*i*Journals: International Journal of Software & Hardware Research in Engineering
ISSN-2347-4890
Volume 6 Issue 5 May, 2018

WEB – based simulator of business processes

Author: Valentin Velikov

Affiliation: Dept. of Informatics and Information Technologies, University of Ruse "Angel Kanchev"

E-mail: val@ami.uni-ruse.bg

ABSTRACT

This paper present a model for web-based BPMN simulator. There are described the architecture, data-model (internal machine representation of the subject area) and design model of the developed system. The system is created as part of big BPMN project and demonstrates some techniques, advanced technologies and knacks in the subject area and to show them in the teaching process.

Keywords: Computer Science, BPMN simulation.

1. INTRODUCTION

The term simulation is used in a different sense - sometimes a simulator of airplanes is adopted for simulation, in other cases web-based business simulations, and in third - a game like SimSity for example.

After developing a model of a business process (BP) [4], the next step is its simulation.

The simulation can be defined as: "Multiple studies of the various probable baseline states of the object by a mathematical model" with appropriate graphic representation.

Because of the algorithmic structure of a BP, it is generally possible to simulate it with special simulation tools referred to as business process simulations software (BPSSs) [5].

There are many simulation software systems [5]. All of them are closed: some of them are commercial, some of them are web-based, some of them are desktop, and some of them are graphics processing applications for mobile devices. Some of them offer excellent functionality. All they have a large number of tuning and excellent graphics representations of the results. But applications that offer such a wide variety of functionalities are paid.

2. RELATED WORK

Several other similar applications have been explored before starting our project [5]: ***IBM products (Rational System Architect, BlueWorks Live, WebSphere Lombardi), Sparx Enterprise Architect, ARIS Express, Oracle BPM Suite, BIMP*** and more [5]. Each of them has its own advantages and disadvantages that have been analyzed and on this basis it has been decided what functionalities the current application should have.

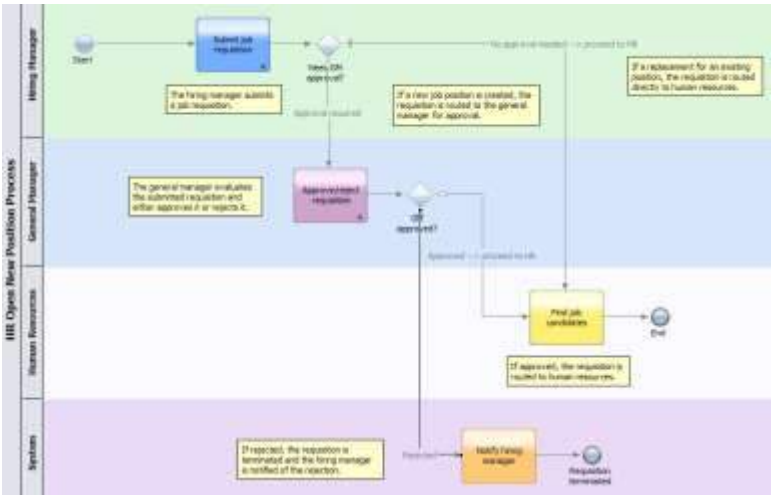

Fig. 1 example for BP from IBM WebSphere Lombardi - BPML subsystem (editor)

Some of them are free, but how the system works, what kind is the applied algorithm – that is closed.

3. DETAILED DESCRIPTION

As part of big project, the final stage includes a model of BP simulator. An own source-code allow a fine tuning of simulation parameters and shown results. It allows using it in education process: in the area of Computer Science / Software Engineering (software developers) and Business Management studies.

The basic steps of the simulation tool are described in [3]. Creating a process model starts with mapping the business processes. The process modeling/simulating tools have to offer a drag and drop type of a graphical interface to transfer the model into the system.

An example for BP is shown in fig.1. After it's taken into the simulator, the first stage of the simulator's work is to "understand" the BP. That's mean to receive the internal machine representation of the BP (fig.2). Every one of the objects (events, connectors etc.) is described with a frame [2] (fig.3.). To do this, it is necessary to drill-down into the processes where sub-processes and activities are defined. Describing the entities that flow through the processes and linking the processes using connectors facilitates the workflow definition (fig.2).

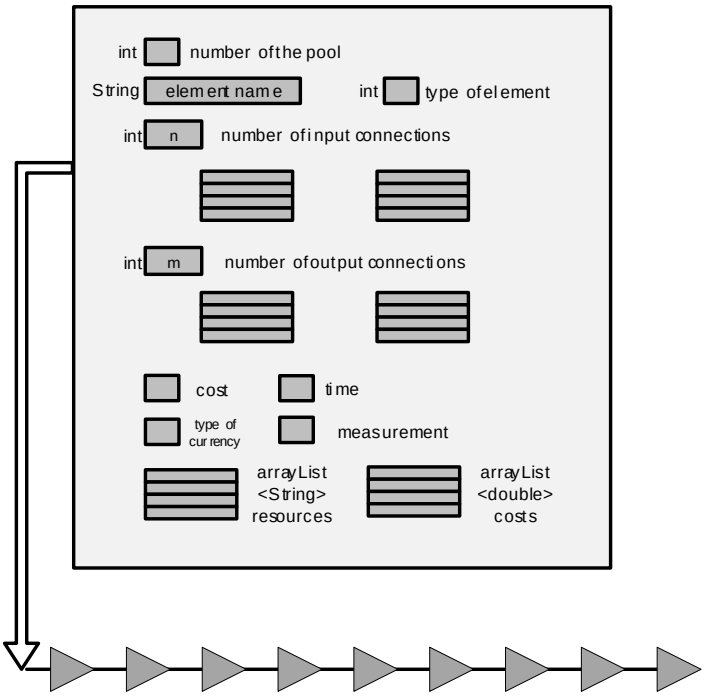

Fig. 2– arrayList <frame>

There is shown the frame "element" (fig.3.), it is used a Java notation.

Every one frame includes the following slots [2] (table 1).

The core set of BPMN elements is shown in fig. 4 [1]. They are used for describe and represent a model.

Finally, it is necessary to define everyone from the resources and assign them to the activities where they are use.

Basic blocks, using for building a model [3] (fig.5):

• **Entities**: the objects, processing by resources. These are customers, products, documents, orders etc. They can have attributes as quantity, priority, due date;

• **Resources**: the agents, that are used for adding value to Entities. Examples of resources are service representatives, automated process equipment, transportation equipment. The human resources can be members of departments and workgroups. The resources can have attributes as cost level and expertise level;

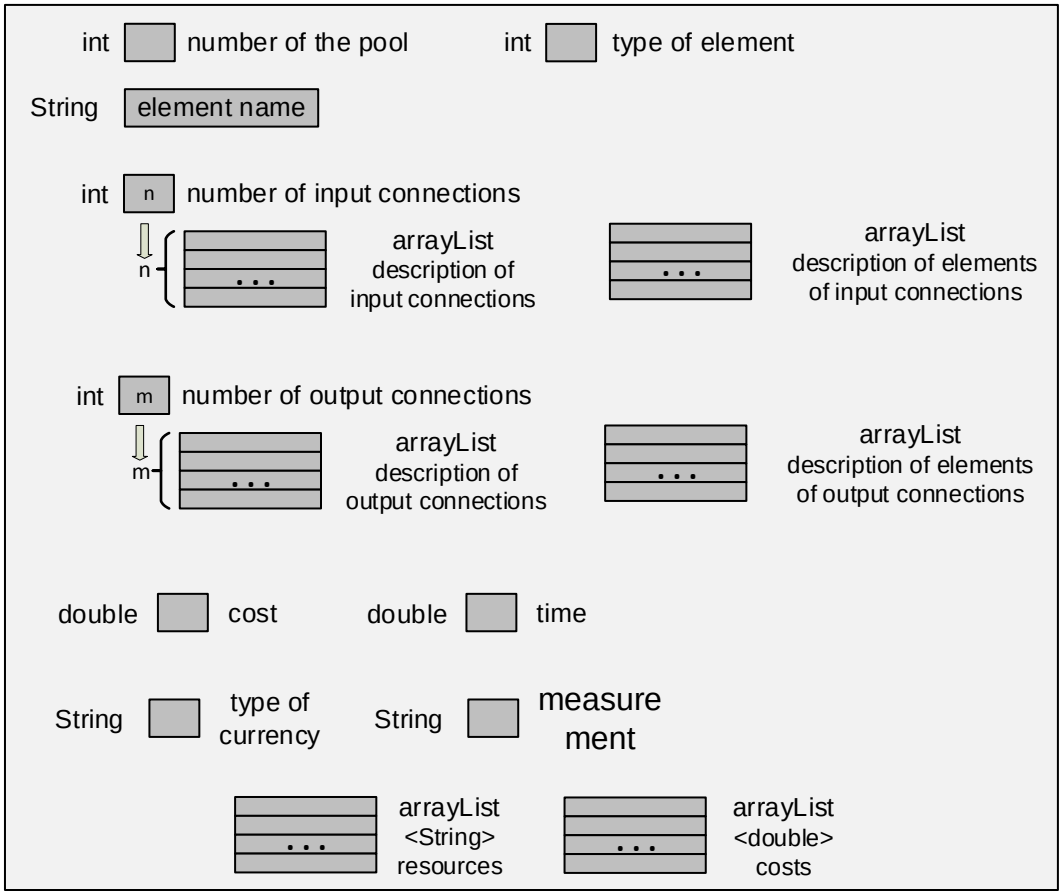

Fig. 3- frame "element"/node

• **Activities**: they are linked by connectors and represent the flow of entities through the simulation model. The activities can have added value or non-added value. Examples of activities are branching, assembly, batching;

• **Connectors**: they are used for linking process and activities. Entities follow the connectors as they are processed by the model. Connectors are helpful for defining parallel flows and rework situations based on deterministic, probabilistic, or conditional decision rules.

Before simulating a model, it is necessary to select the measurement system tor the quantities and to tune them. For example, if for the user is important to receive reports for productivity and time for manufacturing, activity costs for processes and utilization reports for resources, when run a simulation, the simulation tool have to verify the model and begins to advancing into the simulation clock. During the simulation there will be shown different graphics in real-time, some pictures to visualization the flow, the key performance measures and so on. In order to find the best solution, it has to determinate various scenarios and to simulate them.

That's mean that there is an internal editor to select and tune different scenarios. After selecting the current scenario, it is necessary to specify and determinate different parameters:

• how activity flows through the process, moderating the likelihood of a sequence of events and the priorities of certain events;

• time – for every one of the phases on the activities, to determinate how it influences the business processes;

• resources – this include the types and roles of workers and other resources, their required numbers, their costs and their availability.

Table 1 – the slots in a frame

name/destination	data type (Java notation)	description
number of pool	int	number of the pool
element name	String	name of the element (user defined)
element type	int	type of the element (fig. 3) / or N from arrayList
number of input connection	int	number of input connection, number of arrayList elements
	arrayList <String>	description of each one from input connections
	arrayList <String>	additional description of each one from the input connections
number of output connection	int	number of output connection, number of arrayList elements
	arrayList <String>	description of each one from output connections
	arrayList <String>	additional description of each one from the output connections
cost	double	cost (for this element/process)
currency	String	type of currency
time	double	the necessary time
to determinate the "weight" of the element:		
measurement	String	measurement of the time
resources	araryList <String>	the necessary resources/description
costs	araryList <double>	expense for each one of the costs

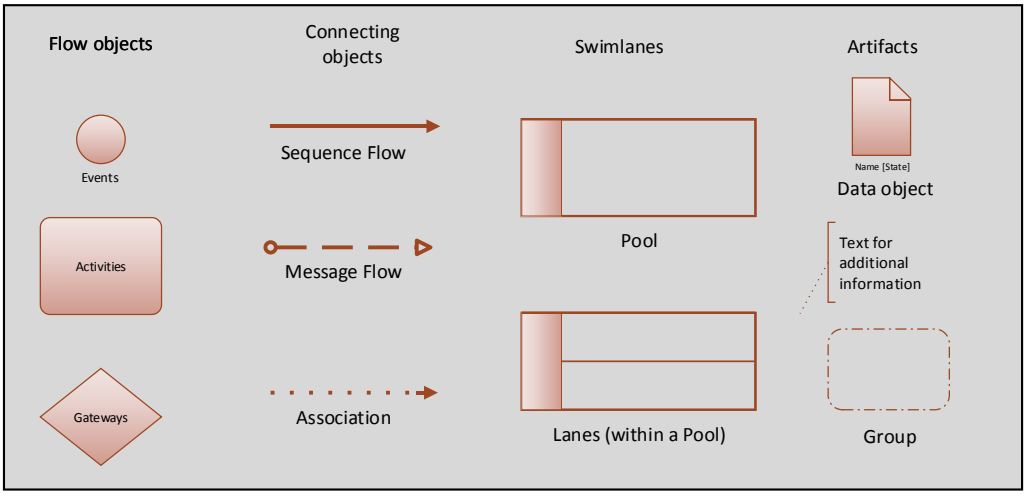

Fig. 4– The core set of BPMN

It also maintain multiply versions of a configuration. This allow easy compare the differences between versions and to see how each configuration will vary the flow of the process simulation or process execution. Once run through a simulation engine, it is possible to examine each result and decide on the relative merits of each configuration. Once establish a baseline configuration then creating multiple 'what-if?' configurations that vary one or more parameters. In this case the simple inheritance of common, unchanged data in one configuration by another configuration that contains only the data being varied.

There is created a set of different user-friendly dialog windows for tuning the different values: for time (calendar), for scenario (date and time at which the process takes effect; the length of time the process

takes; the base unit in which periods of time are expressed in this scenario; the currency unit of any costs recorded in the process; the date and time on which the scenario was created/modified; the number of times the scenario as a whole will be repeated in an execution cycle). The storing values can be remembered in a file, for reusing simulation parameters.

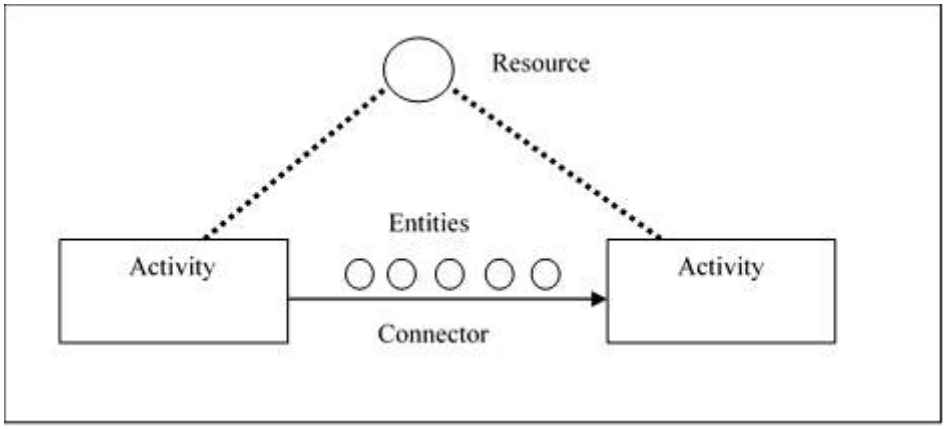

Fig 5 – Basic blocks for building a model

In another dashboard dialog the user can manage:

• costs for process execution – this allow to see the total cost for the current scenario, the minimum, maximum and average cost of individual process instance, all them with appropriates diagrams;

• bottlenecks in the process. If there are not enough resources to handle the scenario, then tasks will start ending up in the queue and cause high waiting times and process cycle times. Distribution of the process waiting times will be shown in a diagram, too;

• resource utilization – there it is possible to see average utilization percentage of each resource in the simulation scenario;

• individual task/element statistics - about cost, duration, waiting time and thresholds;

• visual heat-map of the business process model based on waiting times, counts, costs and duration.

Another dialog window allow to validate the BPMN model, configuration an scenario.

After an execution the current simulation, it is possible to see the receiving results as digital values or to show an appropriate diagrams. So it is possible to remember this results and later to compare the results between few scenarios.

The simulator has been realized as web-based client-server application. This architecture presume some advantages:

• easy add a new functionality, imperceptibly from the user;

• change functionality without stop the system and without installing anything to the user workplace;

• realizing a new functionality as separated module (as servlets, for example), automatically check them (JUnit -test) for correct working and for compatibility with the system, and automatically accept or reject from the system;

• independency from the user hardware;

• possibility to create and add software for monitoring the separated work places – in the teaching process;

• if necessary – easy convert a web into a desktop application. Without converting – it is possible to install the server part into the same computer (with the server, of course).

4. CONCLUSION

There are many tools for business process simulation. Some of them works as desktop application, some of them are web-based. Some of them are self-dependent, some of them are part of big system. BP are too complex and dynamic to be analyzed them with flowcharting and spreadsheet analysis. Discrete event simulation is more powerful. After “understanding” the process, using additional tuning editor for the measurement units and weight for resource rating, it is possible to investigate different cases and depict them

with appropriate diagrams, tables etc. There is possible to provide statistical input and output capabilities and advancing modelling elements to accurately simulate business processes and. Possessing an own source-code is a step into the next level - system for automatic programs generation.

5. ACKNOWLEDGMENTS

This work is supported by the National Scientific Research Fund under the contract ДФНИ - И02/13.

6. REFERENCES

[1.] Clauberg K., William Thomas, BPMN and Simulation – A White Paper, Signavio, Inc. – Nov 2013

[2.] Minsky M., A framework for representing knowledge, Massachusetts Institute of Technology, Cambridge, 1974 / (Марвин Мински, Фреймы для представлении знании. "Энергия", Москва, 1979. (Frames for knowledge representation) http://www.litmir.net/br/?b=134682, http://www.raai.org/library/library.shtml?extbooks 2014.)

[3.] Tumay K., Business Process Simulation, Proceedings of the 1996 Winter Simulation Conference

[4.] Velikov V, Dobreva K., Systems for modelling on business processes in training and education, IV International Science-practical conference, Togliatti State University, Togliatti, 2018

[5.] Velikov V, Dobreva K., Systems for simulation on business processes in training and education, IV International Science-practical conference, Togliatti State University, Togliatti, 2018

