IV. DISTANCE LEARNING AND LIFELONG LEARNING

BUSINESS PROCESS MANAGEMENT SOFTWARE APPLICATION FOR ENHANCING COMPANIES' KEY PERFORMANCE INDICATORS: EDUCATION APPROACH

Roman Šperka

Silesian University in Opava, School of Business Administration in Karvina
Univerzitní nám. 1934/3, 733 40, Karviná, Czech Republic,
sperka@opf.slu.cz

Abstract: This paper presents business process management software application which is intended to be used to simulate trading company behaviour with the aim to improve its key performance indicators. The application is able to be set up according to various simulation models and decision functions. We provide an example of simulation model implementation and introduce the graphical interface and simulation possibilities of the application. The paper firstly introduces some of the main ideas of business process management discipline. Secondly, it describes an implementation of simulation model and finally, it depicts the graphical user interface of the application.

Keywords: business, process, management, simulation, trading.

INTRODUCTION

In these times of significant uncertainty about future revenues, companies are naturally renewing their focus on reducing costs. Businesses are examining ways to improve operational efficiency by paying more attention to process management and improvement. BPMInstitute.org (2015) has observed an increased interest in introducing the concepts and principles of business process management (BPM) to the company's office workforce. Sponsored by the CEO and CFO, process awareness and process thinking is getting renewed attention, resulting in initiatives to understand how current operational activities are executed. Businesses are looking to identify company weaknesses in an effort to remove them. Executives are looking for ways to reduce defects, waste, cycle time, and bottlenecks – and their related costs.

The companies have to ensure the flexibility of their behaviour, speed of decisions, and customer satisfaction leading to the optimal market share, profits and other key performance indicators (KPIs) in order to survive in a global and turbulent market environment. Simulations can improve not only existing decision support systems, but they can also contribute to the teaching of essential managerial skills already during the education process on universities. If simulation models could be placed into the corresponding IT infrastructure of the educational institution, they could be used also in the distance learning environment. The aim of this paper is to introduce the usage of business process management (BPM) software application.

Simulations supporting decision support systems are typically based on business process modeling treated by many researchers (Axenath et al. 2007, Davenport 1992, Eriksson and Penker 2006, Van der Alst 2004, Suchánek and Bucki 2012, Šperka et al. 2013, Šperka and Spišák 2013). Alternative enterprise modeling methods - value chain oriented models have garnered much attention both among researchers in the accounting and later, from enterprise modeling. Value chain modeling concentrates on the value flows both inside the enterprise and on the value exchange with the environment. Currently, the most popular value chain enterprise methodologies are e3-value (Gordijn and Akkermans 2003), and the REA (Resources, Events, Agents) ontology (McCarthy 1982, Hruby et al. 2006, Dunn et al. 2004). Both process and value chain modeling methods often meet difficulties in modeling complex environments, when some social behavior like negotiation, management specific methods, market disturbances and others come into consideration. In this case, some local intelligence is needed within a business process model. This is probably the main reason, why a new software modeling paradigm came into existence – namely the multi-agent modeling approach. Modeling and simulation using multi-agent systems (Agent-based modeling and simulation) can be seen as a new approach to system modeling, especially for decision-making support systems (Macal and North 2006, Wooldridge 2009). In (Vymětal and Scheller 2012) was presented a general agent-oriented simulation framework MAREA (Multi-agent REA framework).

Using this framework, further research focusing on a possibility to define models to be used in education went on in last time. The result of this research is a business process management application based on the REA value chain and multi-agent modeling approach. The application can be used both in standalone PC environment and in distance learning. The aim of this paper is to present the developed application, its general structure and the graphical user interface. The paper is structured as follows. First, business process management approach and example model structure is presented. Next, graphical user interface is introduced. The conclusion sums up the results obtained.

1. BUSINESS PROCESS MANAGEMENT

This section is following the AIIM article published online (2015). The term business process management covers how we study, identify, change, and monitor business processes to ensure they run smoothly and can be improved over time. The term ―workflow" generally does fit under the process improvement umbrella. It is an important piece of the access and use puzzle since no or poor process really degrades your ability to get at and leverage information.

BPM is best thought of as a business practice, encompassing techniques and structured methods. It is not a technology, though there are technologies on the market that carry the descriptor because of what they enable: namely, identifying and modifying existing processes so they align with a desired, presumably improved, future state of affairs. It is about formalizing and institutionalizing better ways for work to get done.

Successfully employing BPM usually involves the following:

- Organizing around outcomes not tasks to ensure the proper focus is maintained.

- Correcting and improving processes before (potentially) automating them.

- Establishing processes and assigning ownership lest the work and improvements simply drift away.

- Standardizing processes across the enterprise so they can be more readily understood and managed, errors reduced, and risks mitigated.

- Enabling continuous change so the improvements can be extended and propagated over time.

- Improving existing processes, rather than building radically new or ―perfect" ones, because that can take so long as to erode or negate any gains achieved.

BPM should not be a one-time exercise. It should involve a continuous evaluation of the processes and include taking actions to improve the total flow of processes. This all leads to a continuous cycle of evaluating and improving the organization. Applying the BPM discipline strategically requires the practice of the following nine areas in a cohesive program (BPMInstitute.org 2015):

- Aligning processes with business strategy.

- Discovering and modeling processes.

- Measuring processes.

- Analysing and benchmarking processes.

- Harvesting policies and rules.

- Improving processes.

- Managing the changing of a culture.

- Governance — decision making, and,

- Deploying technology.

It allows business and technology to better understand implications of how work is performed. It visually identifies problems with processes. It allows the business to define improved business processes and test them prior to implementation. BPM provides value throughout an organization by (BPMInstitute.org 2015):

- Using process-enabled achievement of strategic objectives.

- Accelerating time to market.

- Delivering improvements in cost, productivity, timeliness and quality.

- Improving customer service levels and increasing customer satisfaction.

- Transferring knowledge to ensure that customer teams achieve the necessary competence and autonomy to maintain and develop future capabilities.

- Simplifying business processes to drive effectiveness, efficiencies and agility.

- Managing risks and meeting compliance regulations.

- Providing greater visibility into your organizational performance.

- Introducing new process designs faster.

- Reducing costs and improving revenue streams.

In the next section we will describe an example model structure principles of a business process management application.

2. EXAMPLE MODEL STRUCTURE

The model implemented in business process management application simulates a virtual business company using the REA value chain and multi-agent approach. The general model structure is presented in Figure 1. The model is based on the control loop paradigm. The internal parts of the company are represented by sales representative, purchase representatives and marketing agents. The outputs of the company are measured by the REA ERP system, which also records all activities of the agents. The market environment is represented by customer and vendor agents. Note that all the agents mentioned exist in a large number of instances. The difference between measured outputs and targets is sent as a feedback to the management agent, who takes necessary actions in order to keep the system in the proximity of the targets.

The interaction between the customers and sales representatives and also between the vendors and purchase representatives is a typical negotiation. This is modeled by the classical contract net protocol. The customer decides if he should accept the quotation based on the decision function presented earlier in an example (Šperka and Spišák 2015). If the proposal is not accepted, the sales representative changes the price accordingly (this is one of the parameters that can be changed by the students.).

The decision function for m-th sales representative negotiating with i-th customer is represented by formula

$$c_n^m = \frac{\tau_n T_n \gamma \rho_m}{O v_n} \qquad (1)$$

c_n^m - price of n-th product offered by m-th sales representative,

τ_n - market share of the company for n-th product $0 < \tau_n < 1$,

T_n - market volume for n-th product in local currency,

γ - competition coefficient, lowering the success of the sale $0 < \gamma \leq 1$,

ρ_m - m-th sales representative ability to sell, $0.5 \leq \rho_m \leq 2$,

O – number of sales orders for the simulated time,

v_n - average quantity of the n-th product, ordered by i-th customer from m-th sales representative.

Similar decision function is used in the vendor – purchase representatives negotiation. The aforementioned parameters represent global simulation parameters set for each simulation experiment. Other global simulation parameters are: lower limit sales price, number of customers, number of sales representatives, number of iterations, and mean sales request probability. The more exact parameters can be delivered by the real company, the more realistic simulation results can be obtained. In case we would not be able to use the expected number of sales orders O following formula can be used

$$O = ZIp \qquad (2)$$

Z – number of customers,

I – number of iterations,

P – mean sales request probability in one iteration.

The presented decision function is generally based on the overall market balance for each product. However, quite another approach can be used for the customers decision whether to buy or not. This approach is based on the utility theory and needs data for the preferences and budget constraints.

The management agent can change the purchase limit price, to decide upon a sales representative education, marketing campaign, etc. These interventions lead to higher profitability of sales representatives. The parameters of such action can be set by the students. With such general structure, the students are able to configure the agent types, the management action etc. and to observe the behavior of the system reacting to the management actions.
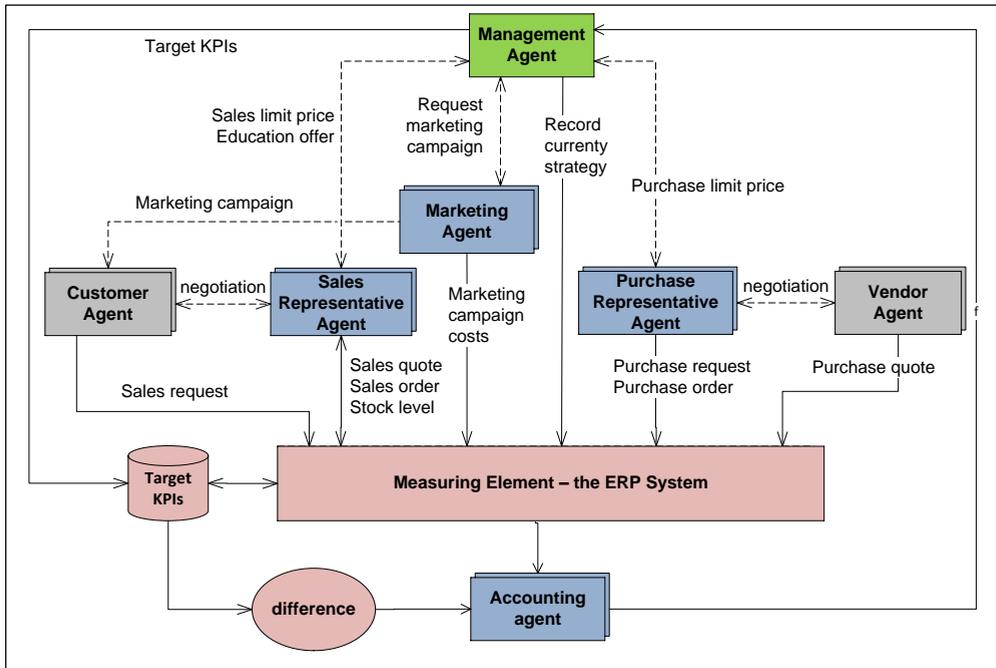

Figure 1. General simulation model structure.

Source: Šperka and Vymětal, 2013

3. BUSINESS PROCESS MANAGEMENT APPLICATION

The application consists of two main components, the Simulation of a multi-agent system (MAS) and the REA based Enterprise Resource Planning system (ERP). The simulation designer can interact with the system by means of a Graphical user interface. The general overview is presented in Figure 2. Next important elements of the application, hidden within the ERP system are the Message viewer and the log file. A simulation designer can either use the ERP system directly, or can program intelligent agents to perform the same activities that a human user can perform. For example, a simulation designer can use the ERP system directly to create initial data for a simulation, then start the agent platform to run a simulation, then using the ERP system to inspect the simulation results, and even adjust the data (within the rules implemented in the ERP system) and then start the agent platform to continue
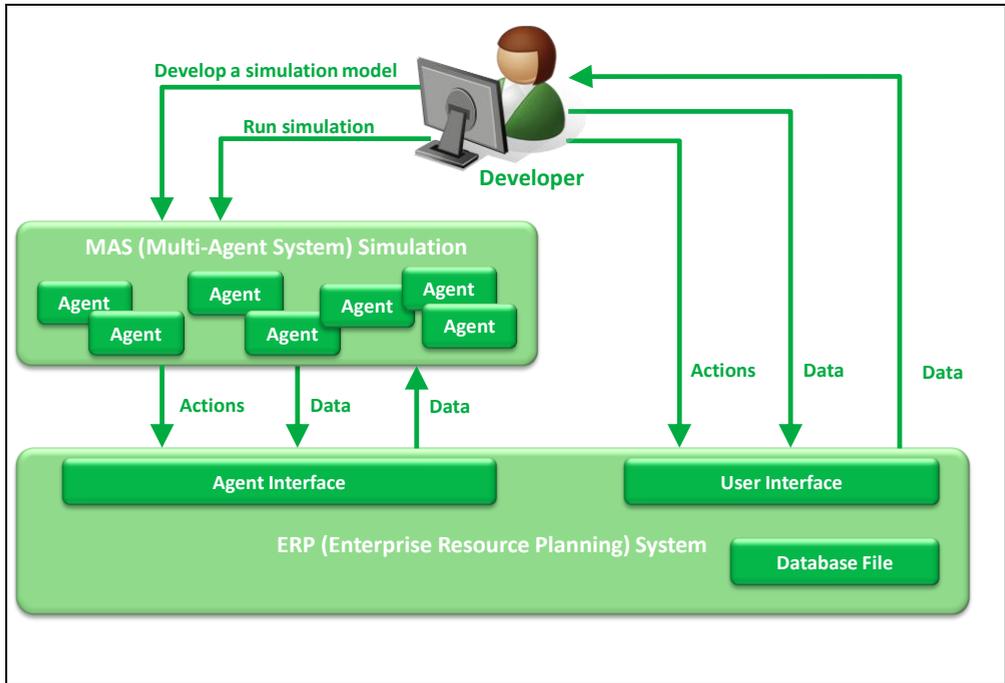
Figure 2. Application overview.

Source: REA Technology official documentation

MAREA application enables users to set up trading company parameters (see the example in Table 1) and run trading simulation for a specific time to interpret the development of KPIs of this company.

Table 1.

Basic simulation parameters

Parameter	Example	Remark
Number of iterations	365	52 weeks also possible
Number of customers	100	Up to several thousand
Number of vendors	5	typically

Mean quantity in one sales order	5 units	
Probability of sales order request	0,01	
Number of sales representatives	2-3	One for e-business modeling
Sales representative ability	0,7	For start

Source: Šperka and Vymětal, 2013

The main screen called Simulation monitor (Figure 3) consists of five panes:

- Logo pane with sponsors of the project. You can hide the logo by clicking it. Clicking the upper area of the window shows the sponsor's logo again.

- Simulation properties. These properties are determined by the agent simulation model, and different simulation models might contain different simulation properties.

- ERP system menu. Within the ERP system menu, two very important buttons can be seen: the Export to XES button and the Message viewer button. The functions and usage of these two buttons will be described in the next section.

- Simulation menu.

- A graph of the cash level of the company, indicating the progress of the simulation. Please note that this graph is updated by ERP transactions that influence cash level. That is, if the simulation runs but none of these transactions occur, the cash level graph in the Simulation monitor will not be updated.

The ERP system has been configured to calculate several key performance indicators (KPIs) by summing up other values. For example, Cash level is calculated as a total of all transactions that change Cash level – payments for purchases, income from sales, payment of bonus, initial cash, etc. Turnover and Gross profit is calculated as a total of gross profits and turnovers of specific product types.
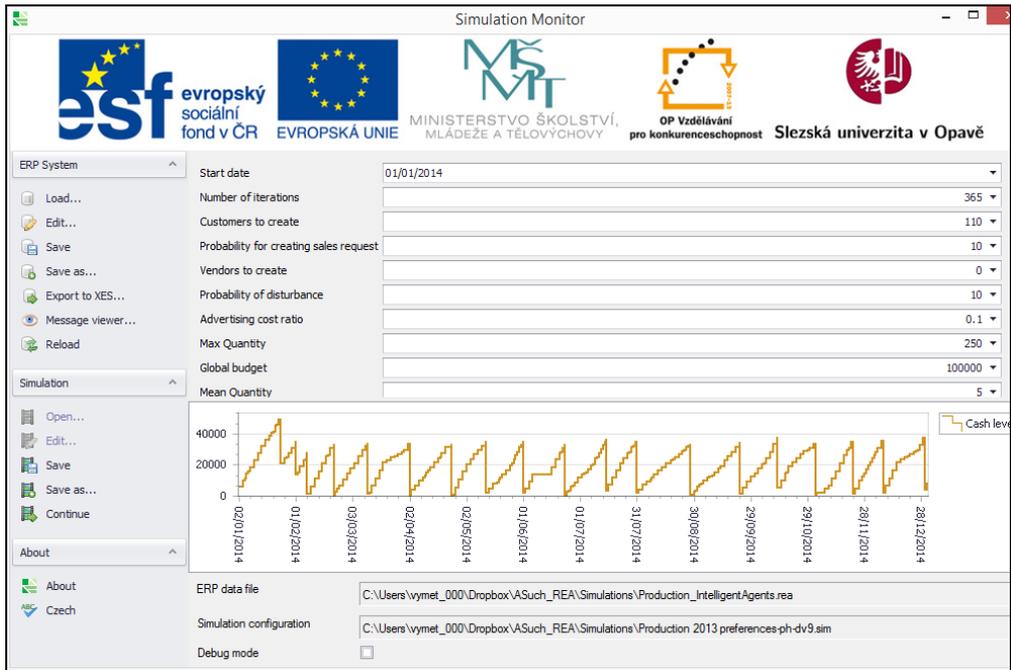
Figure 3. Description of the simulation monitor.

Source: Šperka and Vymětal, 2014

Figure 4. The example negotiation.

Source: Šperka and Vymětal, 2014

All messages sent among the agents including the messages the agents send to each other during negotiation are recorded in a message log file. They can be seen by

means of the Message viewer and can be also filtered on the message type. The example negotiation between sales representative agent and the customer agent is presented in Fig. 4. Here we can see a result of a multi-round negotiation. The originally proposed price of the kitchen set (564) was negotiated down to 450.9. Here again: the parameters of a price reduction within a negotiation are a part of global system parameters that can be changed by the students.

CONCLUSION

We presented basic parts of MAREA business process management application in this paper. MAREA is a prototype of a simulation based software framework. In the first part of the paper we described basics of business process management and a general structure of the simulation model, basic participants and simulation steps. The remaining scope is dedicated to MAREA graphical user interface introduction and the means of structure validation. The MAREA application serves for the decision support of company's management as well as for educational purposes. It enables users to get familiar with the principles of trading using business company virtual model. The setup of the application provides possibilities to edit the company parameters and to run trading simulations. This allows users to analyse trading behavior back-to-back according to the parameters setup. The prototype was tested using real data gathered from the ERP system of high-tech Slovakian company and using randomly generated data as well. The validation shows reasonable results with the necessity to integrate some kind of mechanism dealing with seasonal differences in KPIs. Future research will concentrate on the log files analysis to give us feedback about processes in the running simulation experiment.

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