Management Games for Group Decision Making in a Dynamic Environment

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Abstract

Management games are very powerful teaching and training devices which, however, sometimes suffer from a direct and usually one-to-one interaction between the player and the model.

The paper presents a management simulator for decisions occurring during the innovation process. Several groups of players represent the boards of directors of virtual enterprises, that compete with each other. The computer model serves only as a clearing device to coordinate the decision consequences on the supply side and on customer demand.

Technically, the game is based on a simulation model written in Professional Dynamo. It has an interface for the preparation of the simulation results and the communication with the players, that was realized using Microsoft Excel.

A simulation model for generating data for management gaming must comprise a realistic structure and stable policy rules. The players should be able to use their professional knowledge and their business experience. The computer-model in the paper represents a microworld for testing different strategies, to experience different forms of behavior, and for improving the understanding of the consequences of decision making in a dynamic environment.

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THE STRUCTURE OF THE MANAGEMENT GAME

GAMING IN MANAGEMENT EDUCATION

The game discussed in this paper is designed as a training device for managing innovation processes. Innovation management requires decisions with fundamental importance for the competitiveness and the long term viability of an enterprise. Decision making at this level of complexity cannot be automated, but it is possible to support it by means of formal models and computer based systems. Management games have this very objective. Through the artificial reality of applied causal models, a thorough learning process can be initiated. The expected benefits of such an endeavor justify the substantial efforts required. The interactions with computer simulation models allow insights into the behavior of systems. The gaming approach to management education and training combines the abstract investigations of theoretical science and the practical research of laboratory experiments. It constitutes a third pillar for progress toward more rational decision making.

Innovation management is seen as a learning process about the system and its environment. Insights into the dynamics of the system under investigation, no forecasts nor predictions, are the objective of such a task. Through the process of iterative cycles of "playing", the intrinsic properties of the problem will be better understood. An *a priori* experience for the actual course of actions will be gained in the virtual reality of the game (Milling 1990).

To meet these ambitious objectives, a management gaming simulator should foster training in three areas:

- Improve decision making;
- Teach Systems Thinking;
- Encourage Cooperative Learning.

Decision making under time pressure is a daily managerial routine. Due to the real life consequences of the actions taken, usually no rehearsal of this process is feasible. In spite of the vital importance of their policy choices, management and especially senior management acts always "on line". On the job training, learning by doing or by trial and error are hardly possible. Available and proven techniques from information gathering to decision assessment and evaluation can only seldom be acquired and tested without immediate and very real repercussions. Here, management gaming provides a very useful setting, especially for group decision making (Scheper 1991). All actions taken occur in the virtual reality of a computer model only. Trainee activities, like the mentioned on the job training, etc., highlight the potential benefits of the approach.

A simulation model for generating data for a management game must comprise a realistic structure and stable policy rules. The players should be able to use their professional knowledge and their business experience, and thus, the model should be „tolerant" enough to accept a broad spectrum of input values without generating unrealistic modes of behavior. There are, however, limits for the quantity of information the players can handle. They should be able to understand the sometimes complex relationships between the decisions and the reaction of the model.

In the context of a management game, the typical chain between observed state of the system, decision and action is intersected; the players interfere with the model. They receive and analyze the

model output, discuss different courses of action, decide on one and implement it. Then the model takes over again and continues the circle. Figure 1 shows this relationship.

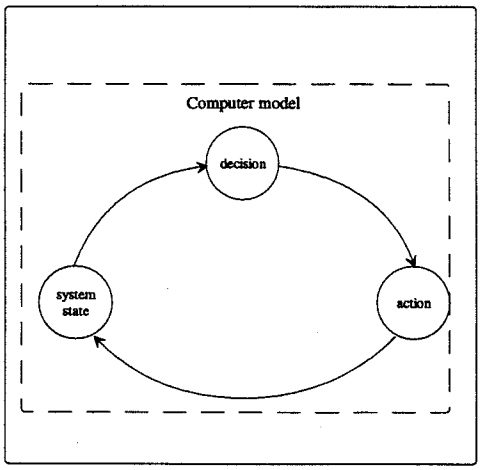

Fig. 1a: Causal Loop between the Variables in a Standard Simulation Model

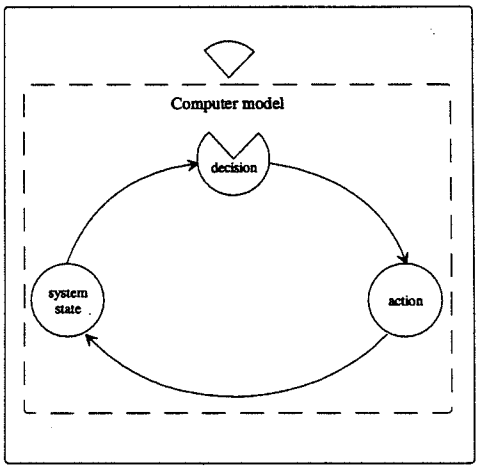

Fig. 1b: Causal Loop between the Variables in the Management Simulator

A MICROWORLD FOR INNOVATION MANAGEMENT

The basic modules of the Innovation Management Simulator represent the diffusion of innovations in the market and several structural identical industrial corporations, competing for the same group of potential customers. To reduce the complexity and to focus on the problems of substitution between different generations of innovative products, the model is limited to only one market.

Four groups of players emulate the boards of directors of virtual enterprises, that compete with each other (Figure 2). At the beginning of the game, all corporations have a product with the same level of technological sophistication and with the same market share. In the course of time, the firms can develop new generations of products which compete with the different technological generations in their own Portfolio and those of other firms. R&D resource allocation and the timing of market introduction, investment and production planning, cost management and pricing policies, product quality and delivery delays are key control variables in these processes.

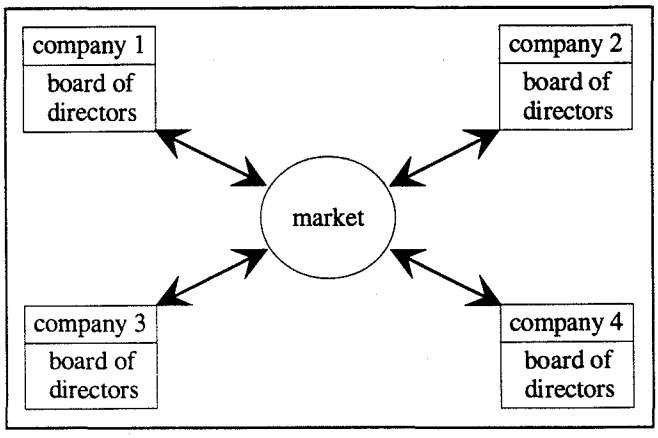

Figure 2: Modules of the Simulation Model

During the game, each group of players is confronted with interrelated decision making requirements, and it is difficult to understand how they interact and how the whole system will react. To improve the performance, the group must identify and collect relevant information. The team members must derive alternative courses of action and evaluate their expected consequences. A feeling for complex system behavior should be gained (Vennix 1990).

Successful corporate management requires specialization, the separation of tasks, which finally lead to "Taylorism", and the delegation of decision making. But the same developments bear the risk of failure through uncoordinated activities; management becomes futile without coherent and unambiguous action. Especially in the dynamic environment of innovation management this (potential) gap between isolated operations and coherent strategy has to be closed. Team or Cooperative Learning is necessary to define and to achieve the overall corporate objective (Senge 1990; Argyris 1990). Management games work as catalysts in such a process of group decision making. They counteract narrow specialization, lead to improved communication between different corporate functions, and encourage the identification and the pursuit of shared values and overall objectives.

The diffusion model is based on the "innovator-imitator" approach as developed by Bass (1969) and others. It was substantially extended for the purpose of the game, especially through competition between different corporations and between different generations of technology over time. Demand depends, among other factors, on the level of technical sophistication, price, marketing and supply capability (Figure 3).

Because of the interdependencies among the competitive factors, model complexity is quite high and the effect of a single measure, as a reduction in price, cannot exactly be forecasted by one group without the knowledge of the decisions from all other groups.

The corporation modules were designed using the array function capability of Professional Dynamo 3.1, which lead to an identical structure for all four firms.

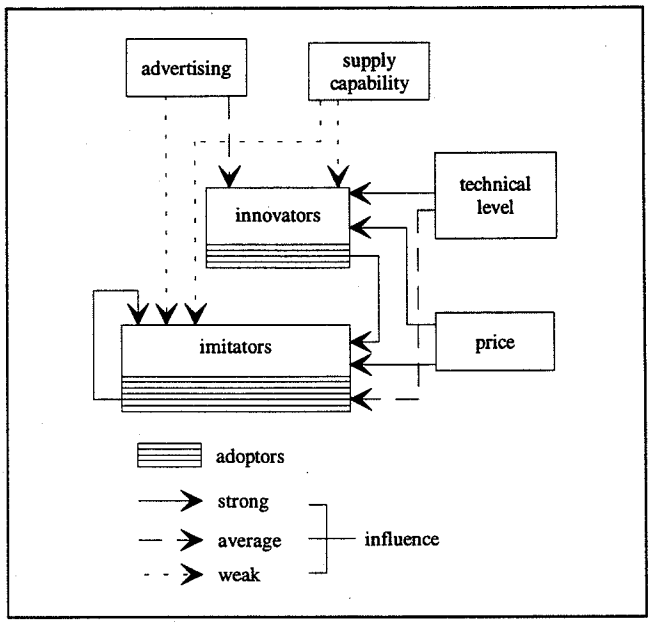

Figure 3: Coarse Structure of the Market Module

A firm, as it is represented in the model, consists of the sectors Research & Development (R&D), production, advertising and accounting. The emphasis of game is on the innovation process, which can be influenced by the financial resources and the scientists working in R&D. The results of this sector lead to improved products, completely new product technologies and/or improved production technologies. The potential volume of production depends on the work force, its experience with the different product generations, and the level of the available production technology,etc. Figure 4 shows the structure of a corporation.

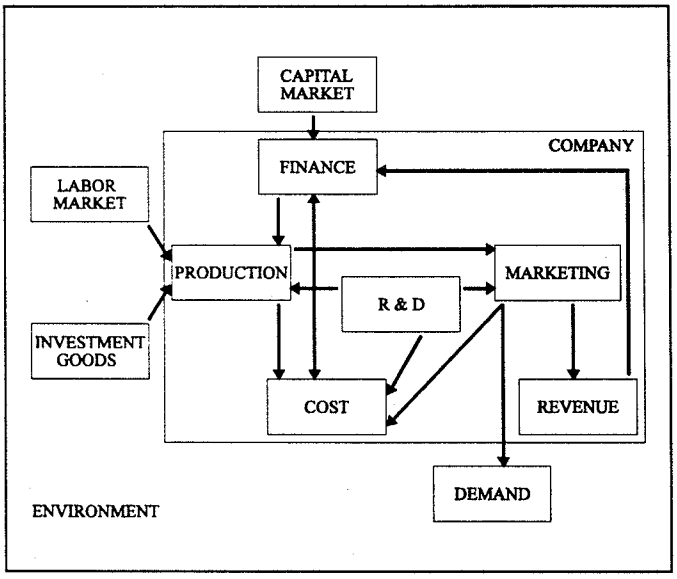

Figure 4: Main Components of the Company Model

A GAMING INTERFACE FOR DATA HANDLING AND CONTROLLING THE SIMULATION MODEL

The gaming capabilities of Professional Dynamo (PD) are rather limited, it is, however, a powerful simulation environment. Therefore, a shell that allows a comfortable data exchange with the simulation model is provided. The modular structure of PD allows to execute each part separately through a DOS command. A module called *trns.exe* transforms simulation results into other file formats like that of a spreadsheet and vice versa. Exogenous Variables allow the definition of values for each period, so that a group can set its decision value for a longer period. The values of the levels at the end of a simulation cycle are the initial values for the next cycle.

The shell for the game was developed using Microsoft's Excel 4.0. User defined macros control the process from the start of a new game to the generation of the final reports, and a drop-down menu is added to the standard appearance of the spreadsheet program. (Figure 5).

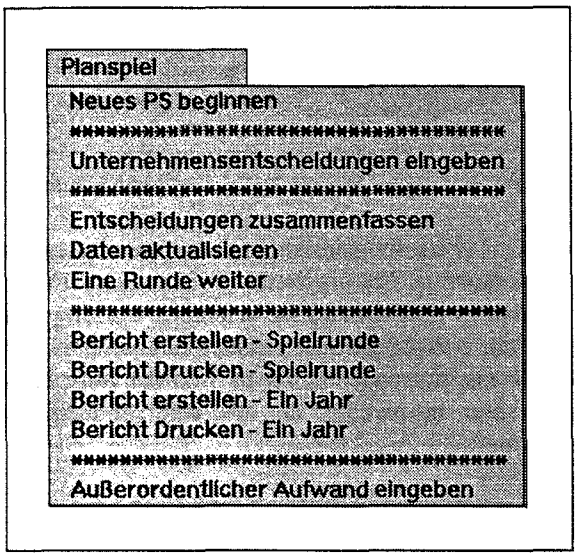

Figure 5: Drop-down Menu for the Management Game

To run the PD modules, an Excel function called AUSF() is used. The following example simulates the model specified in the spreadsheet cell Z7S1 and saves the results under a name identified by the simulation time in cell Z13S1.

=AUSF("smlt "&Z7S1&".smt -go "&Z7S1&"_"&Z13S1&".erg")

With the help of Excel macros, all user interferences with the game were automated. Neither the players nor the game supervisor must know DYNAMO's simulation language or Excel macros. Standard knowledge of how to use Microsoft Windows applications is sufficient to handle the game.

The model produces a multitude of data. For an effective and efficient gaming, it is necessary to aggregate the output depending on the objectives of the particular game. With a spreadsheet program it becomes easy to produce reports. The game generates after each round a six page report for each corporation that is handed to the groups at the beginning of a session. It consists of a balance sheet, an income statement, general and corporation related information about the market, production capacity and production rate, R&D, and information about cost accounting. An additional report is compiled after each full year.

Geplante Unternehmensentscheidungen	1	2	3
Preis			
Generation 1			
Generation 2			
Generation 3			
Generation 4			
Werbebudget			
Generation 1			
Generation 2			
Generation 3			
Generation 4			
Investitionen			
Kapazitätsverteilung			
Generation 1			
Generation 2			
Generation 3			
Generation 4			
Einstellungen			
Entlassungen			
Forscher-Einstellungen			
Generation 1			
Generation 2			
Generation 3			
Generation 4			
Prozeßforschung			
Forscher-Entlassungen			
Generation 1			
Generation 2			
Generation 3			
Generation 4			
Prozeßforschung			
Budget			
Produktforschung			
Generation 1			
Generation 2			
Generation 3			
Generation 4			
Prozeßforschung			
Langfristige Kredite			
Gewinnausschüttung			

Figure 6: Decision Variables of the Companies

In each period the groups have to make decisions about the subjects shown in Figure 6. The length of simulated business period can be changed during the game. A period of three months has proven to be an appropriate interval.

EXPERIENCES WITH THE GAME

GENERAL INSIGHTS

An important result confirmed during several rounds of the game is the fact, that learning in management education can indeed be improved substantially by gaming. The most important insight, however, is - at least for university education - that students do not only learn better, they also get an understanding of the complexity and the dynamics of managerial processes. They experience the consequences of applying what they learned and how it fits together. Attending lectures and reading the literature is only one pillar in the education process; sufficiently realistic management games are another. Furthermore, management games of the type discussed here, are powerful instruments to stipulate group dynamics and to practice social competence. Students learn that an ineffective way in problem solving is the search for those who are to be held responsible for the problem.

In the initial stages of the game players have difficulties to make their decisions due to time pressure and the still missing internal organization of the groups. During the course of the game most groups divide the responsibility for specific functional areas of their company.

In many business games the students play against an imaginary competitor represented through the computer. In such an environment players might blame the failure of a strategy to the supposedly unrealistic representation of the real world situation through the game. Players discuss the shortcomings of the computer model instead of analyzing the real problem. The game presented in this paper uses the computer only to clear the market, to calculate costs, profits or the results of R&D efforts. Unexpected behavior is not caused by an inadequate model. Players realize the causes in their own decision or those of the competitors. The players recognize the usefulness of different management tools and heuristics – like the experience curve or the product life cycle. They experience the difficulties to succeed in a complex and dynamic environment with decision which rely solely or mainly on intuition.

TYPICAL BEHAVIOR OF THE PLAYERS

At the beginning of the game, most students know the discussion about effective strategies for managing innovative products. They know in particular about the impact of low prices on fast market penetration of a new product and the resulting cost reductions caused by experience curve effects (Milling 1986). Many groups agree on a strategy of penetration prices with small profit margins but with the prospect to rapidly gain a substantial market share and to become a cost leader. However, this strategy often fails because competitors have chosen the same strategy. Or it fails because turnover and profits are insufficient to finance the development of new products, or because of inadequate capacity expansion. With the game students recognize, that a strategy of one functional area must fit to the other parts of the company, and that success depends on the competitors' behavior.

Usually after a few periods, the players recognize the risk of relying on only one product. They start to spend immense amount of money for the development of consecutive product generations, but tend to ignore the need of sufficient cash flow to finance the R&D expenses. This then causes cash problems, leads to increased short and long-term borrowing and high capital costs.

With respect to R&D management, the major part of the R&D budget is spent for product development, only a minor part for process development. This is surprising, since many companies tried to implement a strategy of cost leadership. It is also interesting to observe, that R&D budgets follow as fixed percentage the development of the total turnover of a company. This causes cyclical behavior and positive feedback; decreasing turnover and reduced profits lead to decreased R&D resources and a decline of competitiveness. A behavior that in accordance with empirical evidence.

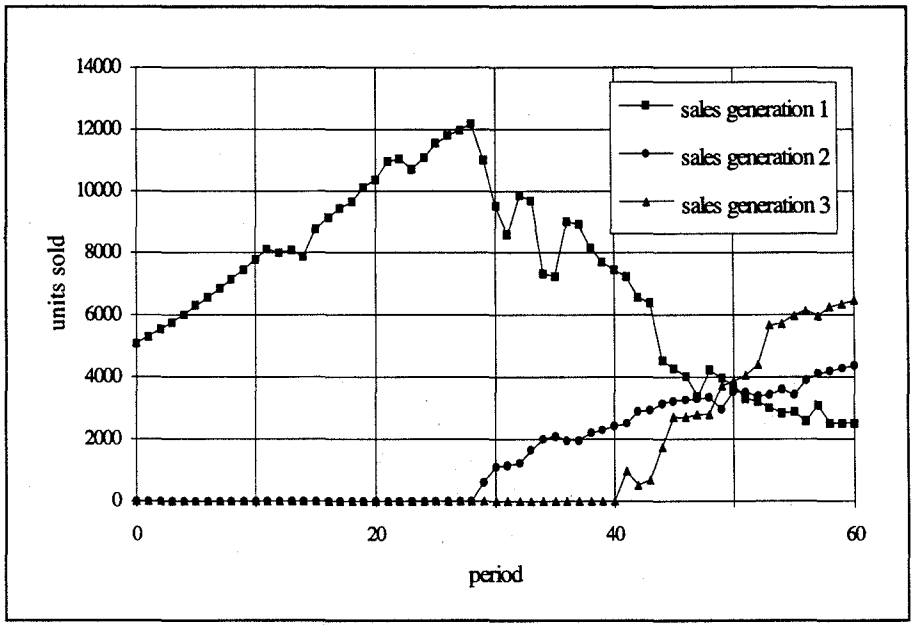

Figure 7: Life Cycles of Successive Product Generations

The diffusion model that is used to generate product demand considers innovative and imitative purchases, repeat purchases and substitution through successive product generations. Therefore, the introduction of a new product causes a decline in the life cycle of the preceding product generation. A behavioral pattern of this sequence of product life cycles is shown in Figure 7. Although the first product was still far away from its maximum sales volume, the competitive environment had the second and third product generation been introduced to the market very early. That caused a steep decline in sales of the previous product generation. In this example, even the second product can not fully utilize its potential;. the next product was introduced with a higher technical sophistication and aggressive prices.

CONCLUSIONS

Even though management games reduce the real world complexity and make concessions to reality, strategic and systems thinking can be learned effectively. It is important, however, to reduce the video game syndrome and to avoid the impression that it is played against a computer. Only if the players accept that their own strategies cause the behavior of the microworld, they will learn for future real world actions.

Experiences with management games shows them as powerful tools to support business education. They also provide excellent opportunities to improve group decision making and to practice the performance in a dynamic environment without the fear of irreversible actions. They indicate, that reading the relevant literature, participating in class room discussions and attending lectures are important for learning the basics; they can effectively be supported by management games.

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