

# Business Software Simulation for Education of Future Engineers

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*Abstract:* - Besides sufficient professional and language preparedness, the present labour market also demands experience in so called soft elements, i. e. in presentation and communication skills, teamwork, and operational and strategic project management. Fresh engineers mostly lack this experience. One of the possibilities how to allow training in such skills for students of technical universities is to simulate conditions of real practice on the academic ground. Growing performance of computer technology provides new possibilities of its use. One of them is to use IT technology to simulate business processes. Such a simulation might also be used, beside common optimisation of physical business operation, for training university students to whom it brings certain virtual experience. The article describes specific implementation of an economic software simulation primarily designed for training in economics and management courses. The simulation is being developed at the Faculty of Transportation Sciences of the Czech Technical University in Prague. Existing experience suggests that an economic software simulation is a managerial tool allowing for the analysis and synthesis of business processes including evaluation.

*Key-Words:* - Management, education, managerial game, simulation, business, e-learning, team, ESIM.

## 1 Introduction

We often hear in interviews with end employers of fresh graduates of technical universities that their professional knowledge is sufficient but that they have difficulties in understanding the wide range of business processes, which is essential for efficient labour performance. Employers also often point to lacking teamwork and team communication skills of fresh graduates. To do away with these deficiencies, it is necessary to bring business decision-making on the academic ground.

One of the possibilities how to bridge this gap is to use modern IT technology allowing for implementation of certain rough virtual experience thanks to its computing performance. This approach has allowed creating a managerial game where students use both simulated assets (paper components) and a business software simulation in a simulated world (virtual business). The focus is not only on the creation of an economic model but also on a simple use of the game by students. We thus develop a system designed for groups of students (teams) “competing” e. g. for virtual customers within virtual competition.

The text below describes the implementation of the software simulation of business activities. We call the project “Electronic Strategic Interactive Management” (“ESIM”).

## 2 ESIM project

### 2.1 Electronic Strategic Interactive Management

The ESIM business simulation should simulate real economic environment in which several competing businesses compete under market conditions. As in the real world, the main objective in the ESIM economic simulation is to reach the maximum benefit for the business (e. g. profit) together with sound economic health and a favourable outlook. Each system user may become one of the managers of a virtual business operating in the same way as in the real world. Usually, several managers take part in managing a business, which is taken into account by the ESIM business simulation.

A virtual business within the ESIM economic simulation solves the same problems as does a business in the real world. As a rule, the top management get regular operational and financial reports on the business and on its surroundings on the basis of which they take further steps to realize long-term strategic business objectives. The virtual management of a business within the ESIM economic simulation also get regular quarterly operational and financial business reports on the basis of which they may make a number of decisions leading to success.

At the beginning of the simulation, users are formed into groups (management teams) and the ESIM business simulation allocates them virtual businesses and gives them financial and operational reports for several past quarters. Of course, there are several user groups in the market and the simulation allows them to compete for customers and for a market share, to fight for costs, to obtain a technologic advantage, etc.

Every user is expected to be a member of one group only. If the simulation organizer requires for some reason one user to physically exist in more groups, it is necessary to make the corresponding number of registrations of the user in the system.

The aim is to reach the best economic position of the business as possible; the ESIM business simulation evaluates this and allocates score to the business. The better business economic health and position, the higher the score. There is a given virtual period for managing the business and at the end, success and managerial skills of users are evaluated on the basis of the score and the most successful team is announced.

## 2.2 Virtual business

As a real business, the virtual business has inputs, internal processes, and outputs and its activity is evaluated by its success rate. The main criterion of assessing success of a business (team) is final equity that depends on the demand for output production.

Main inputs in the simulation are material, energy, workers, capital, and information. Technologic and organizational processes decided upon by the business management (student team) result in desired products at the output. The objective of the business (team) is to adapt the business to changes coming from the outside as efficiently as possible. At the same time, students are informed that the business may damage environment (both internal and external). Students are thus taught that it is necessary to manage a business in a way mitigating particularly the damage of external environment.

The environmental burden caused by a business may be curbed by timely technology innovation (both of individual components and of comprehensive units) corresponding with present scientific, research, and project intentions.

The problem is that a business is a mixed system involving a number of heterogenous elements (technical, economic, social and other links). To harmonize those heterogenous elements is a substantial task of a business manager. Basic links are outlined in Figure 1.

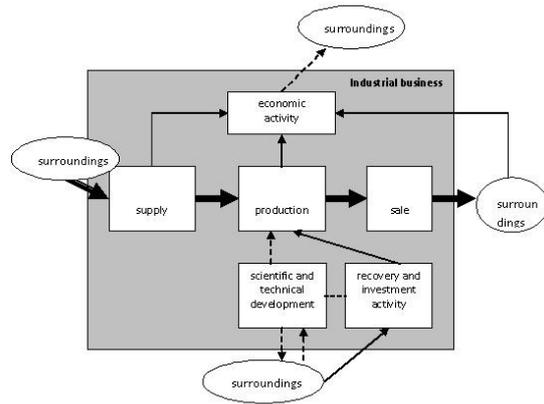


Fig. 1: Links arising in industrial activities [1]

The following input data have been selected for the software simulation:

- production lines and their capacity
- human resources and their allocation to individual activities
- contracts – volume, deadlines
- producers data
- shift rate
- management system
- research
- deployment of production facilities, area, material flows
- equipment availability
- finance
- supply

## 2.3 Course of the software simulation

The ESIM simulation falls among so called discrete simulations, i. e. individual state values discretely change at given discrete moments of virtual time. The ESIM system works with the following terms:

**Simulation** – simulation of real internal and external business processes takes place in discrete intervals of virtual time based on certain input parameters.

**Round** – a discrete interval of virtual time, typically a virtual quarter. Users may always decide on business operation only between the intervals = rounds.

**Decision** – users enter certain parameters at the beginning of each round through which they

manage their virtual business. This process is called a decision.

**Report** – at the end of each round, users get a summary of the current state of their virtual business. This summary is called a report – evaluation.

The physical course of the simulation is outlined in blocks in Figure 2.

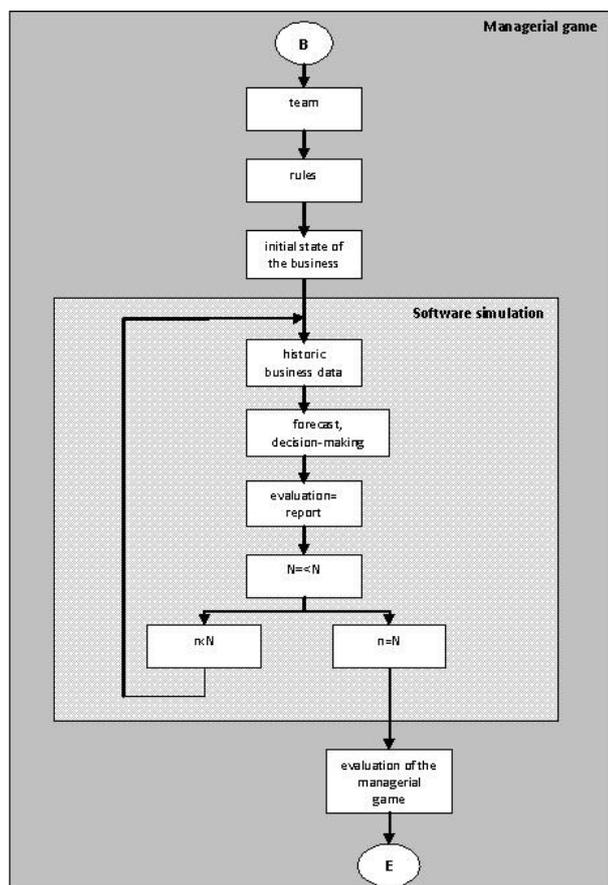


Fig. 2: The managerial game (software simulation – block diagram)

where:

$n$  – a current step, interval, round

$N$  – a standardized step,  $N = \sum_{k=1}^{k=N} n_k$

$B$  – the beginning of the managerial game

$E$  – the end of the managerial game

In real time, the simulation takes place in individual intervals preset by simulation time schedule determining sequence of the intervals:

1. Simulation announcement (posting at the notice board, websites, by a leaflet – announcement

encompasses basic information on the simulation, including the time schedule)

2. The end of registration of participants (it need not be determined if the number of participants is fixed at the moment of announcement and the organizer does not plan to admit further participants)
3. Division of the users into teams
4. Handing out the rules and the initial state of the virtual business to every team
5. Start of round 1 of the simulation,  $n=1$
6. End of round 1
7. Handing out the results of round 1
8. Start of round 2 of the simulation,  $n=2$
9. End of round 2
10. Handing out the results of round 2
11. Start of round  $N$  of the simulation (last round),  $N = \sum n$
12. End of round  $N$  of the simulation (last round)
13. Handing out the results of round  $N$  of the simulation (last round)
14. Announcement of results (based on the score reached in the last round)
15. End of the whole simulation

where:  $N=4, n=1, 2, 3, 4$

The simulation thus takes place in individual discrete intervals (i. e. there are no continuous changes in time), the smallest unit is 1 quarter. Operation of a simulated business moves by quarters and the team always reacts at the interface between two neighbouring quarters (see Figure 3).

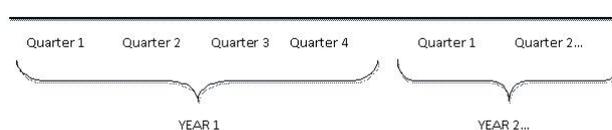


Fig. 3: The size of the virtual time unit

### 2.4 Teamwork

Currently, teamwork is still more and more used in all areas and fields. This trend relates to the need for fast and efficient changes in decision-making. A suitable composition of a team is a prerequisite of efficient and successful business operation.

Teams are groups that we may call synergic. Values reached by the group start to exceed sums

of values that the group members are able to reach separately [2].

A team role is, in Meredith Belbin's opinion, a tendency to behave, contribute and interrelate with others in a particular way [3].

The basic division of team roles by Belbin [4]:

- Implementer
- Coordinator
- Shaper
- Plant
- Resource Investigator
- Monitor- Evaluator
- Team- Worker
- Completer-Finisher
- Specialist

Belbin states nine types of team role behaviour and their contribution and admissible weaknesses. Teams are formed to be as diverse as possible regarding team roles. However, a problem arises when important team roles are missing [5].

The minimum number of teams in one group suitable for the simulation is four. The ideal number of students in a team is 4 to 5.

#### Expected team positions:

- *team leader* (team coordination and presentation, business income statement)
- *financial planner* (budget, financial investment, loans)
- *production planner* (production optimization, machinery purchase/sale)
- *marketing specialist* (market survey, contracts, research)
- *stock manager* (stock planning)

## 4 Conclusion

The project of the business software simulation in the form of a managerial game arose in response to the call of the commercial sphere for better

preparedness of graduates of technical universities for practical project management, team decision-making, and strategic management of operations or entire businesses.

As regards professional and technical knowledge, the background of students and graduates of the Czech Technical University is very good. Nevertheless, development of so called soft skills and experience at the university is mostly insufficient. Moreover, an overwhelming majority of businesses support an idea that young people should develop such skills at universities. However, businesses have to realize that the development of soft skills requires long experience under practical business conditions that, unlike technical systems, differ business by business due to different corporate culture.

The current trend of IT technology development substantially shifts possibilities of its use in various fields. A software simulation is one of the means. Its application in economic fields is very perspective.

Our aim is to support students of technical universities entering the working life in development of personal skills, which will make their integration in the labour market easier. Indeed, we realize that only universally prepared students prove out in the current labour market and therefore we would like to help them as much as possible. Furthermore, it is necessary to help students integrate in today's ever-changing economic environment easily and fast.

Undoubtedly, a tool to reach this goal is a simulation of real business processes through the ESIM business simulation – a managerial game whose concept we are going to improve.

Drawing on our existing experience, we may say that a simulation of business processes is a suitable tool for practical managerial exercises, as outlined in Figure 4.

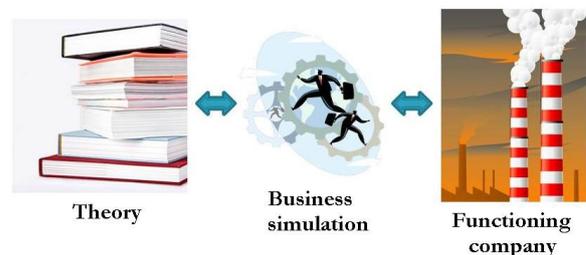


Fig. 4: Business simulation as bridge between theory and practice

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