MODELLING OF AN NAUTICAL TOURIST PORTS BUSINESS SYSTEM (NTBS)

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ABSTRACT

Simulation modelling of a nautical and tourist port NTBS (Nautical Tourist Business System) in relation to investments in sports objects will result in an increase of the quality of the total offer and an increase of competitive forces of the observed system. The system of nautical and tourist ports NTBS has all the characteristics of a complex organisation and business system, for which dynamic modelling efficient methods of simulation techniques have to be used.

In this paper, the NTBS will be determined through a global model of integral nautical and tourist service (from berthing service as a basic service to all other additional services). The subsystem of investments in new capacities, like sports and additional capacities will be determined by exogenous variable **VINK** – value of investments in new capacities.

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Keywords: Simulation modelling, business system of nautical and tourist ports, investments in sports objects, competitive advantages,, sports and recreation market.

SYSTEM DYNAMICS QUALITY SIMULATION MODELS OF A NAUTICAL TOURIST BUSINESS SYSTEM

The subsystem of investment in sports objects of a business system of a nautical and tourist port must have the characteristics of intelligent behaviour, which implies the following characteristics of managing behaviour: “If the capacity of NTBS is full and if in the last several years the income per guest has not increased, it is necessary, in the next mid-term period, to invest in new facilities which will improve the quality of the total services of NTBS.

In this case it is planned to build at least 4 outdoor and two indoor tennis courts, one beach volleyball court and one swimming pool of $50m^2$, including facilities like dressing rooms, sauna, showers, massage and medical assistance, etc.). In case there is a decline of interest in the main NTBS services, berthing, then it is necessary to stop the construction of new capacities. This implies that the started objects will be finished, while the others will be built after the demand increases again. Also, if the state of the cash-flow account of NTBS is not positive or there are not sufficient means to cover the investment, it is necessary to ensure the mid-term and long term loans in order to complete the investment."

In order to determine the global system dynamics simulation model of NTBS, it is necessary to determine the following relevant subsystems: subsystem of berthing capacity (the main nautical and tourist service); subsystem of servicing vessels; subsystem of capacities of additional services (trade and catering); information subsystem; subsystem of the state of cash-flow; subsystem of credits for performed services; subsystem of debts; subsystem of income; subsystem of marketing and sales; subsystem of long term and short term loans; subsystem of engagement of total capacities; subsystem of the new sport capacities and their facilities.

Simulation of NTBS begins on the first day of April of the observed business year (TIME=120 days). The first season finishes at the beginning of October of the same year (TIME=300 days). The next period of off-season business begins in October of the same year (TIME=300 days) and lasts to the beginning of the new season (TIME=485 days). The new tourist season begins on the 485th day (TIME=485 day) and lasts to October of the next business year (TIME=665 days). New off-season business begins on the 665th day and ends on the 850th day (TIME=850 days).

Investing into new capacities begins on the 380th day (TIME=380) and lasts on average 180 days, which means that it ends on the 560th day of business, and the first positive effects of the investment (variable KPNI), or increase of the total income (UP), total operating costs (UTP), generator of the vessel arrivals (GDP) and average realised revenues per vessel per day (POPPD) stars in time TIME=406 days.

MENTAL, VERBAL AND STRUCTURAL SYSTEM-DYNAMICS SIMULATION MODEL OF NTBS BUSINESS SYSTEM

In accordance with system dynamics simulation quality methodology, it is possible to present the mental and verbal model of LNT in the following way: "If the variable *generator of the vessel arrival* GDP increases, *the number of vessel registration a day* BPPD will also increase, which shows a positive (+) cause-effect connection UPV", i.e., as abbreviated**:**

GDP(+)→(+)BPPD.

«If the *number of vessel registration a day* BPPD *increases, the total number of registered vessels* UBPP will also increase, which shows a positive (+) cause-effect connection UPV», i.e., as abbreviated**:** BPPD(+)→ (+)UBPP.

If the *total number of registered vessels* UBPP increases, *the number of vessel checkouts a day* BOPD will also increase, which shows a positive (+) UPV.", i.e., as abbreviated: UBPP(+)→ (+)BOPD.

"If the *number of vessel checkouts a day* BOPD increases, *the total number of registered vessels* UBPP will decrease, which shows a negative (-) UPV", i.e., as abbreviated: BOPD(+)→ (-) UBPP.

"If the *average staying time of vessels* PVZP increases, then *the number of vessel checkouts a day* BOPD decreases, which shows a negative (-) UPV", i.e., as abbreviated**:** PVZP(+)→(-) BOPD.

(-) FBL1: The variables UBPP and BOPD create the so called negative (-) retroactive circle, or self-governing (-) KPD1", i.e., as abbreviated**:** UBPP(+) → (+) BOPD(+)→(-) UBPP.

"If the *number of vessel checkouts a day* BOPD increases, *the total value of the issued invoices* UVIR will also increase**,** which shows a positive **(+)** cause-effect connection UPV", i.e., as abbreviated: BOPD(+)→(+)UVIR.

"If the *average time of stay of vessels* PVZP increases, *the number of vessel checkouts a day* BOPD will be decreased, which shows a negative (-) UPV, i.e., as abbreviated: PVZP(+) →(-)BOPD.

"If the *average realised revenue per vessel per day* POPPD increases, *the value of the issued invoices a day* VIRD will also increase, which shows a positive (+) UPV, i.e., as abbreviated: POPPD(+)→(+)VIRD.

"If the *value of the issued invoices a day* VIRD increases, *the total value of the issued invoices* UVIR will also increase, which shows a positive (+) cause-effect connection UPV", i.e., as abbreviated**:** VIRD(+)→(+)UVIR.

"If the *total value of the issued invoices* UVIR increases, *the value of the collected debts a day* VNPD will also increase, which shows a positive (+) cause-effect connection UPV: UVIR(+) → (+)VNPD.

"If the *average time of collecting debts* PVNP increases, *the value of collected debts a day* VNPD will decrease, which shows a negative

(-) cause - effect connection UPV". PVNP(+)→

(-) VNPD..

"If the *value of collected debts a day* VNPD increases, the *total value of issued invoices* UVIR will decrease, which shows the negative (-) UPV." VNPD(+)→(-) UVIR.

The remaining FBL are shown in short form as follows:

(-) FBL2: The variables VNPD and UVIR create the so called negative (-) retroactive circle, or self-governing (-) FBL2", i.e., as abbreviated: UVIR(+)→VNPD(+)→(-)UVIR.

(-) FBL3: The variables SUSZR and VISZRD create the so called negative (-) retroactive circle, or self-governing (-) FBL3",, SUSZRD(+)→VISZRD(+)→(-) SUSZRD.

(-) FBL4: The variables **VUD and VIOPD** create the so called negative (-) retroactive circle, or self - governing **FBL4**", VUD(+) → VIOPD(+)→(-)VUD.

The value of investment into new capacities – VINK will be determined:

VINK.KL=DELAY3(PULSE(500000,1,380,1000),180)+DELAY3 (PULSE (2000000, 1, 400, 1000),180)

Remark: The first item of the equation VINK.KL (500,000 EUR) denotes the total investment of the marina during the construction period of 180 days (its own financial means and bank loan as the outer finances); the other item of the equation denotes the possible investment in total of 2 million US$ of the foreign partner investors, and it will not have a negative effect (increase of costs) to financial state of the giro account, but the new investor will ensure the return on investment by an agreed share in the profit.

The investment effect will reflect for the first time in the realisation of the increased revenues in the following season.

Positive effects of the investment will reflect in the variable KPNI coefficient of the increase of new investments:

KPNI.K=TABHL(KPNIT,VINK.KL,500,^2500,500)

KPNIT=1,1.2,1.5,1.8,1.9

The variable KPNI denotes an increase of revenues in the future period (after completing the investment and the beginning of work of the completed new capacities). The symbol KPNIT denotes the tabular amplitudes of a relative factor of increase of new investments to the growth of total revenues, costs, average costs per vessel and the generator of vessel arriving.

The state of the total assets in the giro account – SUSZR, will be determined:

SUSZR.K=SUSZR.J+DT(VUSZRD.JK-^ VISZRD.JK),

Remark: If the state of the total assets in the giro account is higher than zero, then the marina is solvent, and if it is zero or less than zero, then it is financially insolvent and in order to be capable to pay its liabilities it has to ensure cash assets on the basis of loans (mid-term or short term loans).

SYSTEM DYNAMICS STRUCTURAL FLOW DIAGRAM OF THE NTBS

In accordance to the completed mental and verbal simulation model of investing into sports and other objects in the NTBS business system, it is possible to determine the system dynamics simulation flow diagram of NTBS.

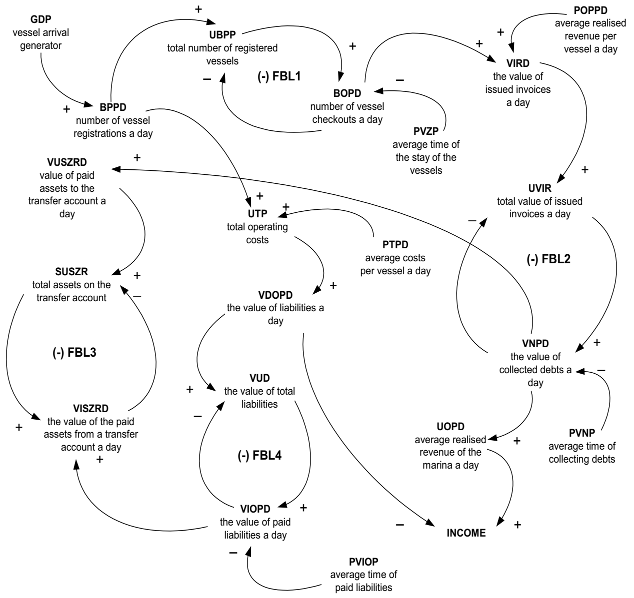


Figure 1: System Dynamics structural model of NTBS

THE RESULTS OF SIMULATIONS OF 0/1-SCENARIO OF NTBS RELATING TO INVESTING INTO NEW SPORTS OBJECTS

Graphic results of the simulation following variables:

SUSZR= state of total assets of the cash flow;

UVIR= total value of issued invoices;

UBPP= total number of registered vessels

UOPD= average realised revenue of the marina per day;

UTP – Total operating costs

INCOME – Income of NTBS (euro /year)

VUD – The value of total liabilities

VINK – The value of investments into new capacities

BOPD – Number of vessel checkouts a day

VIRD – The value of issued invoices a day

VUSZRD – The value of paid assets to the cash flow day

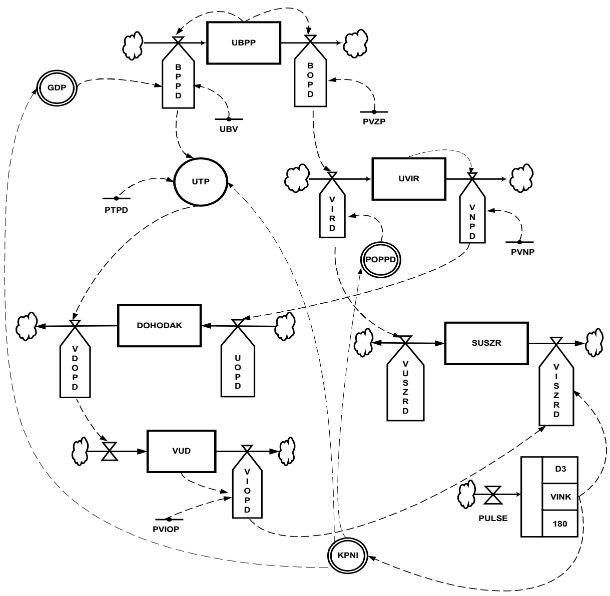


Figure 2: SD Structural flow diagram of the NTBS

The following figures show the state of the variable depending on the input variable GDB (generator of vessel arrival). For scenario 0 input variable is: GDP.K=STEP(100,100), a scenario 1 input variable is GDP.K=STEP (100,100)*PULSE(8,1,120,2)*(2-NOISE()).

Comments

Analysing the obtained graphic results of the simulation of 0 scenarios it is possible to notice that performance dynamics of variables is in accordance with economic regularity of the

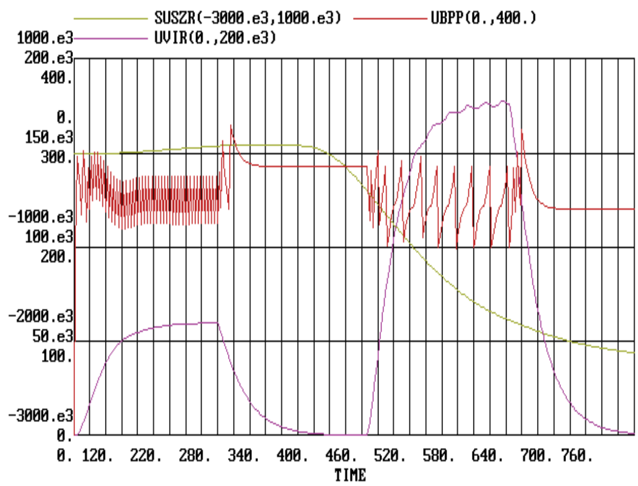


Figure 3: Graphic presentation of the simulation of 0 scenario – variables SUSZR, UVIR and UBPP

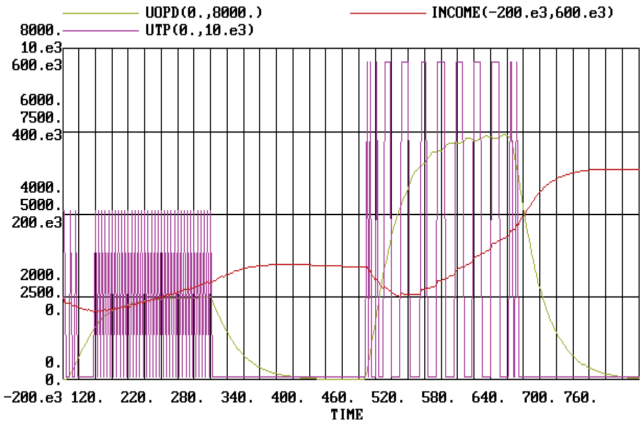
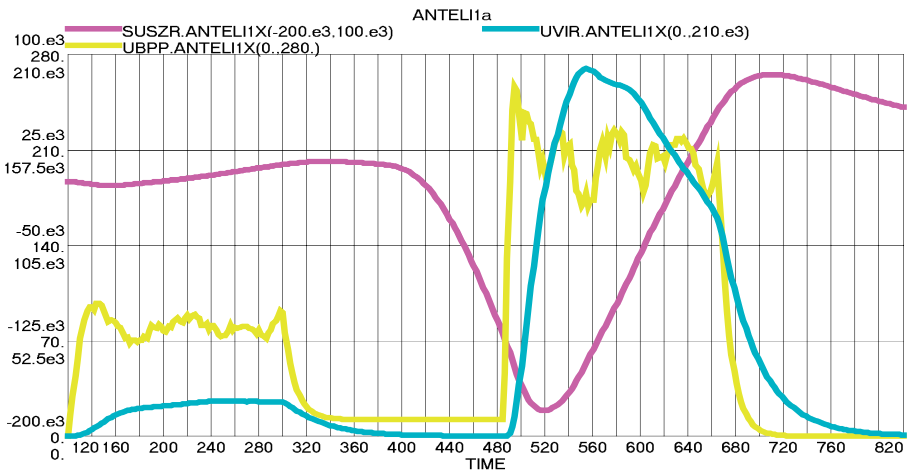
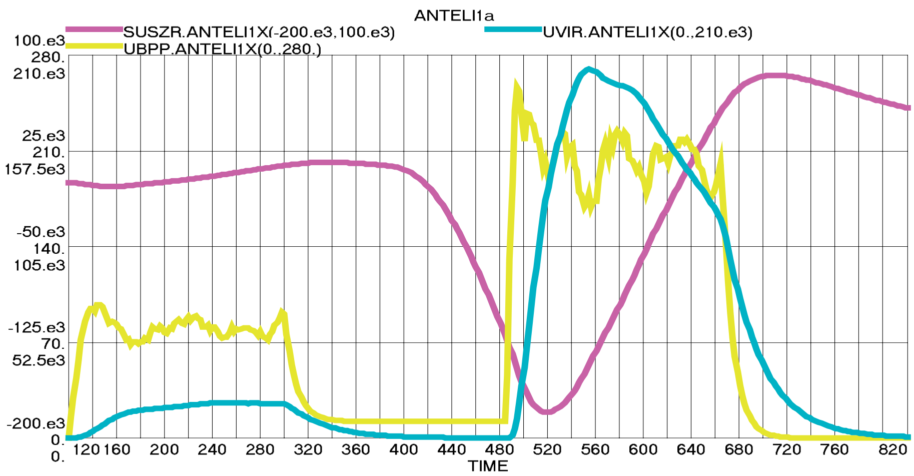


Figure 4: Graphic presentation of the of 0 scenario – variables UOPD, INCOME and UTP





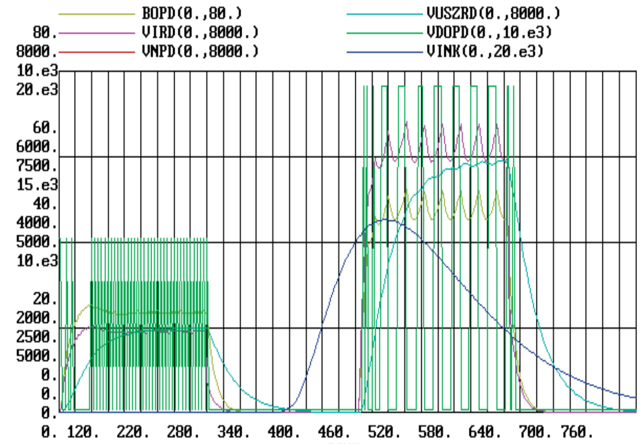


Figure 5: Graphic presentation of the of 0 scenario – variables BOPD, VIRD, VPD, VUSZRD, VDOPD and VINK

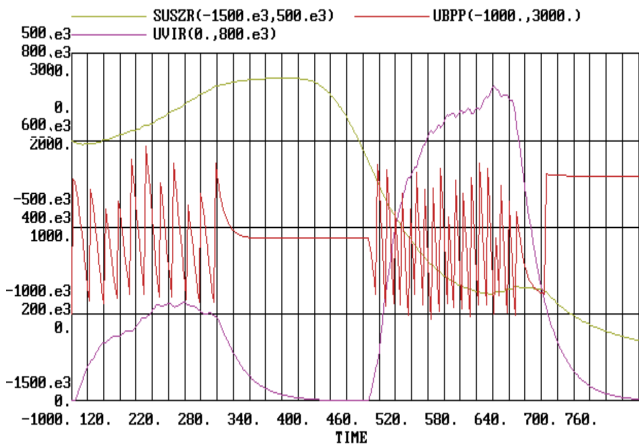


Figure 6: Graphic presentation of the simulation of 1 scenario – variables SUSZR, UVIR and UBPP

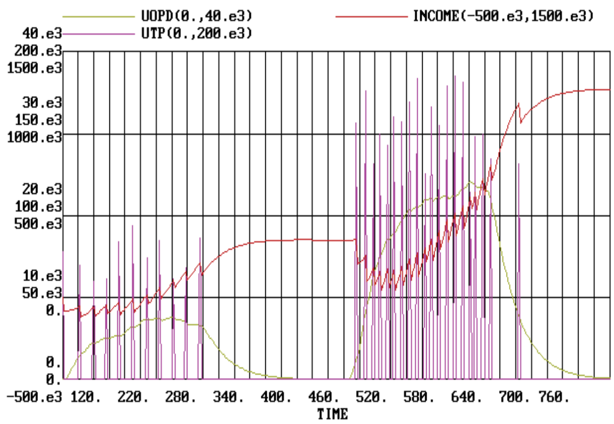


Figure 7: Graphic presentation of the of 1 scenario - variables UOPD, INCOME and UTP

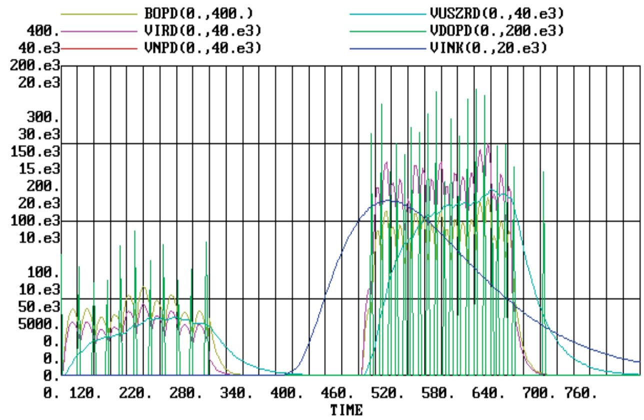


Figure 8: Graphic presentation of the of 1 scenario – variables BOPD, VIRD, VNPD, VUSZRD, VDOPD and VINK

NTBS as a unit within its surroundings.

The total number of registered vessels – UBPP, will in the first tourist season realise a maximum of 285 vessels, while in the following season, due to the gradual finishing of the investments into new capacities, or sport and other objects, the interest of the nautical tourists will increase, which will result in the increase of the total number of vessels, and thus the highest number of registered vessels, in total of 292 a day TIME=530. The characteristic of the number of vessels is stochastic.

The total realised income per day – UOPD, in the first tourist season will reach it's maximum of about 641 EUR per day, while in the following tourist season, due to greater offer of sports facilities, the income of 6,749 EUR a day (TIME=555 day) will be realised.

In the first tourist season, or the period of TIME=120 day to TIME=304 day, the income of the marina has a negative value (loss) with the greatest loss of 0.33 EUR a day TIME= 240, after which it becomes positive on the day TIME=304 to the new tourist season on the day TIME=486, and reaches its highest amount of 78,860 EUR a day on the day TIME=392. In the period of the following tourist season TIME=486, the income is negative, and it has the highest loss in the amount of -2,000 EUR a day on the day TIME=530. This loss will gradually decrease, and it will become positive again on the day TIME=542, and by the end of the second tourist season will remain positive, reaching its maximum value of 309,500 EUR a day on the day TIME=790.

In the first tourist season the total operating costs UTP are in their highest amount of 5,100 EUR a day on the day TIME=184, and have stochastic character. In the first off-season period UTP from the day TIME=302to the day TIME=485 they have their constant off-season value of 100 EUR a day, and cover all operating costs of the marina out of the season. In the second tourist season which starts on the day TIME=485, the costs grow to their maximum of 4,279 EUR on the day TIME= 492. In the second off-season period the costs have again the value of 100 EUR a day.

The state of the total assets in the giro SUSZR in the first part of the tourist season to the day TIME=195 have a negative value, with the maximum shortage of cash money of –2,902 EUR on the day TIME=156. Thus, from the day TIME=170 SUSZR becomes positive, realising the highest amount of assets of 86,050 EUR on the day TIME=364 and retaining that value for several days. Before the beginning of the new, second season on the day TIME=417 SUSSZR again becomes negative, because of new investments, and reaches its maximum of 2,118E3 EUR on the day TIME=519, after which it becomes positive again on the day TIME=631 the end of the simulation period.

The work was given second scenario in which we increase the number of vessels in the marina. The results of simulations are shown in pictures 6, 7, and 8. With the increase of vessels in a marine, the value of observed variables will increase.

The total realised income a day – UOPD, in the first tourist season will reach its maximum of about 758 EUR a day, and by the end of the second tourist season will remain positive, reaching its maximum value of 22,520 EUR.

The income of the marina has a negative value in beginning of scenario 1 (from TIME=120 to TIME=226), after that has positive values to end of scenario 1 and reaches its highest amount of 1,271E3 EUR a day on the day TIME=810.

In the first and second tourist season the total operating costs UTP has stochastic character, and first tourist season the total operating costs UTP are in their highest amount of 86,580 EUR a day. The second tourist season's highest amount of 183,600 EUR a day.

The state of the total assets in the giro SUSZR in the first part of the tourist season to the day TIME=158 have a negative value, with the maximum shortage of cash money of –20,790 EUR a day. After that it has positive value to end of the first tourist season. In the second tourist season SUSZR has a negative value.

On the basis of the comments of the results of NTBS, and in view of the two observed tourist seasons and the considerable investment with the aim of improving business as a whole, it may be concluded that the observed NTBS business system for such a scenario 0 and scenario 1 of the observed development period is stable and it gives positive financial results (revenues, income, solvency etc.) and total positive results in the observed period.

CONCLUSIONS

On the basis of the system dynamics research of the performance of the complex business system NTBS, with the aid of a fast digital computer on which the performance simulation was done, it is possible to bring forward a number of relevant conclusions:

1. A direct application of system dynamics simulation complex models in the field of scientific research of performance of nonlinear management systems has full rationalization, because it ensures to the model constructor an extremely suitable software medium which may be determined as intelligent models of the second generation, if the first generation refers to present expert systems.

2. System dynamics and its efficiency of intelligent modelling of a business system may be considered as a logic order of development of intelligent systems in the field of applying research of dynamics of cybernetic business systems.

3. System dynamics uses special methodology and special software packages, the most outstanding being: DYNAMO; Powersim, Stella, Vensim, and iThink.

4. System dynamics is especially convenient for the study of performance dynamics of business systems in which a great number of non-linear retroactive circles operate, or for systems where at operating the system the use of manager's intuition alone fails.

5. A special importance and quality of applying system dynamics in education, training, designing and exploitation of complex business management systems may be considered in acquiring new knowledge which classic management methods cannot offer.

On the basis of the above presentation, the authors of this paper recommend the implementation of system dynamics methodology tool into all fields of human activities with the aim of understanding various complex systems, in which the experiment cannot be performed in real life without jeopardizing their existence, growth and development.

The possible scientific contribution of this paper is primarily in authorised determining of general multiple simulation models which allow for acquiring new knowledge about dynamic performance of real nautical and tourist business systems, but also sports organisation systems. Also, in order to follow successfully the development of modern sports industry, the students of kinesiology need knowledge and skills in various areas, especially economy, management and marketing. By using the proposed tools and system dynamics simulation methodology, the students will acquire knew knowledge about performance dynamics of complex organisation systems in the field of tourism, sports and recreation.

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