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# TEACHING ABOUT INFORMATION WITH MANAGEMENT GAMES

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## ABSTRACT

This paper shows how three types of management games may be used to teach business students about information. Standard management games can be used to teach about the use of accounting systems, model games are used to teach working with models, and information games are used to teach about the information systems development process.

## INTRODUCTION

One of the major challenges in business education is teaching the concepts of *information* and *information systems*. This task is certainly not made easier by the lure of personal computers, the world-wide web and other technical achievements that purport to enhance the importance of information. In our view, the advances in data processing, data communication and data processing do not change the fundamental concept of information. In this paper, we start from the notion that information and decisions are intimately tied. On the one hand, decisions cannot be made without information. On the other hand, information has no value if it cannot change the decisions to be made. Theoretically, this is often demonstrated through the Bayesian approach as exemplified by the *newsboy problem*. We distinguish operational decisions, which involve a relatively small part of the organization's resources, and strategic decisions, that have an important influence on the future of the organization. Usually, operational decisions must be made at short notice, whereas there is ample time for strategic decisions. Moreover, many operational decisions are well structured, whereas strategic decisions are never fully structured. However, not all decisions can be classified in this way. For example, in a crisis, important decisions must be taken immediately, and there are many examples of unimportant, but unstructured decisions. Teaching how to make operational decisions is relatively easy. First, operational environments can be modeled with fairly simple analytical or simulation models, and second, students can get practical experience in making such decisions in many jobs.

In this paper we focus on strategic decisions. Such decisions are made by *managers,* who use information provided by an information system. Several terms have been used for such information systems. In the late sixties, the term *management information systems* was introduced to distinguish them from operational data processing systems. However, this term has been misused so often that information systems for managers now are more often called *decision support systems* or *executive information systems*. We use the term management support systems and we address the question how educators influence students' views on management support system by introducing a specific type of management game. To this end, we distinguish three types of management games. In standard management games, players get the reports that are normally provided to managers, in model games, players have access to the complete model of the simulated economy and in information games, players only get raw data on states and events in the game world.

The remainder of this paper is structured as follows. Section 2 is devoted to standard management games, section 3 discusses model games, and section 4 describes information games. In all three sections, an actual game is

used as an example. Finally, section 5 contains conclusions and directions for future research.

## STANDARD MANAGEMENT GAMES

A management game is a game where players take on the role of company managers in an artificial environment created by computer simulation. Management games have been used for education and research in business since the late 1950s (Ricciardi et al. 1957). Since then, the development of management gaming has been characterized by publication, proliferation and downloading to PC's (Burgess 1994). The changes in the basic model, however, have been remarkably few. In a management game, players or player teams compete in a consumer market by using marketing instruments such as product quality, price, advertising and number of retail outlets. All decisions and computations are made for a round, which represents a year or a quarter in the real world. Because the market model and competitors' marketing decisions are unknown, players face demand uncertainty. In most games, there is less uncertainty on the supply side, though in some games, personnel or materials must be acquired on a competitive market.

MAGEUR is a standard management game where players may produce and market a large number of different products. For example, in a 1998 game, 12 teams introduced 146 different products in six industries. Because the business unit that produces and sells a product may be renewed after its original creation, firms in the game invested 278 times in a new producing unit. In total, 37 different industry-quality combinations were produced with 74 different technologies. In MAGEUR, all companies start from scratch, because the use of investment opportunities would be severely restricted if players would start with going concerns.

In each round, players determine the amount produced or, in a newer version, the number of workers, the selling price and the marketing expenses for each product. The only variable that cannot be accurately predicted is the amount that is actually sold. On the supply side, the only uncertainties for players are the number and quality of new technologies that result from research expenses., and in the new version, the number of employees actually hired.

Data processing in MAGEUR is based on the accounting model. Profit from a standard profit-and loss account is used as the primary success indicator and solvency is determined from the balance sheet. In addition, sales and production statistics for each individual product are given to determine the profitability of individual products. To support marketing decisions, market reports for specific industries may be acquired at a fixed price. Those reports list quality, price, advertising expenses, number of outlets, and sales in four market segments for each product in the industry.
The first characteristic of information processing in MAGEUR is the sharp distinction between strategic and tactical decisions. Introducing a new product is a strategic decision, because it involves a large investment in fixed assets as well as large initial marketing outlays. Expected profits cannot be calculated with precision, because future sales depend on an unknown and complex market model, and on the behavior of competitors. So educators may show that a discounted cash flow model can be used for investment decisions, but that its quality depends on the quality of the input data used. A strategic decision that is often ignored is the decision to close or sell a business unit. In many MAGEUR sessions, players delayed closing unprofitable businesses.

A second characteristic is the importance of planning and data analysis with incomplete data. The main tactical decision is the formulation of the game plan (Volmann e.a. 1992), that states projected sales and production for each product. This determines financing requirements, and an incorrect prediction in-

creases interest charges. Data analysis is particularly important because data on business units is in a different format from company data. As a result, it is difficult to determine which business units are profitable. Hitherto, such computations had to be done by hand, but in the version of MAGEUR that is now being tested, data are made available in a spreadsheet.

In effect, we see that the complexity favors intuitive and satisficing rather than rational and optimizing behavior from players. This attitude is reinforced by the group process in a team. In many instances, MAGEUR players copy the results of successful players, and, as a result, differences in prices and other marketing expenses of similar products tend to diminish. For educators, this offers the opportunity to point to comparable cases in the real world, and to ways to improve decision making. The general approach to information processing in standard management games is that managers use accounting and statistical information without concern about information processing. However, they may further process those data by means of end-user tools such as spreadsheets, both for strategic purposes such as investment decisions and for tactical purposes such as determining advertising budgets.

## MODEL GAMES

In many European countries, business students take a degree in business economics, a field that comprises accounting, finance, marketing, and organization. In the first year, business students are taught together with economics students and both get an introduction into the field of business economics, as well as courses in micro- and macro-economics. Although, in recent years, other business curricula have been developed, business economics remains popular with students as well as prospective employers. Apart from the difference in subject, economics and business economics differ in approach, as economics focuses on quantitative modeling techniques, whereas business economics is more qualitatively oriented.

A particular game, the VIP-game (VanderHeijden 1999), was designed to give first-year students in (business) economics some practical experience in integrating the two fields. Following the design principles of an earlier macro-economic game (Gremmen 1989), a strict division was made between the design of the interface by a professional programmer and the design of the model by an economist. The model is described by a set of equations that are interpreted by a special purpose program. As a result, all teachers involved in the use of this game can easily understand the working of its underlying model, and even propose changes to this model. Moreover, students are explicitly asked to study the model and use it for decision making. For example, production is defined by a Cobb-Douglas function, and students are asked to compute the optimal allocation of machines and labor under given prices. In another exercise, students have to estimate elasticities from market shares and marketing instruments. The results can easily be verified, because the market model is based on elasticities.

The main characteristic of a model game is that players operate in a simple world where information is free and correct and optimal solutions can be found. This is quite useful to teach the concepts of modeling, but it is a long way from the real world. During the use of the VIP-game, some students indeed expressed a preference for a more complex game that stimulated intuitive rather than analytical thinking. On the other hand, students learnt to understand the concept of a business cycle, just because the model contained a cycle with a constant length and amplitude. Hence, students could predict its course, and take appropriate action by decreasing price and production. An important feature of a model game is that it offers a forum for discussion on topics that are important in education. This feature was not exploited during the design of the pre-

sent version of the VIP-Game, because most business economists involved in the first-year curriculum were not interested in modeling. This resulted in a model with a predominance of economic principles. For example, because most relations are continuous, the distinction between strategic and tactical decisions is blurred, items like depreciation and profit are calculated according to economic, rather than accounting principles, and in one version, companies were awarded so much cash that they had no financing problems.

In the VIP-game, output to players is provided in a spreadsheet, which was mainly used to compute some data that is missing in the input. For example, though both the size of the bank account and the interest rate are given, the actual amount of interest received is not. Another use was the design of graphs to facilitate decision-making.

## INFORMATION GAMES

Infogame (Casimir 1995) is a management game that has been specially developed for research and education in information systems development. Players or player teams manage a firm that produces and markets one or more products. Up to 25 firms compete in one to five consumer markets by product quality, price, and advertising budget. Players make production and marketing decisions for a game period that represents a quarter in the simulated world.

From the point of view of the player, two features distinguish Infogame from a standard management game. First, players are not provided with standard reports such as financial accounts and production and sales statistics, but with detail data that cannot be interpreted without further processing. Accordingly, players really need a separate information system for decision making. To provide sufficient data, operations are simulated in detail. For example, sales for a single product are not aggregated, but several hundreds of individual sales transactions per quarter are generated. Similarly, data on purchase of materials, employment, and production are reported in detail. Second, whereas decisions on investment, price, supplier selection, and similar topics are entered in the same way as in conventional business games, some player decisions are specified in the form of *rules*. For example, a player does not specify how much of a product must be produced, but he defines a *reorder level* and an *order quantity* to ensure an adequate production level.

As in MAGEUR, Infogame players start a company from scratch. This enables them to make two fundamental decisions, that also influence information systems requirements, the selection of the industries in which the company will operate, and the choice of an appropriate company design. Infogame simulates three types of industry:

a) Industries with *production to order only*, where each consumer order is translated into a production order, that may be annulled when late.

b) Industries with *production to stock only*, where a sales transaction can only be made if the product is in stock. Production is controlled by a player defined *reorder level* and *order quantity*. Whenever the stock is below the order level, a production order for the amount specified by the order quantity is executed.

c) Industries with *production to stock with back-orders*, where production is controlled by reorder level and order quantity, but when a production order is completed, existing back-orders are filled first. Consumer orders that are not met in time are annulled.

The type of industry determines what information is needed for decision support. In industries with production to stock, information on stock levels is important. This is even more so if no back-orders are allowed, because in that

case, a low stock level may indicate that possible sales have been lost. Both in industries with production to order and in industries with production to stock with back-orders, information on annulled orders and delivery times is of paramount importance.

Company design involves the choice between (i) a *single-product company*, that produces a single product with a single technology, (ii) a *diversified company*, that produces more than one product and/or applies more than one technology, and (iii) an *integrated company*, that produces both semi-finished products and end products. Information processing in a single-product company is simple, as there is no need to compute results for different products or technologies. In a diversified company, results for each product must be computed separately. If one product is produced with several technologies, or different production processes share machines, intricate planning, scheduling, and accounting problems arise. An integrated company asks for a complex information processing system. It poses problems in planning and in monitoring the overall efficiency of the production process, especially if the semi-finished products are used in several end products.

A distinctive feature of Infogame is that the player decides what types of events will be reported. For example, a player who opts for cash sales has no need to separately record both sales and sale payments. If a type of event is reported, every single event of that type is recorded in the report file. Apart from collecting event data, a player can collect inventory data at specified intervals. This allows the development of simple information systems that only monitor stocks and utilization rates. A cost is attached to the collection of each data item to foster efficiency in data collection. Apart from the event mode described above, Infogame supports an aggregated mode, where data are aggregated over player-defined time buckets and read into a spreadsheet. This mode is better adapted to end-user computing with spreadsheets, whereas the event mode is better suited to sophisticated decision support systems.

Player decisions that also occur in standard management games are investment in machines, demand for loans, credit terms for customers, and acceptance of credit from suppliers. Employees are simulated individually, and there is a labor market, where employers compete for labor and employees compete for jobs. The labor market operates only once a month, and the number of employees is not automatically adapted to variations in production during a quarter. Accordingly, though the player can prevent the accumulation of stock by setting a low reorder level and order quantity, he cannot prevent employees from becoming idle.

The main characteristic of information games is that players are actively concerned with information processing as such. Of course, Infogame contains an operational information system that computes the cash level to determine interest charges, and stock levels of materials and finished products to determine whether sales are allowed, production can be started or purchase orders must be placed. However, variables in this information system are only accessible to the player if they are explicitly reported.

There are three views on the relation between managers and the information systems development process. One view is that managers just have to say what information they need and that information systems specialists must execute those demands without fuss, in a fixed time and at fixed cost, just like the taxi driver who transports the manager from the airport to his hotel. In this view, managers do not need to know anything about information systems development, apart from the fact that information systems are usually late, and do not meet budgets and specifications. In this view, we may expect that business students as players specify information systems that are similar to

the accounting systems in standard management games. Hence, in this view, for business students the only additional value of Infogame over standard management games stems from the involvement with information systems developers, a role that will be taken on by information systems or computer science students. At the other extreme is the view that state-of-the-art software enables managers to extract the information they need from available databases. In this view, end-user computing is an essential part of business education. To facilitate end-user computing, aggregated reports were introduced into Infogame. In this view, Educators may use Infogame to demonstrate the advantages and pitfalls of end-user computing to business students. A middle view is that information systems development is a cooperative process between managers and information systems specialists. Both business and information systems students may learn more about this process by cooperating in developing an information system for Infogame.

## CONCLUSIONS

In the preceding sections, it has been shown that the three types of management game discussed are complementary because they focus on special aspects of information. Standard management games focus on accounting systems, model games on models and information games on information systems development. Because standard management games are more complex than model games, and information games are more complex than standard management games, business students should be exposed first to model games, than to standard management games and finally to information games. However, there is no agreement on the importance of the information systems development process for managers, and hence on the use of information games in management education.

Some topics that are widely discussed in the modern information management literature are not covered by any of the games discussed. First the existence of efficient and effective transaction processing systems is taken for granted in all three types of games, and hence there is no scope for experimenting with new types of transaction processing, such as electronic commerce. Second, no game offers opportunities for business process redesign, a radical change in business process organization, coupled to a change in information systems. Such topics, however, may be the subject of future management games that center on the use of operational rather than management information.

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