

# The Application of Computational -Management Game Metodology to Graduate Business Education

Virgil Chichernea

Faculty of Computer Science for Business Management,  
Romanian –American University, Bucharest, Romania

## ABSTRACT

In universities, into many of the cases and management games, companies and situations are outdated. Therefore, it would seem appropriate to introduce a new methodology, *live computational-management games & case studies*. A live computational-management games & case studies allows students to examine real companies with real problems in real time. The ability to apply learned skills during their educational experience is essential in a competitive world. When students learn how to define issues, they begin to determine what is critical. The live computational-management games and their ensuring discussions allows them to further examine the ever changing management process. Within the Curriculum of several Master's Degree programmers students have as object of study „DECISION SUPORT SYSTEMS“ whose main goal is shaping economic mathematical thinking ( based on the three- fold approach: Problem Forms – Pattern Design- Identifying the Algorithms and Program Packages for Solving the Propose Issue) of future users and specialists in the economic field.

## 1.BUSINESS GAMES IN MANAGEMENT DEVELOPMENT

„ DECISIONS IN CASCADE“ is a decision-making business game conducted with the assistance of a computer. The game outlines the main correlations existing among the various departments in a company and simulates the evolution of a company as a system. The evolution of the company is the outcome of decisions (numeric values) proposed by the

managing team (management council) for all entreprise functions.: The production function; Research and development activities; Personnel activity; Distribution activity and Finance and accounting activity. The trainees (participants in the game) can be grouped in a number of 2 to 9 management councils whose task is manage the 2 to 9 companies modelled in the game for planning period (years/quarters). During a round, the team (management council) has go through a full „analysis-decision-follow up-evaluation“ decision making cycle, as follows:

- analysis of the modelled company evolution until the present moment;
- preparation and making of decisions on planning of all the activities in the modelled company for the following period ( $t + 1$ );
- follow-up of the modelled company performance in the interval  $t + 1$ ;
- evaluation of effects produced by the decisions that have been made, correction of decisions and proceesing to a new decision making cycle (a new round of the the game to a new decison in which decisions are made for the following quarter).

The economic-mathematical model and the program package associated with it make it possible to study the evolution of the company as a system within a planning period ( $t+1$ ).They simulate and quantify the effects of various decisions made within that interval.

During the past four quarters, the companies participanting in the game have performed almost identically. The data contained in the company data base show a normal performance to date of the respective company. The data ofer information on: market potential, money assets, existing manpower, raw materials inventories, results of research and

development, financial position of the modelled company the trainees are expected to manage.

In order to ensure a certain continuity of the whole modelled process and facilitate the understanding of the simultaneous running of activities going on in parallel (see purchasing – production – sales correlation) it is important to define their evolution in time. Raw materials are ordered during quarter 1. They are delivered after a three month interval and, therefore, production can start in quarter t+1, using the raw materials delivered. Finished products are manufactured during the t+1 quarter and at the end of the quarter they may be stored in the company warehouse, or storehouses for four types of markets. Those products can be sold during the t+2 quarter. Each function of the enterprise has been modelled by means of deterministic economic-mathematical models (for the production and finance – accounting functions) or of stochastic models (for the personnel, distribution, research & development functions).

### The production function

The modelled 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. 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 through investment);
- Manpower (there are three categories of personnel available to operate four types of machines (varying degrees of skill); an optimum structure 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 ungraded);
- 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 assigned to

each of the product attributes (color, design, appearance, etc.);

- Production capacities (four 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 (CP) is calculated according to the formula:

$$CP = Tef * W = Tef * Pp * Pm * M * K$$

Where:

Tef = actual running time (total time minus time for maintenance);

W = machine productivity;

Pp = product productivity;

Pm = machine output;

M = manpower structure allocated for each machine;

K = maintenance productivity (amount of time necessary for maintenance increases as the machine gets older and as its wear increases);

RESULTS OF THE ENTREPRISE QUARTER: 4				
PRODUCTION:	MACHINE 1	MACHINE 2	MACHINE 3	MACHINE 4
SEMI-FIN. PROD. "A"(P)	10050	10050	-----	-----
SEMI-FIN. PROD. "B"(P)	0	0	-----	-----
FINISHED PROD. "A"(P)	-----	-----	94184	117957
REJECTS A	-----	-----	-----	400
FINISHED PROD. "B"(P)	-----	-----	0	0
REJECTS B	0	0	0	0
TOTAL TIME(H)	80994	81637	75505	94564
USEFULL TIME(H)	68845	69391	64180	80379
WAITING TIME(H)	12149	12246	11326	14185
UNUSEFULL TIME(H)	327	874	-4338	11861
OVERTIME (HRS)	4050	4082	3775	4728
MACHINE CAPACITY (H)	90000	90000	90000	90000
MACHINE EFFECTIVENESS	1.20	1.20	1.20	1.20

It should be noted that the technological process allows for storing of raw materials, semi-finished and finished products. Storage is limited and, therefore, for quantities above a certain limit a storage charge must be paid (expressed in monetary units/unit of product). Quality inspection (if no funds are allocated for quality inspection, no rejects are expected, but demand for the product is likely to fall). The finished products are transported to the warehouses.

### Research and development activities

The modelled company owns fixed assets as follows: company buildings; four groups of machines (two to produce semi-finished products and two to produce finished products); warehouses for raw materials, semi-finished products and finished products. During the game, it is possible to replace machinery, to expand storage and to 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 the new product are available in the research report supplied by the program package). The new product can be phased – in immediately, and it is possible to advertise for it.

### Personnel activity

The company can hire and fire personnel, can grant rest leaves and can upgrade groups of personnel. The increase in number of personnel during one quarter cannot exceed 10 percent of the total number of personnel existing in the three groups. There are internal policies

RESULTS OF THE ENTREPRISE IN THE MARKET(TRANSPORT-SALE-INVENTORY)					
TYPE OF MARKETS	STOCK INITIAL	TRANSPORT FROM FACT. STORE	SALE	TRANSPORT FROM FACTORY	STOCK FINAL
HOME : PRODUCT A: PRODUCT B:	82200	0	46667	22800	58333
EXPORT ZONE 1: PRODUCT A: PRODUCT B:	91000	0	46667	43900	88233
EXPORT ZONE 2: PRODUCT A: PRODUCT B:	30000	22800	46667	32900	39033
EXPORT ZONE 3: PRODUCT A: PRODUCT B:	19500	13900	45043	32900	21257
FACTORY STORE PRODUCTION <> DISTRIBUTION:	36700			56800	54800
PLEASE CORRECTION IN THE DECISIONS(part 2)					

regulating the hiring of manpower by each of the two to nine companies. The labor situation (actual employees and potential employees) is

RESULTS OF THE ENTREPRISE3 QUARTER: 4			
PERSONNEL	SKILLED WORK.	SEMI-SKILLED W.	UNSKILLED W.
NO IN THE LAST QUARTER	178	199	232
NEW EMPLOYEES (PRS)	15	14	9
INCREASE ON PROMOTION	0	0	0
DECREASE ON PROMOTION	0	0	4
RESIGNED	0	0	0
PRESENT NO OF WORKERS	193	213	237
ON TRAINING (PRS)		6	6
ON HOLIDAY (PRS)	12	7	7
WORKING STAFF	181	200	224

very sensitive to the conditions offered by each company (wages, rest leaves, upgrading courses, social welfare, housing, canteens, kindergartens, rate of pay for extra time, 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.

### Distribution activity

The model associated with the distribution activity in this management game involves competition. Each company distributes its products to four categories of markets (domestic, Eastern-European, industrially development, and others). Selling prices are different in the four different types of markets and are fluctuating freely. The management council set prices according to the distribution policy they wish to adopt for each market segment. Total demand in every market (market potential) is variable and is influenced by marketing efforts (advertising, level of prices, 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 marketing effort, on the quality of products as well as on a probability factor expressed by coefficient close to one which represents the random factor of the market. The effect of advertising is not immediate. It has a dynamic evolution in the following intervals (quarters).

### Finance and accounting activity

The financial operations of the 2 to 9 companies modelled in the game are performed automatically by the program package. At the end of each round in the game (decision-making period equal to three months) 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 the 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 game each round and the correction of decision with long terms effects. The decision-making parameters of the game, grouped by functions of the modelled company are as follows: Productions (36 parameters), Distribution (30 parameters), Research and development (3 parametres), Finance and Accounting (16 parameters).

FIN. GOODS PROD. COSTS:			
FINISHED GOODS:	PRODUCT A	PRODUCT B	TOTAL
VALUE OF THE BEGINNER STORE	21629480		
WAGES	2036930		
VALUE OF USED SEMI-F	9049500		
GENERAL FACTORY COST	926141		
COST OF PRODUCTION	12012571		
VALUE OF SOLD FINISHED GOODS	58206144		
VALUE OF SALEABLE GOODS	29911881		
NOT DIVISIBLE COSTS	1495594		
COST OF TRADE	118000		
ADVERTISING	560000		
TRANSPORT	540500		
NEW EMPLOY.COST	150000		
TRAINING	84000		
COST OF RESEARCH	140000		
TOTAL COST OF PRODUCT.	15100665		
SALES RECEIPTS OF PRODUCT.	18014277		
PROFIT	2913612		

Belloow is a brief presentation of GAME PACKAGE, pointing out specific decision-making elements.

## 2. „DECISIONS IN CASCADE“ PACKAGE

**2.1. Program name :** “ DECISIONS IN CASCADE ” - (GAME.EXE)

**2.2. Short description:** The package simulates the evolution of 2 to 9 companies as a ssystem , using data base of game companies and the trainees decisions.

DECIZIILE INTREPRINDERII				
LABOUR	SKILLED WORKERS	SEMI-SKILLED	UNSKILLED	
NEW EMPLOYEES(PRS)	16	16	10	
DISMISSAL(PRS)	0	0	0	
TRAINING(PRS)		6	6	
HOLIDAY(PERSONS)	12	7	7	
WAGES PER HOUR(U.M.)	14.00	11.20	9.00	
PRODUCTION	MACHINE 1	MACHINE 2	MACHINE 3	MACHIN
PLANNED PROD.:SEMI-FIN. "A"(P)	10000	12000		
PLANNED PROD.:SEMI-FIN. "B"(P)	0	0		
PLANNED PROD.: FINISHED PR. "A"(P)			10000	12000
PLANNED PROD.: FINISHED PR. "B"(P)			0	0
MACHINE MAINTENANCE (U.M.)	5000	5000	5000	5000
SKILLED WORKERS(%) /MACHINES	25.00	25.00	25.00	25.00
SEMI-SKILLED WORKERS(%) /MACHINES	20.00	30.00	20.00	30.00
UNSKILLED WORKERS(%) /MACHINES	20.00	39.00	25.00	25.00

CORRECTIONS(Y/N)? N

**2.3. Disciplines the program** is mainly used in business administration;economics

**2.4. Software type :** Tool for learners

**2.5. Keywords:** educational simulation; educational software; training software

**2.6. Languages of the package program:**

DECISIONS OF ENTREPRISE NO:(part 2)									
MAXIMUM OVERTIME(%)	5.00	COST OF QUALITY		10000	COST OF RESEARCH		140000		
RAW MATERIALS ORDER	A	B	C	D	E	F	G	H	
	400000	400000	400000	400000	400000	400000	400000	400000	
TRANSPORT PRODUCE	HOME	EXPORT		ZONE 1		ZONE 2		ZONE 3	
	A	B	A	B	A	B	A	B	STORE F
FACTORY D	0	0	0	0	22800	0	13900	0	
FACTORY	22800-39677	43900	0	32900	0	32900	0	54800	0
ADVERTISING	20000	0	130000	0	160000	0	150000	0	
SELLING PRICE	98.40M	0.00	95.60	0.00	98.20	0.00	97.20	0.00	
COST OF MARKET INVESTMENT DECISION	8000		10000		40000		60000		

CORRECTIONS(Y/N)? N

FOXPRO; Languages of the help texts: ENGLISH, FRENCH, ROMANIAN; Languages of the manuals: ENGLISH, ROMANIAN

**2.7. Hardware configuration:** PC; Operating systems: Windows; Storage medium: Medium, on which the software is delivered) DISKETTE OR CD

## 2.8 Installation routine:

- Create a STUDY directory on your hard disk; Copy all files from GAME DISKETTE to this directory; Start GAME.EXE (c:\study\game.exe <CR> and <CR>); Number of Enterprise: 3 <CR> (for test purposes);
- Read BREA F DESCRIPTION ( Select this option <CR>); Select language of output reports;<CR>); Select HELP option (User's manual);<CR>); your enterprise has no.3; Select HYSTORY/EVOLUTION and studding the evolution of the Enterprise. no.3 in the quarter no.5,6,7,8 or 1,2,3,4 - using the menu; The Enterprise no.3 after quarter no.8 is Bancroft. Why? . Please solve this problem.
- Select DECISIONS option and update your decision (corrections) or new decisions; Select SIMULATION option <CR>, and run for quarter no. (see menu);

- Select RESULTS option and study simulation results; Repeat the same steps for each quarter;
  - Select EVALUATION for final evaluation;
  - QUIT out of the package;
- NOTE: It is possible various sceneries: ( for e.g.: competing between 2 to 9 teams; competing between expert-computer, etc)

**2.9. Summary description:** 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 & development, production, purchase and sales, personnel, finance and accounting). The students make decisions by typing inputs into PC/AT, programmed with a series of interacting mathematical models. The trainees make decisions and package simulates the evolution of companies as a system using data base of game companies and provides output reports ( market, production, sales, raw materials, costs). This game is used for training purposes in management development courses ( graduate or post graduate level).

**2.10. Program description:**

a) This package ("DECISIONS IN CASCADE" - MANAGEMET GAME) is used for training purposes in management development courses.

b) The game outlines the main correlations existing between the various departments in a company (research and development, production, purchase and sales, personnel, finance and accounting) and simulates the evolution of the company as a system;

c) The evolution of the company is the outcome of decisions ( numeric values) proposed by the managing team. Each team control over a number of decision variables (about 110 variables) which determine its success or failure in competing with each other. During the past four quarters, the companies have performed almost identically. The teams have take decisions for next periods ( the quarters no. 5,6,7,8...). As the game progresses participants make multiple runs of one or more years (quarters) and output reports help them in

orienting and understanding management activities.

d) After learning the rules of the game (See user's manual - HELP) the students make decisions and typing them into PC/AT, simulation and obtain the output reports.

e) The output reports are: MARKET, PRODUCTION, SALES, RAWMATERIALS, COSTS and list of DECISIONS by each quarter.

f) The management game has two attributes: co-operation and individual education.

g) Reports, in display or listing forms, are produced in English, French, Romanian, and file text (DIC.DBF) can be translate in any language ( e.g. in DIC.DBF is in German).

**REFERENCES**

[1] Lowley, D.N. and Maxwell, A. E. **Factor Analysis as a Statistical Method**, Butterworths,1996

[2] Chichernea V. „**DECISION IN CASCADE“ Game in Management Training**, WACRA Eleventh International Conference, Montreal, Canada, June - 1994

[3]Annual International Conference - Operations Research. **GMOOR** Physical – Verlag A Springer-Verlang Company

[4]Chichernea, V. **Sisteme informatice in economie**. Editura Sylvi, 2001

[5]Chichernea V. **Information Systems &Operations Management**, Workshop, Editura Universitara, 2004-04

[6][www.rau.ro](http://www.rau.ro)