.



An example business process describing the order process of a travel agency

The *Order process* consists of the following activities. Ordering a trip starts with the *creation of the order*. An order can be either online or manual such that the decision is exclusive denoting by an *Online?* XOR gateway: the possibility that a buyer chooses the *online order* is 40%, and in the 60% of the cases the buyer selects the *manual order*. In case of an online order, the *flight ticket* and the *hotel room* are searched and reserved simultaneously which is represented by a parallel gateway.

The manual order can be done either in the *main office* or in the *secondary office* such that the choice is alternative, i.e. the extended attribute *IsAlternative* of the XOR gateway *Main office?* is set to true. After the reservation is ready, the *voucher is created* and the process ends.

In order to execute the tasks three clerks are employed. *Clerk1* is assigned to perform tasks *Create manual order*, *Create online order*, *Manual reserve* and *Create voucher*. *Clerk2* has to execute either the task *Main office* or the task *Online trip reservation*, while *Clerk3* may perform the task *Secondary office*.

The cost of a task is given by the wage of the performer (participant *Clerk1*, *Clerk2*, and *Clerk3* earn 50, 35, and 45 cost unit per hour) and the duration of the task that is 5, 5, 6, 5, 10, 20, 25, 5, and 5 minutes for tasks *Create online order*, *Ticket order*, *Hotel reservation*, *Online trip reservation*, *Create manual order*, *Main office*, *Secondary office*, *Manual reservation*, and *Create voucher*, respectively.

Let us suppose in the example that we have 5 number of cases or process instances, i.e. there are 5 incoming orders.

In case of business processes with time and cost parameters a possible question is to give a cost optimal scheduling within a deadline, i.e. the cost of the process has to be minimized such that the overall execution time does not exceed the given deadline. Another task can be the generation of a time optimal scheduling according to a given cost limit. In other words, a scheduling has to be generated that is executed within minimal time and its cost is not greater than the given cost limit. Of course, the scheduling may change in case of changing the deadline or the cost limit.

2. Optimization technology

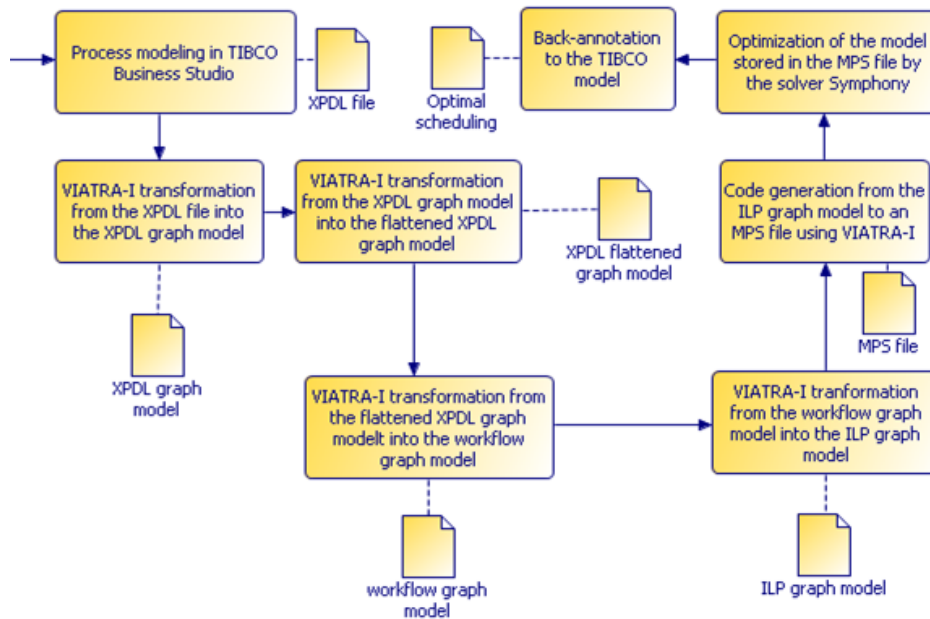
The aim of the technology is to create optimal scheduling for tasks of process instances, running in parallel, using shared resources.

In order to unify the formats of the individual vendors of business process modeling tools and workflow management systems, the Workflow Management Coalition elaborated a standard process design format called **XML Process Definition Language (XPDL)**. Thus the optimization technology is integrated into the **TIBCO Business Studio** that supports the XPDL language together with some extensions and restrictions.

The optimization of the business process consists of the following steps.

At first, the XPDL file of the TIBCO business process is transformed into the graph model of the XPDL model. Then the processes are flattened that results in an XPDL model which contains as many process instances as expected due to the possibilities and the case numbers. This model is transformed into an abstract workflow model that contains only those process elements that are important for the optimization. Then this simple workflow model is transformed into an abstract

integer linear programming problem (ILP) format. Finally, the MPS code of the ILP problem is generated that is the input of the solver **Symphony**. In order to transform the original XPDL file the paradigm of model transformation is used by applying the Viatra-I graph transformation engine. The input of the method is the XPDL file generated by TIBCO, i.e. a process package that is modeled in TIBCO together with minor restrictions (e.g., no loop is allowed). The modeler can choose either **cost** or **time** optimization (according to a deadline or a cost limit if it is needed), i.e. the transformation provides the optimal scheduling by cost minimization at a given deadline or time minimization at a given cost limit. In the first case the process is transformed into an LP model that retrieves a scheduling that is cost-optimal and the overall execution of the process is finished within the given deadline. In the latter case the solution of the transformed LP model delivers a scheduling with minimal time with respect to a cost limit, i.e. the execution cost of the schedule is not greater than the given cost limit.



Optimization of business processes

3. Example results

As our aim was to generate an optimal scheduling of the business process, the optimization method delivers the optimal scheduling of the individual activities of the process instances according to selected minimization features (cost or time minimization at given deadline or cost limit).

In the travel agency example we had one conditional exclusive gateway with possibilities. In the example we assumed 5 process instances, thus the flattened model contains two and three instances where the online order and the manual order are selected, respectively. The resulted scheduling is shown below.

The horizontal lanes show the individual processes, i.e. the five process instances. Within a process the horizontal bars represent the activities, and the lines between them the transitions. In the optimal scheduling all processes are interrupted during execution which, of course, can violate some policies in real life business process execution environment. However, in the next version of the plugin, we also plan to include priority for the processes.

