

INTERACTIVE METHODS USED IN GRADUATE PROGRAMS

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Abstract: *Any professional act will lead to a significant change. How can one make students understand “managing change” as a consequence or as an intended objective? “DECISION IN CASCADE” – is a Management Computational Game for the Education of University Master Students and Junior Executive – simulates five economic functions: research and development, production, purchases and sales, personnel, finance and accounting of five to nine companies operating on a free market. The program package handles a data base of the modelled companies and provides reports on sales by types of markets, on the output of the company, personnel, raw materials in stock, production costs, innovation and research.*

Key words: Management game; stochastic simulation models; program package; research & development; production; purchases & sales; personnel; finance & accounting

1. Introduction

The management game "DECISIONS IN CASCADE" is using in teaching and development purposes of the future managers. This game is a sensitive instrument for measuring the cumulative effects of the decision sets, spread over time, concerning all the activities going on in the enterprise departments (research and development, production, purchase and sales, personnel, finance and accounting). This is a competition computational game. The number of the participant teams is request: (2 to 9 teams : implicit is 3).

The file JOC1.DBF contains the data bases from 9 enterprises and their economical results from 4 quarter. The game start with the quarter no. 5. (Please read BRIEF DESCRIPTION and HELP). After end of quarter no.4 all enterprises have the equal results. In this moment the game start. In run example the Enterprise no.3 at the end of quarter no.6 is bankruptcy. WHY?? Try to solve this problem. (Modify decisions and simulation for quarter no.5 and no.6.

Although the quality of a management simulation cannot only be determining by the number of the simulated function, most important is the question how these functions are integrated in the whole system of the game.

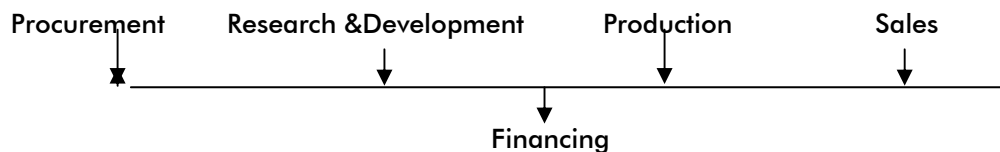
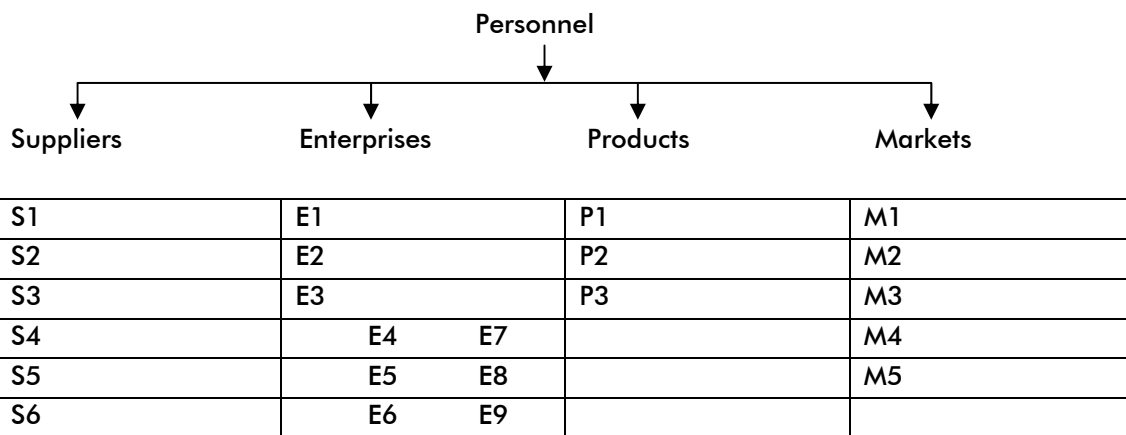
2. Game structure

The computer simulation into "DECISION IN CASCADE" management game is based on both deterministic and stochastic elements which can be reduced to the depiction of pure deterministic interdependencies in order to adapt to the education of the participants which of course may vary.

The integration of the economic functions in "DECISION IN CASCADE" is carried out with the help of two aspects:

- a) In the game, the situation of competition of five enterprises is simulated, and
- b) The enterprises are able to participate in five different markets.

We hope you will find this didactical software use-full and pleasant instrument.



3. Simulation models

"DECISION IN CASCADE" allows the simulation of three to nine enterprises which are competing in five markets with up to two products. The enterprises are represented by five groups which have the task of forming the management and make strategic decisions relative to the functions of the enterprise. The economic –mathematical models and the program package associated with it make it possible to study the evolution of the company as a system within a planning period (t+1). The simulate and quantify the effects of various decisions made within that interval. The data contained in the company data base show a normal performance to date of the respective company. The data offer information on: market potential, money assets, existing manpower, raw materials inventories, results of research and development, financial position of the modeled company the trainees are expected to manage.

The package contains the menu for HELP (trainer's manual and supplies), PARAMETRES (the number of teams, the language used, the type of printer etc.) HISTORY (enterprise evolution), DECISION, SIMULATION REPORT (the results of simulation), QUIT.

The program package contains five mathematical models in which all the relevant data (decision and data of data base) is integrated to evaluate the evolution of the companies as a system. In this context, the following simulation models are used:

a) Simulation model (deterministic) for production functions:

The modeled company develops, manufactures and sells products. The products are manufactured in a technological process that has two stages. In stage one the mixture is prepared, while in stage two the mixture is processed into finished products. Both production divisions have two groups of identical machines. Planning can be done by the following methods:

1. The quantities of products to be made are set up and accordingly the requirements of resources (manpower; raw materials; production capacities etc.)
2. Taking into account the various factors of the production proces,the lowest level resource (bottlenecks) is specified and then the quantity of products to be made is set up function of these bottlenecks.



Here are the main elements of the production process:

- Raw materials (there are seven types of raw materials which are acquired on a quarterly basis. Storing costs are charged, the storehouse capacity could be increased thought investments).
- Manpower (there are three categories of personnel available to operate four type of manpower for each type of machine is sought, expressed as a percentage of the total number of employees; existing manpower can be trained and upgraded).
- Finished products, these are defined according to: product name, specific raw materials consumption per unit, productivity (number of units/hour), product quality expressed through numeric values assignment to each of the product attributes (color, design, appearance, etc.);
- Production capacities (for groups of machines , two by two identical – each machine has an input, an output and a transfer function);
- Production Plan for machine groups (product quantity/machine (PQ)) is calculated to the formula:

$$PQ = T_{ef} * W$$

Where T_{ef} is actual running time (total time minus time for maintenance) and $W =$ machine productivity (units/hour).

b) Simulation models (stochastic) for research and development

Activity for research and development Fixed assets: 4 groups of machine, storehouses of raw material, semi-finished products, finished products enterprise buildings . During the game, it is possible to change the layout of machines, to extend the warehouses or to build new buildings.

The modeled company owns fixed assets as follows: company buildings; four groups of machines to produce semi-finished and finished products; ware-houses for raw materials, semi-finished and finished products. During the game, it is possible to replace machinery, to expand storage and build new buildings (houses, canteens, kindergartens etc.) . Research work will be performed on contract by specialized institute. The value of research work outcome depends on the allocated funds (the qualitative parameters of new product are available in the research report supplied by the program package) The new product can be phased-in immediately, and its is possible to advertise for it.

c) Simulation model (stochastic) for personnel activity:

In the course of the game various personnel activities can occur such as: hiring, leaving for another enterprise, scheduling holidays, updating courses by groups of workers. The duration of a worker's holiday is 3 weeks a year; The holiday is given compulsorily and it is entered in the decision form as follows: 1 worker is on holiday for 3 weeks; there are 12 weeks in a quarter, therefore value 1 entered in the form means that 4 workers were on holiday in that quarter; In the modelled enterprise if a worker does not go on his holidays in due time (1 year since the date of the previous holidays) he is automatically transferred to another unit; Any increase in the number of workers during a quarter cannot be more than maximum 10 % of the number of workers in a group; Overtime is paid according to a differentiated criterion; There are inter-conditionings in distributing the workers to be hired (an increase in worker's number in one enterprise is detrimental to another enterprise; i.e. the number of the latter decreases). Hourly wages by groups of workers is the same as in the previous period.

| RESULTS OF THE ENTREPRISE1 | | QUARTER: 4 | | |
|----------------------------|---------------|-----------------|--------------|--|
| PERSONNEL | SKILLED WORK. | SEMI-SKILLED W. | UNSKILLED W. | |
| NO IN THE LAST QUARTER | 178 | 199 | 232 | |
| NEW EMPLOYEES (PRS) | 14 | 14 | 8 | |
| INCREASE ON PROMOTION | 0 | 0 | 0 | |
| DECREASE ON PROMOTION | 0 | 0 | 0 | |
| RESIGNED | 0 | 0 | 0 | |
| PRESENT NO OF WORKERS | 192 | 213 | 240 | |
| ON TRAINING (PRS) | | 5 | 5 | |
| ON HOLIDAY (PRS) | 12 | 7 | 7 | |
| WORKING STAFF | 180 | 201 | 228 | |

The company can hire and fire personnel, can grant rest leaves and can upgrade groups of personnel. The increase in the number of personnel during one quarter cannot exceed 10 percent of the total number of personnel existing in three groups. There are internal policies regulating the hiring of manpower by each of the two to nine companies. The labour situation (actual employees and potential employees) is very sensitive to the conditions offered by each company (wages, rest leaves, upgrading courses, social welfare, housing, canteens, kindergartens, rate of extra time pay, financial position of the company). A change in these parameters will make manpower migrate from one company to another. The management council must provide the necessary conditions to stabilize and attract manpower).

d) Simulation models (stochastic) for purchase and sales

The models associated with sales involved competition. Each company distributes its products to four categories of markets. Selling prices are different in the four different types of markets and are fluctuating freely. Finished products are delivery for four categories of markets: Home Markets; ZONE I, ZONE II; ZONE III. Selling prices are differentiated by the four categories of markets and have the same value as in the previous period; Total demand is at random and it is influenced by marketing (advertising, prices, market information) and seasonal factors. Sales stochastic model (interactive). Advertising effect is not direct, but it has a dynamic evolution in a longer interval of time. Storing and transport costs are shown by trainer.

| RESULTS OF THE ENTREPRISE IN THE MARKET(TRANSPORT-SALE-INVENTORY) | | | | | |
|---|------------|---------------|----------------------------|------------------------|-------------|
| TYPE OF MARKETS | | STOCK INITIAL | TRANSPORT FROM FACT. STORE | TRANSPORT FROM FACTORY | STOCK FINAL |
| HOME : | PRODUCT A: | 82200 | 0 | 46667 | 58333 |
| | PRODUCT B: | | | 22800 | |
| EXPORT ZONE I: | PRODUCT A: | 91000 | 0 | 46667 | 88233 |
| | PRODUCT B: | | | 43900 | |
| EXPORT ZONE 2: | PRODUCT A: | 30000 | 22800 | 46667 | 39033 |
| | PRODUCT B: | | | 32900 | |
| EXPORT ZONE 3: | PRODUCT A: | 19500 | 13900 | 49913 | 16387 |
| | PRODUCT B: | | | 32900 | |
| FACTORY STORE | | 36700 | | 54800 | 54800 |
| PRODUCTION <> DISTRIBUTION: PLEASE CORECTION IN THE DECISIONS(part 2) | | | | | |

The management councils set prices according to the distribution policy they wish to adopt for each market segment. Total demand in every market (market potential) is available and is influenced by marketing efforts (advertising, level of price, information on the market) and by season factors. The associated economic- mathematical model is a stochastic model. The amount of products sold to various market sectors depends on the company's market effort, on quality of products as well as a probability factor expressed by a coefficient close to the one which represents a random factor of the market. The effect of advertising is not immediate. It has a dynamic evolution in the following intervals (quarters).

f) Simulation model (deterministic) for finance and accounting activity:

The financial operations of the 2 to 9 companies modeled in the game are performed automatically by the program package. A part of the financial operations are executed by the program (e.g. payments, quarterly balance sheet, expenditure balance sheet by product); Quarterly production expenditures (costs) include direct production costs and overhead charges of the period; The difference between the value of sales and the costs represents the benefit, or losses, if the case. A profitable enterprise may not, at a certain moment, be able to settle its payments. In such circumstances the bank grants a loan at 4 % interest. At the end round of the game (decision- making period equal three mounts) the profit for every company is calculated. Any company may, at a certain moment, be unable to make payments. In such cases a loan can be granted by bank. Each company can obtain a loan only twice throughout the duration of the game. Repeated negative results cause bankruptcy. All data referring to the state of each modelled company for every quarter are stored in the data base of the program package. This enables the analysis of results obtained from running the decisions made during each round and the correction of decision with long term effects. The decision-making parameters of the game, grouped by functions of the modelled company are as follows: Production (36 parameters); Distribution (30 parameters); Research and Development (3 parameters); Personnel (28 parameters); Finance and Accounting (16 parameters).

g) Simulation period

The simulation of a period begin with a phase of decision-making by the three to nine groups [enterprises]. These decisions can be fed directly into the computer or be formalized in writing on a decision sheet and be handed to the director.

| EVALUATION OF THE ENTREPRISES | | | |
|-------------------------------|-----------|-----------|-----------|
| | ENTREP. 1 | ENTREP. 2 | ENTREP. 3 |
| PRODUCTION | 166667 | 166667 | 166667 |
| PERSONNEL (TOTAL) | 555 | 555 | 555 |
| ♦ SKILLED WRK. | 164 | 164 | 164 |
| ♦ SEMI-SKILLED WRK. | 174 | 174 | 174 |
| ♦ UNSCHILDED WRK. | 217 | 217 | 217 |
| SALE (TOTAL) | 175900 | 175900 | 175900 |
| ♦ HOMA MARKET | 57100 | 57100 | 57100 |
| ♦ EXPORT ZONE I | 57100 | 57100 | 57100 |
| ♦ EXPORT ZONE II | 37800 | 37800 | 37800 |
| ♦ EXPORT ZONE III | 23900 | 23900 | 23900 |
| stocuri prod.finite | | | |
| ♦ HOMA MARKET | 40000 | 40000 | 40000 |
| ♦ EXPORT ZONE I | 40000 | 40000 | 40000 |
| ♦ EXPORT ZONE II | 40000 | 40000 | 40000 |
| ♦ EXPORT ZONE III | 40000 | 40000 | 40000 |
| ♦ depozit | | | |
| RAW MATERIALS STOCK | 0 | 0 | 0 |
| PROFITS | 3425167 | 3435667 | 3435667 |

One version allows at the same time a "pre-simulation" of decision that are taken, which then can be taken over by the director for the actual simulation. Before the director starts the simulation , he has possibility to inspect the decisions of the groups for the current period and modify the economic conditions. The simulation can be started. At the end of each period the enterprises received reports.

3. Reports

The report handed to each at the end of each period contains approximately 12 pages. They can be printed or viewed on the screen. The report is organised as follows:

- report of purchase and stock
- a report of production, haulage and stock for finished products
- a report of research and development, if necessary with suggestions for a product-variation or innovation
- market statistics
- required information on market
- report of personnel
- report of cash flow
- contribution margin accounting per product
- profit and loss account
- a balance sheet

In the following table shows all functions that can be found in MANAGER

| | |
|--|---|
| 1. business functions | Procurement; Sales, Research and Development Production, Finance, Personnel |
| 2. way of proceeding | Deterministic, stochastic, interactive |
| 3. number of participants | Max. 30 in five groups |
| 4. maximum number of simulated periods | 15 periods (one period represent one business quarter) |
| 5. number of decision parameters | For participants :125 per period For director : 52 per period |
| 6. Pre-simulation | Possible with the help of player version |
| 7. data capture | With the help of decision sheets or player disks |
| 8. EDP – equipment | Minim 1 PC with printer , when operating with player version: 6 PC's with printer |
| 9. target group | Junior executive, university students majoring in business economies (from 3 rd year on) |

4. Technical aspects

“ DECISION IN CASCADE” requires an IBM-compatible PC, WINDOWS version system and a hard disk. The operation can be done with the help of the mouse. There are menus and input [templates] and explanation [help] function. For the implementing of the program, CLIPPER , a programming language, was used.

5. The strategic value of gaming simulation:

What is the purpose of the game? What are the risks for education? What educational value does gaming simulation acquire in the process of education when it highlights the hazard significance of decisions? How does gaming simulation relate not only to the theory – and therefore the probability theory – but also to the entrepreneurship theory, to the studies on learning, to the educational technologies, to virtual realities?

The management game has two attributes: co-operation and individual education. Co-operation, which stands out as the winning strategy in competition games. Individuality of education: if each person has to have a particular individuality, as it happens in the case of role playing. It means that the value of the human person and his right to self-determination must be recognised. So, not only must we have teaching imparted through gaming simulation, but also education, meant as an interactive relationship between those who know and those who have to learn.

Reports, in the forms of display or listing, are produced in Romanian, English, French, and file text can be translated in any language. The package is accompanied by a work kit consisting of: trainer's manual, managing team manual, listings on the evaluation of companies, forms for filling un the decisions.

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¹ Curently Virgil Chichernea is full professor and dean at Management Information Department within the Romanian American University, Bucharest. He is the author of more 20 books and over 90 journal articles in the field of e-learning; mathematical modeling, object oriented design; simulation models and decision theory.

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He has coordinated over 20 research projects and provided technical assistance for many economic information projects.