DESIGN AND DEVELOPMENT OF A FLEXIBLE BUSINESS SIMULATION GAME

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Synopsis

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Availability of managers competent in managing organisations operating in a competitive and global market is among the key factors affecting the likelihood of the success of the transition economies. This in turn will depend on the ability of the higher education institutions to align their curriculum with the needs of industry and commerce. Changes in the curriculum need to be underpinned with the appropriate learning material. This research project, in a small way, fulfils this important need.

The primary aim of the work presented in this dissertation is to develop an interactive learning tool that enables the management student to acquire relevant managerial competencies, and knowledge regarding functions and processes of a firm operating in a competitive economy. Development of a business game demands a framework that specifies its requirements. This framework was established by examining the relevant literature, existing business games, and the specific needs of the transition economies. These requirements were used to identify the detailed objectives of the research.

The research methodology consisted of:

(a) analysis of relevant published papers and existing business games;

(b) modelling of business processes;

(c) testing the internal validity of the business game using multivariate statistical tools; and

(d) testing the external validity of the business game using structured observations, report feedback, and survey of participants.

In line with the objectives of this research, a multifunctional Business Simulation Game (BSG) was developed. The game enables the student to acquire skills and knowledge of functional areas, as well as, to develop an understanding of the relationship of those functional areas in the organisation.

The resultant BSG has a number of unique features. First, it can operate in two languages, English and Hungarian. Moreover, the program can be easily modified to accommodate other languages. This is important because a majority of students in transition countries can not speak English. Second, based on the "white box theory", the students have access to detailed analysis of each functional area. Third, BSG allows the students to choose between practice (playing against the computer) and competitive (playing against other students) mode. Fourth, the development of the functional areas used in the BSG contains new concepts and methods. A new dynamic aggregate market model was developed and validated by using real life data. A new approach for modelling short run production and cost function allows for a deeper understanding of economic theory. The accounting function of BSG includes a completely new methodology for the harmonisation of different accounting systems, and a new approach to computerised accounting.

BSG was validated internally and externally. The internal validation included face validation; sensitivity tests; consideration of the existence of dominant factors; and examination of the stability of decision variable - performance criterion relationships. These were accomplished using the response surface methodology and multivariate regression analysis. The external validation was concerned with the effectiveness of BSG as a learning tool. The data was collected by structured observation, report feedback, and survey data from three different cohorts of graduate and postgraduate students. This data was analysed using factor analysis; discriminant analysis; cross tabulation; and independent sample t-test. The analysis of the qualitative and quantitative data suggests that students found BSG to be an effective learning tool.

The conduct of this study has found room for further research and improvement to BSG. These include methodological design; content; and the platform of the program. Methodologically, incorporating a linear programming method can improve the final evaluation of the market influential factors of companies, and help to optimise the product distribution. A comprehensive model with short-run revenue and profit functions allows for building up a more comprehensive model. Sustainable development will be included in the future that will be developed on Windows platform.

The output of this research project is an interactive learning vehicle that can help the Hungarian business students at all levels to acquire the managerial competencies required to manage in a competitive economy. BSG can also be used by students in other transition economies, as well as students in first and third world countries.

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CHAPTER 1 - Introduction

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Business simulation games are not new in the West, they are used as a learning tool in management education to a great effect (Wolfe, Roberts 1986). They enhance the learning experience of the participants and enable them to attain important managerial competencies (Elgood, 1988). In the late 80s, about 95 per cent of business schools - members of Association of Collegiate Schools of Business (AACSB) - reported using simulations (Miller, Leroux-Demers 1992 p. 266). Business games represent a fusion of developments in war games, operation research, computer technology, and education theory (Wolfe 1993). In 1957 only four business schools in America, who belonged to the AACSB used business simulation in their curriculum (Wolfe 1993, p. 447). Since then several hybrids of business simulations have been developed and used in America. A new simulation should provide a unique contribution to the area of business simulation.

1.1 Aims and Objectives

Broadly, business simulations have a multitude of different purposes. The objectives vary according to the purposes and rational for which the game was developed. The primary objective is to develop an interactive learning tool that facilitates the acquisition of knowledge in business processes of firms, operating in competitive economies. The tool further enables the participant to understand the notions, methodologies and strategies used by firms. The main objectives of this research therefore are:

- to prepare and develop a game that allows the participants to understand the business processes in a competitive market;
- to design a game that operates in at least two languages;
- to create special subparts that function as pure explanatory parts to enable the participants to learn functional areas of business management; and
- to design a game where there are practice *and* competitive modes to allow participants to interact with each other.

A *valid* simulation can achieve higher learning effects as discussed in Chapter 8. Therefore, the validation of the new business simulation is an essential part of the development work. Further objectives therefore are:

- to validate the new simulation game with real life data;

- to test the accuracy of the simulation against business reality; and
- to ascertain the effectiveness of the new game in classroom situations.

With these objectives in mind it is necessary *to establish a set of principles and algorithms for the development of a business simulation game* as discussed in Section 1.2. For all of these principles and algorithms the starting point is to consider the business as a *system and at the same time as a complex set of inter-related different subsystems.*

1.1.1 Business as System and a Set of Subsystems

Jauch and Glueck (1988) analysed the systems of business and classified them as internal factors. They identified five different classes of subsystems:

1. R&D and engineering - they can lead to improved products and improved manufacturing.

2. Marketing and distribution - they are applied for delivering the products from producer to customer.

3. Finance and accounting factors - they analyse the financial position of the firm, develop budget and profit plans, and deal with the stockholders.

4. The management area - they contain production and operation management, that is concerned with

efficient production and utilisation of materials and equipment, maintenance and other factors.

5. Corporate and personnel factors - they comprise the corporate image, highly qualified employees, labour.

An understanding of the different subsystems is a necessary but not sufficient for comprehending the workings of the whole system. This is because the whole system has its own characteristics. Furthermore, the sum of the parts of a system is usually less than the whole system, otherwise there would be no synergy. In the case of a firm, the participants may learn about different subsystems such as marketing and production, but not about the interrelationships of the subsystems as a whole system. An appropriate tool for studying a firm, and the dynamic of a firm is therefore a *business simulation.* The simulation of a company requires the modelling of the different parts of the company which are related to each other. A business simulation allows the participants to study the interrelationships of the subsystems. Building the time effect into the simulation also allows for the dynamics of the firm to be studied.

For the design of an appropriate system plan for a business simulation, the definition of some basic principles is necessary.

1.2 Basic Principles of the Game

A number of principles were considered to be of utmost importance to the development of the business simulation. These are listed below, and each of them is discussed in greater detail in sections that follow:

- The simulation has to be a computer based game;
- The simulation has to be an interactive game;
- The simulation models a firm as a business unit;
- The game should simulate a competitive business environment;
- A multifunctional game has to be developed that represents the interrelationship between the functional parts of a company;
- The business simulation has to achieve a high level of flexibility and variability;
- Validation of the business simulation is necessary;
- The simulation should contain a three level manual;
- A white box system should be applied; and
- A two language simulation should be developed.

1.2.1 The Simulation has to be a Computer Based Game

Computers have exerted a great influence on management games with their ability to handle extensive mathematical problems easily (Elgood 1988, p.12). Without necessary complexity a game does not trigger sufficient involvement and motivations (Miller and Leroux-Demers 1992 p. 280). The advancements made in computer technology have provided good opportunities to use complex games - if such games are available. The use of computers will enable a more complex model of reality to be used. Business systems are often made up of many subparts in the form of functions or processes. The processing speed of computers will allow more complex and interdependent functions and task to be simulated to reflect the real business world.

The participant will benefit directly by the use of new technology because of the number of variables affecting decisions that can be used. Moreover, the participant can use trial and error decisions to understand the interaction between variables in a business environment without fatal or costly end results.

1.2.2 The Simulation has to be an Interactive Game

When simulations were first developed, the most simple model-based games created output data from a single input data, e.g. sale from price (Elgood 1988, p.21).

Later with the development of mainframes the participants could run more complex games. After setting the input data on spreadsheets, the administrators entered the data into the computer and after data-processing the results were returned to the participants who analysed the output and made their decisions. This is a non-interactive method. Interaction allows a two-way flow of information between the user and computer (Concise Oxford Dictionary, 1990). With the spread of personal computers it became possible to obtain immediate feedback for the participants' decisions. The immediate response is necessary for greater learning effectiveness. The learning process is accelerated if the response is immediate. Corrections can be made and the availability of instantaneous results enhances the learning effect.

1.2.3 The Simulation Models a Firm as a Business Unit

The complexity of the program has to be controlled for modelling purposes. A *Strategic Business Unit (SBU)* is not too complex but has a well-defined set of activities. Buzzel and Gale (1987) define the main characteristics of an SBU as:

> "A business unit ... is a division, product line, or other profit centre of a company that:
>
> - produces and markets a well-defined set of related products and/or services;
> - serves a clearly defined set of customers, in a reasonably self-contained geographic area; and
> - competes with a well defined set of competitors" (Buzzel, Gale 1987, p 32).

Because of the relative simplicity of this type of business organisation SBU is an appropriate base unit for a business simulation.

1.2.4 Competitive Business Environment Should be Simulated

Hungary is similar to other post socialist countries in the sense that it moves towards a competitive economy. The changes in the post socialist countries are definitely directed towards competitive economies, therefore the most useful business simulation would be one that can simulate a competitive environment. The relevance of a business game capable of simulating the micro situation faced by firms in an emerging competitive market is recognised by a number of researchers. For example Wolfe (1993) stated that

> "The greater integration of Europe and the need for Central and East Europe's post-socialist countries to quickly move to a more competitive status among the world's economic powers should provide an even greater stimulus for the spread of business games throughout that region." (Wolfe 1993 p. 457 - 458)

As Hungary moves towards a market economy, the need for skilled employees familiar with western business concepts becomes greater. This need has arisen due to the increased interactions between companies in Hungary and the rest of the world and because of the history of the country's government that has previously imposed a controlled economy. Companies in Hungary operated under a centrally planned economy for 40 years. It is unrealistic to expect changes to close the gap in a few years. However, the gap can be closed in a shorter time if countries like Hungary use more modern styles of education. Business simulation is one such form. More importantly, the initial goal has to be to enable the future employees of Hungarian companies to learn western skills. Again a simulation game can assist in this process.

1.2.5 Multifunctional Game has to be Developed

A business unit is the smallest organisational form that has all the necessary functional elements to work in a competitive environment.

> "...it represents the *smallest* subdivision of a company for which it would be sensible to develop a distinct, separate strategy." (Buzzel, Gale 1987 p.32)

A software package, based on a SBU can simulate all of the functional areas of the business previously discussed in Section 1.1.1. The simulation can demonstrate the interaction between the functional areas and the impact of the decisions in one functional area on other areas. Most games focus on one function only, but there are general, multifunctional simulations. A multifunctional simulation will be developed, where the relationship between marketing, production, accounting, finance, labour, material and equipment can be studied. These multifunctional (or general functional) simulations will be discussed in Chapter 3.

1.2.6 The Business Simulation has to Achieve a High Level of Flexibility and Variability

Managing a firm is a complex and demanding task. However, in the design of a simulation package it is necessary to control the complexity of this task (Cryer 1988, Elgood 1988, pp. 55-56). The outcomes can be predicted quickly if the conditions and the operational possibilities are constant. It is therefore the designer's responsibility to create a game where the Umpire and/or the participants can install several different types of game conditions and can use different types of task to develop managerial skills. Sufficient flexibility and variability can avoid the problem of predictable simulations. This reduces the necessity for a trade off between the level of simplicity and sophistication, that will retain the interest of the participants.

1.2.7 Validation of the Business Simulation is Necessary

Validation is an important part of a simulation game. If a business simulation is valid, then the participants can benefit more, as discussed in Chapter 8. Validation has to be accomplished partly on the basis of a real database. Another reason to use the SBU as a basis is that the PIMS database, that is allegedly the only available strategic management database, collected data from strategic management units. The PIMS database provided a factual basis for establishing the value of the initial parameters, furthermore, it facilitated the assessment of the internal validity of the game. This is discussed more fully in Chapter 8.

Participants are likely to accept and enjoy a simulation, if it is close to real life (Faria et al. 1992). The more complex the model, the more accurate could be its verisimilitude, but complexity is not absolutely necessary for real-life simulation. Validating the business simulation is necessary to prove its verisimilitude. The validating process comprises both the external and internal validates. These parts are discussed further in the methodology section of this chapter and in Chapter 8 (Validation of the Business Simulation Game).

1.2.8 The Simulation Should Contain a Three Level Manual

An effective business simulation manual needs to satisfy several criteria. A manual needs to be flexible enough to allow fast access to the game for those who have sufficient experience in business simulations. For this reason a three level manual was developed. The first level manual contains only the necessary minimum information in one page; the second level manual comprises only a brief summary of rules and the third level manual is an extended version with examples and references. These references might be replaced by or supplemented with on-line hyper-text help facilities. With hyper-text, every help screen contains highlighted words and phrases, that can be followed from one screen to the next. This help method is used in most Windows programs, but not in business simulations. The first two manuals are presented in *Appendix VI and VII.*

1.2.9 A White Box System Should be Applied

A simple system allows the participants to become quickly acquainted with the structure of the game (Section 2.7). This is one of the reasons why the designer and/or the umpire usually prefers not to permit the participant to know the workings of the whole system. Moreover, to become acquainted with the logic of a program triggers learning. Usually the purpose of the business simulations is to convey knowledge, and the game has to be used by the participants if they are to become familiar with it.

In a more complex system the participant can be allowed to know the workings of the system, since computing every variation at each decision point is nearly impossible. As a learning tool, allowing participants to become acquainted with the workings of the system is beneficial. Consequently, it is more effective to apply a *white box system,* as discussed in Chapter 2, that allows the participants to follow their decisions and mistakes.

1.2.10 A Two Language Simulation Should be Developed

The business simulation game is not only a two language simulation. It can be considered as a two culture simulation to a certain extent, as discussed later in this section. The simulation developed is capable of recognising the different accounting and financial regulations and able to produce outputs such as profit and loss account using different regulations.

As mentioned earlier, studying the competitive market is an essential need for the participants in management programs offered by the educational establishment of the post-socialist countries. When designing a simulation that promotes this process, consideration of additional factors is necessary. An important issue here is that participants, who are not familiar with the language and/or the culture of a competitive economy, can play the business simulation. A program that has an objective to facilitate this process has to have tools to surmount the two most important difficulties: the language problem; and the different rules existing in different countries. The simulation game should be able to emulate different regulatory realities and be available on different languages. These difficulties can be overcome by developing a two language simulation.

A *two language* simulation can be designed in two ways: (i) installing the simulation for a special language; or (ii) switching between the two languages. The *different rules* mainly exist as problem in the accounting system, because financial tables and ratios have special significance in the evaluation of a firm. A system designer has to solve the *harmonisation* of the different accounting systems. That is to say, the designer has to prepare equally understandable financial tables in both accounting systems. Creating a really efficient system requires an immediate and appropriate evaluation from the viewpoint of both countries. This problem exists not only in the case of business simulations, but also in the case of multinational enterprises. If a thorough knowledge of a foreign firm is essential, then a simple translation of the financial tables is not sufficient. A sufficient system requires both the correct language translation and the inclusion of the differing rules. This is discussed in greater detail in Chapter 7.

1.3 Relationship of the Research to Previous Work in the Field

The relationship of the business simulation developed to previous work in the field will be evaluated in two ways. The first is to consider a *global game,* and the second is to examine the *internal parts of the game.*

For simplicity from hereon the business simulation developed will be referred to as Business Simulation Game, or BSG.

1.3.1 The BSG, Overall/System Construction of the BSG

The simulation of a company and the relationships amongst the functional areas indicate, that a multifunctional business simulation game is more than the simple sum if its parts. This feature of the business game requires the evaluation of the simulation globally. From this point of view, the contributions of the BSG to the existing knowledge are listed below. These are discussed in greater detail later in this section:

- The menu system is designed to reveal the economic background of the models;
- The simulation provides the opportunity to follow the probable effect of the decisions;
- Two types of playing methods have been developed; and
- A two language BSG has been developed.

1.3.1.1 Menu System

Some elements of the menu system are designed to help the participants to reveal the history and the process of the results, according to the white box theory discussed in Section 1.2.9. For example in "Production" part there are "Details" about the interaction among labour, equipment and the number of products, as discussed in Chapter 4.

1.3.1.2 Probable Effect

The BSG provides the opportunity *to follow the probable effect* of the decisions the participants will make *before* they actually make their decisions. In the "Trial" menu in the "Marketing" part for example, the participants can estimate their possible market share in the case of unchanged competitor behaviour. Additionally, the competitor's data can also be arbitrarily set for studying the market effect of the expected behaviour of the competitors. This is as far as the author been able to establish is unique to business simulations.

1.3.1.3 Playing Method

Examination of well known business games suggests that existing simulations allow only one type of playing method. The BSG has *two types of playing methods*. A *practice method*, which allows play against two artificial firms, generated by the computer, and a *competitive method* that admits up to 5 competitors. The practice method has two further possibilities: (i) to build a new company from the beginning (full method); or (ii) to run a simulation of an existing company. The practice method allows the participants to practise and to become acquainted with the game before they compete with other groups. The full method features artificial competitors, but allows for building a new enterprise.

1.3.1.4 A Two Language BSG Has Been Developed

The importance of a two language simulation was discussed in Section 1.2.10. This feature is unique amongst the existing business simulations. The two language simulation is a unique feature of the BSG. Additionally, the game is designed to work with any two languages, not only with the Hungarian and English language.

1.3.2 The Functional Parts, Subsystems of BSG

The functional areas of the BSG also contribute to the existing knowledge of the area of business simulations, in the following ways:

- new market model;
- validation of the new market model by real-life data;
- application of a new approach of modelling short run production and cost function;
- activity run accounting system;
- complete methodology of the harmonisation of different accounting system; and
- automatic evaluation.

1.3.2.1 New Market Model

The BSG applies a new market model (Chapter 6) that can be adapted to different environments, and requires only a basic knowledge of mathematics for the participants. A brief overview of three existing models provides persuasive arguments for developing a new market model.

The simulation of Carnegie Tech University (1978) uses a simple model. The advertisement factor has a quadratic effect, while the other market-influential factors - quality, price - have a linear effect on the demand function. The parameters are constant, and the forms of effect (linear, quadratic) are predetermined. The real market movement can be better expressed by other mathematical forms, as discussed in Chapter 6.

Carvalho (1992) suggests a theoretically complex model. It starts from the assumption that all consumers will maximise their utility. Carvalho's market-influential factors are price, marketing (globally), product and service quality, economic index and seasonal index. On the basis of these factors a demand function can be designed where the long-term demand trend is properly modelled. The model is therefore a demand function based model.

This model has two disadvantages. The first is that not every participant has the sufficient level of mathematical knowledge to follow the operation of the model. The second is the basic assumption that all consumer will maximise utility. The utility maximisation is the behaviour of rational-economic man and it is necessary because of the starting conditions of a given mathematical model. In practice this assumption may not hold true (Cryer 1988).

Goose and Kusel (1993) suggested an interpolation approach to develop any type of equation that contains multiple interacting variables. This method starts from base quantity and with the help of percentage change scheduled for each variable it creates the demand function. The suggested model is not difficult to use, but it is difficult to follow the computations and to check the results.

The approach adopted for simulating marketing facets of the BSG is different from the models described above. The BSG applies an aggregate dynamic demand model that is developed on the basis of existing market share, general attraction and aggregate models, as discussed in Chapter 6. The applied model is a linear model. The linear form can express real market movements (Lilien et al., 1992) and the only mathematical background, broadly required to follow the behaviour of the model is the linear regression analysis.

1.3.2.2 Validation on Real Life Data

A business simulation's basic assumption is that a model should have verisimilitude to be an appropriate teaching tool. A simple model can be suitable for modelling a market if it has the same characteristics as a real situation. The PIMS database provides examples for different industries, collecting strategic business unit's data from different industries. Linear multiple regression analysis can determine the exact ratios of the different factors within an industry. The regression coefficients provided by the regression analysis allow the use of real-life weights for market-influential factors.

1.3.2.3 A New Approach of Short Run Functions

The production part applies a new approach of short run production and cost functions that is more appropriate for educational purposes than those contained in existing models.

Gold developed an algorithm to model short-run cost and production functions using Sheppard's lemma (Gold, 1992). The process of determining these functions requires the use of appropriate mathematical tools. However, these mathematical tools assume a higher level of mathematical background that is not necessarily given in the case of business students or managers.

The BSG adopts a simple approach for the short run production and cost function that allows the study of economic theory in a simulated environment. Chapter 5 provides arguments for the usage of the functions.

1.3.2.4 Accounting

A new philosophy of accounting system had to be developed and applied in the accounting part of the BSG. The new system has two key concepts: an activity run accounting system and a harmonisation methodology.

1.3.2.4.1 Activity Run Accounting System

The generally applied accounting systems of simulation models have pre-determined, constant accounting rules for the accounting process. The BSG allows modification of the accounting rules without modifying the program itself. The applied accounting systems are further discussed in Chapter 7.

The BSG applies a group of accounting items, connected to a well-defined activity of the company, for example ordering materials, or selling the products. Using this type of accounting system, it is not necessary to record the accounting transactions. A well-defined group of accounting items, together with the value(s) of transactions, is sufficient for the accounting process.

1.3.2.4.2 Methodology of the Harmonisation

The harmonisation of different accounting systems emerged from the importance of understanding the evaluation of other country's firms. A simple translation of different financial tables and ratios would not provide the necessary content and explanation of how the decisions are made. The rebuilding of the tables needs an enormous amount of work and time, therefore the BSG uses *automated model building process* to help the participant to learn about the different accounting environments.

1.3.2.5 Evaluation of Participating Groups

Automatic evaluation is unique in itself, as discussed in Chapter 4. The BSG computes a weighted mark for the performance of the participants from some of the more important factors of the firm. Evaluation of a company is accomplished by different factors and/or financial ratios. Good will, return on investment, net revenue and market share are all characteristic values in an evaluation process. Chapter 4 describes the methodology for calculating a score for the competing firms on the basis of the performance of the company.

1.4 Research Methodology

In the development of BSG, *analytic research* was used. Analytic research stratifies the whole problem into its component parts (Buckley et al, 1975, p. 26). Therefore, the whole simulation is broken down into its functional parts. This analytic research is also applied within the functional parts to separate the basic component parts of the functional parts. In the marketing, production and financial models, *mathematical modelling* is used as the formal technique. Mathematical modelling is

> "a series of mathematical equations which form systems of analysis and embody precise measurements of the relationships of the variables, parameters and constants" (Buckley et al, 1975, p.25).

The accounting component was modelled using the *algorithm* technique. Here, a fixed step by step procedure accomplishes the result (Buckley et al, 1975, p.27).

The three major functions of modelling (description, explication and simulation) are simultaneously present in the BSG.

> "Description, explication and simulation are the three major functions of modelling. Each of these functions is appropriate for applied research of theory building. Descriptive models seek to describe the behaviour of elements in a system where theory is inadequate or non-existent. Explicative models are used to extend the application of well-developed theories or improve our understanding of their key concepts. Simulation models go beyond the goal of clarifying the structural relations of concepts and attempt to reveal the process relations among them." (Emory and Cooper, 1991, p. 64).

The BSG comprises the sets of various models. The functional models of the BSG have the function of description and explanation. On the basis of the above definition, the BSG as a complete model, also has a simulation function.

The validation of the BSG uses experimental design and control. Therefore, the validation procedure is *empirical research,* more specifically *laboratory study* (Buckley et al, 1975, p. 35).

> "The laboratory study is the most precise domain for empirical research, as both experimental design and control are present." (Buckley et al, 1975, p.38)

Ascertainment of the effectiveness in a classroom situation uses different methodologies. Opinion research is used to capture the participant's opinion.

> "The salient advantage of opinion research is its ability to capture people's impressions about themselves, their environments, and their response to changing conditions." (Buckley et al, 1975, p.35).

Opinion research provides the opportunity to analyse data through a variety of standard statistical procedures. Results of the questionnaires used are recorded. This *secondary* data set is the basis of the analytical statistical procedures. However, one section of the questionnaire is used as the *primary* data source for the analysis of the three most important managerial skills that the BSG conveys best.

The research methodology follows a twofold objective. The first objective is directed by the primary aim of the thesis: to develop an interactive learning tool. The second objective is the validation of the developed business simulation.

1.4.1 Develop an Interactive Learning Tool

The development of an interactive learning tool requires a thorough examination of existing papers and business simulations. In the design of the global and individual models the combination of the existing theories and new ideas has to be examined. A verification procedure is necessary to prove the usefulness and validity of the developed business simulation.

1.4.2 Validation Methodology

The validation methodology comprises mathematical and statistical methods. Exact probability values can provide results that can show the validity of a business simulation. This section consists of the external and internal validation methodology and the verification methodology of the BSG.

1.4.2.1 External and Internal Validation Methodology

Carvalho (1991) proposed a five-step validation procedure where the internal and external validity are equally tested. The five premises are:

1) face validity;
2) validation from the perspective of the participant;
3) sensitivity of the decision variable;
4) validation for the existence of dominant factors; and

5) stability of the relationship between decision variables and performance criterion.

Response Surface Methodology (RSM) is the means for evaluating complex systems. RSM comprises the data collection and the calculation of regression equation.

Databases of the validation procedure are two experimental design matrices that ensure orthogonal decision variables. The matrices have to be sufficiently far from each other in time to avoid overlapping. The two matrices provide the database for the mathematical models.

Premise 1, 4 and 5 require regression analysis. F- and t-statistics can test the equality hypothesis of the response surfaces and the sensitivity and stability of the parameters of decision variables. The PIMS database ensures the face validity also with the help of regression analysis.

Three software were used in the validation process:

- REGAL, Expert System for Multivariate Regression Analysis (Kiss, 1991)
- Regression analysis (PIMS Institute's specific statistical package)
- Continuous Probability Distribution Functions (Hajdu and Kiss, 1992)

The methodology section in Chapter 8 provides the complete description of methods adopted for validating the game.

1.4.2.2 Verification Methodology

Databases for the final verification of the BSG are based on questionnaires. The sample was provided by all the graduate and postgraduate students using the BSG in the academic year of 1994/95 and 1995/96. The sample size is 57 and was determined by the number of students attending the sessions.

In the USA Teach and Govahi investigated the efficiency of business simulations on the basis of a set of forty-one managerial skills. The same investigation was repeated at the Faculty of Business and Economics at Jannus Pannonius University, in Hungary. Comparison of these two sets of results provided arguments for the effectiveness of the BSG.

The first questionnaire examines the importance of managerial skills from the viewpoint of the respondents. Univariate statistics were used for the evaluation of the different managerial skills, and a comparison was performed.

The second investigation asked the participants to rate the same managerial skills from the viewpoint of teaching methods, such as lectures, experiential exercises, case studies and business simulations. Discriminant analysis was performed to evaluate the data. Comparison of the Hungarian and the American experiment resulted in valuable information about the characteristics of the BSG.

Factor analysis and cross tabulation ensured further results that provided additional features about the Hungarian experiment.

Software used in this section, are different from those that were used in the validation procedure. The statistical package used for data processing is SPSS for Windows (SPSS, 1993). In addition, three output processing programs (Kiss and Jones 1994, Kiss 1994,1 and Kiss, 1994,2) were used to facilitate the presentation of the data.

The methodology is fully discussed in the methodology section of Chapter 9.

1.5 The Structure of the Thesis

This section describes the title and the brief content of the chapters of the thesis, that are as follows:

Part I - Introduction and survey

- introduction (Chapter 1)

- literature survey (Chapter 2)
- review of existing business simulations (Chapter 3)

Part II - A new business simulation model

- outline of the model (Chapter 4)
- production (Chapter 5)
- marketing (Chapter 6)
- accounting and finance (Chapter 7)

Part III - Validation

- validation of the business simulation (Chapter 8)
- verification in classroom situation (Chapter 9)

Conclusion (Chapter 10)

1.5.1.1 Literature Survey

The literature survey in Chapter 2 demonstrates the usefulness of business simulations. The survey provides a brief summary of the history and the main areas of business simulations. This process attempts to show the rationale for the use of simulation games and the reason why a new game had to be developed.

1.5.1.2 Review of Existing Business Simulations

Some of the existing games are reviewed in Chapter 3. Studying the existing models and manuals is a necessary process to avoid creating a simulation that duplicates what other games offer.

The first step is to discover the basic framework of these games; the second is to map their characteristics. This knowledge provides the opportunity to design a simulation that uniquely contributes to the area of business games.

Chapters 2 and 3 provide the basis and the foundation knowledge required for the development of *a more powerful business game.*

1.5.1.3 Outline of the Model

The "outline 'of the model" in Chapter 4 provides details of the framework for developing a universally applicable business simulation suitable for use in a learning environment. The learning environment assumes an umpire, the use of computers, and participants working in groups to run the business simulation.

1.5.1.4 Production

The production chapter demonstrates and shows the interactions amongst production planning, research and development (R&D), material, labour and equipment. The production model has three unique features.

The production model establishes the new concept of short-run functions developed by economic theory.

The unique production activity control for the BSG is based on the production theory of capacity management. The capacity planning screen provides a practical interactive tool for the participants to follow the consequence of their decisions and illustrates the impact of making those decisions.

1.5.1.5 Marketing

The market model developed for the BSG is an aggregate dynamic market model. The development process was established on the basis of the theory of marketing models. This is further discussed in Chapter 6, and a brief theory of the market-influential factors is also given in the same chapter.

The practical speciality of the marketing section, described in Chapter 4, is a trial possibility where the participants are allowed to follow the effect of their decisions. The trial possibility has the advantage of an unlimited trial procedure that facilitates the realisation of the effect of the different market-influential factors.

1.5.1.6 Accounting, Finance

A brief summary of present accounting methodology has enabled three new elements to be developed for the field of accounting theory and practice. The introduction of harmonisation of different accounting systems is based on the accounting records of the company. The activity run accounting system on a modifiable set of accounting rules provides an opportunity to account on an activity base, such as the sale or ordering of materials. The promotion of learning process is the third unique feature of the accounting model, where more immediate accesses are provided for the participants to acquire some important knowledge of accounting theory. The financial part of the BSG provides the necessary element for managing the financial side of a firm.

1.5.1.7 Validation of the BSG

Both the internal and external validity of the BSG has to be proved. *Internal validity* refers to the correct environmental connection of simulation and assumes that the participant's decisions reflect the environment defined by the simulation. The *face validity* of a BSG is an important factor of internal validity as well. It means that the data input has verisimilitude.

Between the input data and output results there is the simulation model. The process between the input and output data has to be verified. The examination of the validity of this model is also the task of the *internal validity* test.

External validity is concerned with the effectiveness of the BSG. Collected data were analysed using statistical analysis in order to prove the effectiveness of the BSG is classroom situation.

The internal and external validity is discussed in more detail in Sections 1.4.2.1 and 1.4.2.2.

1.5.1.8 Verification in Classroom Situation

Transferability of lessons learned through simulations to the practical world also has to be proven. A developed business simulation has to convey skills to the participants, otherwise the usefulness of the simulation is doubtful. Chapter 8 and 9 provide more details about the verification process.

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PART I - INTRODUCTION AND SURVEY

CHAPTER 2 - Literature Survey

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The primary aim of this literature survey is to examine the effectiveness and usefulness of Business Simulation (BS) as a learning medium. There are several books and articles that explain and discuss the workings of BSs. However some of the books and articles are too wide in their coverage of the topic (Elgood, 1988), whilst the majority focus upon a specific area within BSs. This chapter will focus on literature which discusses the effectiveness and usefulness of a BS as a learning medium. Other relevant literature will be examined in the appropriate chapters, for example, in the *Validation, Marketing and Production* chapters.

2.1 Active Learning

Traditional management education mainly relies on "passive learning" mode. Learners in this educational form are only required to listen, make notes, and accept information, concepts and ideas without experiencing them. The information is of no value, unless it can be understood and accepted by the learners. Learners have to learn new concepts and ideas, as well as learn to integrate these concepts and ideas with knowledge that they already possess (Elgood 1988, p.17). Due to the developments in educational techniques and the understanding of what and how managers learn, management education can become active learning based.

Three types of educational techniques or method can be considered as *active learning tools.* These include: *Case Studies, Business Simulations and Experiential Exercises.* These learning tools do not place the learners into a subordinate position, of merely requiring them to listen and memorise the information, concepts or ideas. These learning tools instead, provide the learners with the opportunity to act, to test, and to experience the result of their own actions. Elgood stated that:

> "There is a world of difference between knowing that something is true, because one has been told it by some authority, and knowing that it is true, because one has experienced it (albeit in a simulated situation) for oneself." (Elgood 1988, p.17)

The efficiency of active learning does not mean that active learning is the only appropriate educational form. Only a *complex set of methods* can convey the necessary *set of skills* (Teach and Govahi, 1993) that is required by learners. Teach and Govahi conducted an investigation into the role of classroom techniques in teaching management skills (Teach and

Govahi, 1993 and Teach, 1993). The authors examined four types of educational tools: *Lectures, Cases, Experiential Exercise* and *Simulations*. These four tools were examined by looking at forty-one managerial skills. Teach and Govahi developed questionnaires to evaluate the effectiveness of skill acquisitions for each method. The skills were associated and connected to educational methods that could best convey the managerial skills. However, they did not give specific details of what they meant by those managerial skills. One set of the results depicts the highest average values of skills related to the educational tools. The list of the tools with their associated managerial skills is provided below:

Lectures: Reflective listening

Cases: Analyse problems; Analyse data; Gather pertinent information; Conceptualise; Think creatively; Put structure to unstructured problems; Write effectively; See the "big picture"

Experiential Exercises:

Solve problems creatively; Resolve conflict; Conduct interviews; Speak in public; Lead; Exert influence; Persuade; Direct the work of others; Motivate others; Manage people; Supervise; Manage stress

Simulation:

Make decisions; Forecast; Assess a situation quickly; Adapt to new tasks; Solve problems systematically; Develop people/teams; Organise; Plan; Make presentations; Schedule and co-ordinate; Prioritise tasks; Measure objectives; Set goals; Develop consensus; Set objectives; Delegate responsibility; Manage time; Appraise performance; Enforce rules of policies; Form coalitions.

If the experiment above was recreated, the investigation would probably not show the same results, because of the different circumstances, existing amongst business schools and universities. However this examination does give a broad, overall picture about the *kinds of skills* associated with different learning and teaching strategies.

The questionnaire used by Teach and Govahi is shown in Appendix I and II. The same investigation was repeated by the author; this is discussed in more detail in Chapter 9. This enables the author to assess the effectiveness of the new business simulation game in classroom situations with a different group of students operating in a different environmental context.

It should be remembered that after nearly forty years of state controlled economy, Hungary and other similar countries, with the same historical developments, need managerial skills which are compatible with those prevalent in the western countries with competitive markets. The changes in these countries towards a competitive economy require changes in managerial skills (Rekettye, 1991). Findings of Rekettye (1995, p.5) suggest that "the Hungarian market in its characteristic features, is moving closer to a modern market economy". Educational establishments in the previous state controlled countries have to teach the necessary skills required to manage in a competitive economy.

The term *"clinical ability"* also implies active learning. Miller and Leroux-Demers (1992) describe management as a clinical ability.

> "Successful managers integrate formal knowledge and experience with skills and apply them in practical circumstances; good managers develop accelerated professional judgement and skilful appreciation of when to use adequate theories and techniques. This type of

judgement and expertise is called 'clinical ability'."
(Miller, Leroux-Demers 1992, p.262)

The impact of the management development programme on the role of experience is presented graphically in Figure 2-1 (Miller, Leroux-Demers 1992, p.263). The duration of the management development program is shown between the two vertical lines in the middle of the figure.

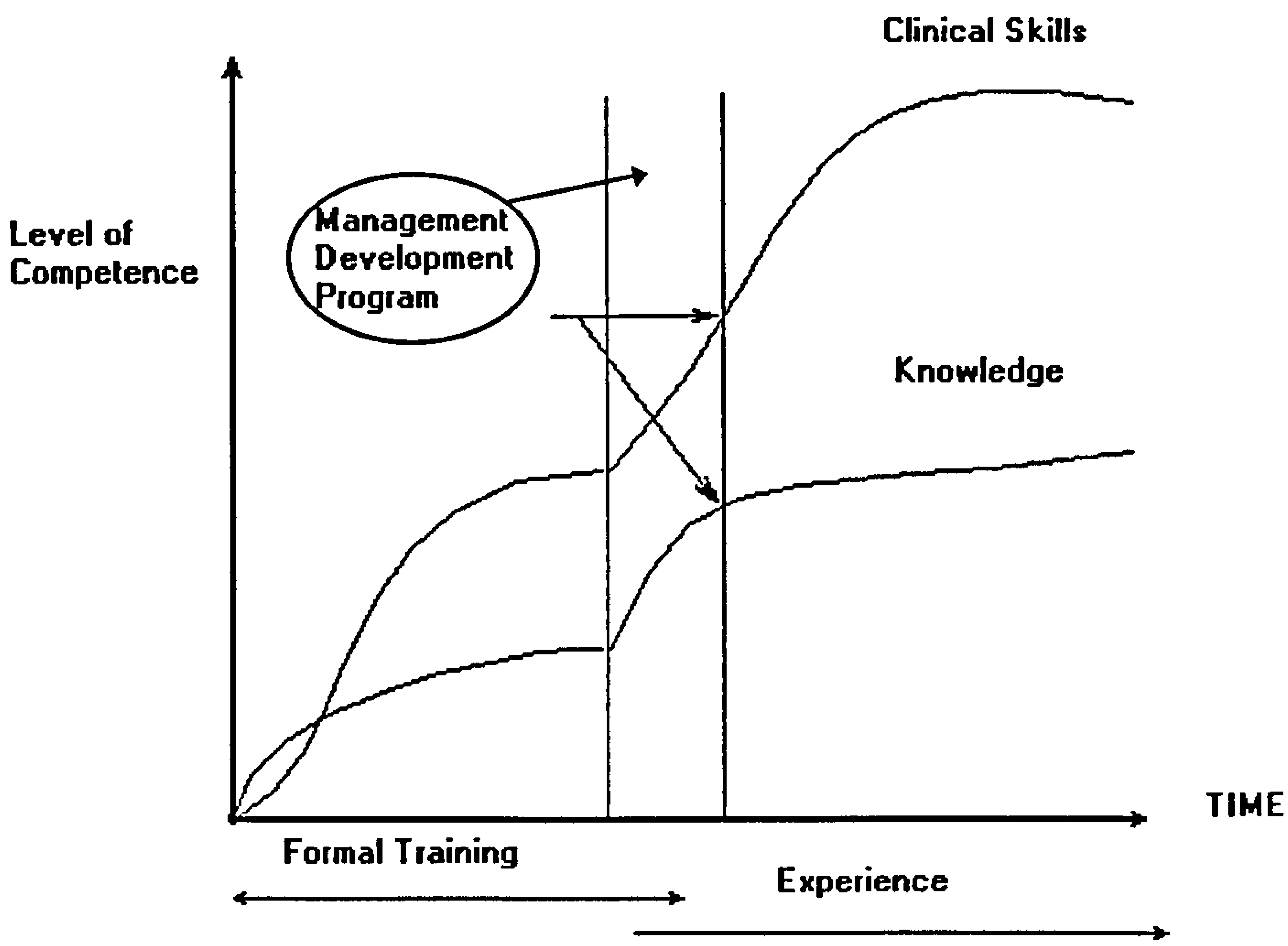

FIGURE 2-1 IMPACT OF MANAGEMENT DEVELOPMENT PROGRAMME ON INDIVIDUALS
Source: Miller, Leroux-Demers 1992, p.262.

Figure 2-1 shows that a BS can assist in making a strong initial step towards gaining better clinical skills. If management development programmes are not used, then the curves of clinical skills and knowledge cannot be shifted. However, the participation in a management development programme can accelerate the learning process and can shift the curve of clinical skills, because participants - during their work - can relate their experiences with theoretical approaches and new practical methods. They are therefore given an opportunity to test new ideas in an environment similar to real life.

BS can effectively teach managerial skills (Teach and Govahi, 1993, Kiss, 1994), so the "Clinical skills" and "Knowledge" curve can be shifted to a higher level with help of BS to achieve competence in a shorter time.

2.1.1 Role of Umpire

The designation of "Umpire" does not have the type of authority that the name itself implies.

> "Through dialogue, the teacher-of-the-students and the students-of-the-teacher cease to exist and a new term emerges: teacher-student with student-teachers. The teacher is no longer merely the-one-who-teaches, but who is himself (sic) taught in dialogue with the students, who in their turn while being taught also teach." (Willmott, 1994, p. 123).

The role of the Umpire is important. The Umpire is responsible for creating an atmosphere, which is directed towards making the business simulation realistic. One of the main advantages of the environment of a simulation game is the informal and experimental atmosphere where the learners will work with more innovative behaviour (Cryer 1988, p. 115-116). An appropriate tool is to use warm-ups at the beginning of the course (Malseed, 1994). Warm-ups are specially designed to use in group learning situations. It can help 'break the ice' in new groups, prepare groups working together, wake people up both physically and mentally, help focus groups (Malseed, 1994, p. 56). Jenkins and Bearder discuss other type of ice-breaking techniques (Jenkins, Bearder, 1994) but they will not be reviewed here.

The Umpire has several objectives to maintain the interest of participants in the game, to give the necessary amount of information, or to evaluate the participants at the end of the game. The business simulation, as a game, can fulfil the role of maintaining the interest for the most part, but the Umpire has to supplement the effect if the inner or outer environment shifts to a disadvantageous situation.

The Umpire may let participants have additional information about the game itself, that is not included in the manual of the game. He also needs to emphasise and bring the attention of learners to the key points that arise from the structure and the objective of the game. Umpire can ensure the technical conditions of running the BS. Umpires have to organise the whole process from the beginning to the end (Saunders, 1994, p. 92-93). Scheduling the time table and evaluating the intermediate positions of the firms are also the tasks of Umpire. To satisfy safety needs, participants have to be protected from potentially threatening people and situations (Cryer, 1988, p.115).

The experience of the Umpire can be conveyed as well. This type of managing a simulation can extend the knowledge of participants (Willmott, 1994). The Umpire has knowledge of the complete workings of the business simulation. The strategy and interrelation of functions are important characteristics of the simulation that has to be conveyed by the game. The Umpire has more experience of the substance of the business game and can provide information that is essential for understanding the main concepts of the simulation. The Umpire's experience facilitates the learning process of the users.

2.1.2 Motivation

Active learning is a strong motivator. Miller and Leroux-Demers stated that:

> "Realistic management simulations trigger complex sets of motivations which include:
>
> (i) desire to learn;
>
> (ii) intense competition; and finally
>
> (iii) desire to confirm that a selected strategy yields acceptable performance."
>
> (Miller, Leroux-Demers 1992, p.280)

When suitable conditions are provided, business simulations can generate spontaneous methods such as independent learning, discussions and role-plays (Cryer 1987).

Considering the psychological aspect of motivation, Cryer (1988) gives a summary of the different views. In the first half of the century the *rational-economic man* dominated, and later the *self-actualising man* changed this concept. A self-actualising man is mainly self-motivated and self-controlled. To achieve their purposes there are some conditions to fulfil. According to Maslow (1954) there is a hierarchy of needs and the pinnacle of this is the self-actualisation. Physiological needs (to eat, to sleep), the safety needs, social needs (others give and receive support and friendship) and *esteem* needs (self-confidence and respect from others) precede the self-actualisation. The participants can only deal with their self-actualisation after the safety, social and esteem needs have been satisfied by the Umpire and the simulation (Cryer 1988 p.115-116). To ensure the participant's safety needs and to create a free atmosphere to encourage the teamwork may be the task of the Umpire. The BS itself can simulate the necessary conditions for the social and esteem needs at a much higher level than the traditional educational form (Cryer 1988 p. 115).

Herzberg (1959) used another approximation, where he differentiated *extrinsic* and *intrinsic* factors. Herzberg stated that there are circumstances that could lead to dissatisfaction. Working conditions, light, computers, meals are extrinsic factors. Even in the case of all extrinsic factors existing, satisfaction can not be guaranteed. Responsibility, roles to play, proper teamwork are intrinsic factors and they are also necessary to lead to satisfaction. (Cryer 1988, p.117)

A simulation game has an obvious advantage from this viewpoint. The extrinsic factors can be fulfilled quite easily with the help of the Umpire. The BS itself has to simulate the intrinsic factors if there is to be a real simulation and the participants are to have the appropriate attitude. Responsibility and proper teamwork are special, necessary features of a BS. There should be no need for any additional efforts on the part of the Umpire to ensure that these types of intrinsic factors are satisfied (Herzberg et al., 1959).

2.1.3 Type of the Games

There are two factors that have exerted great influence on management games (Elgood 1988, p.12). The first factor is the scientific management movement with its emphasis on measurement. The second factor is the widespread diffusion of computers. As a result of these influential factors very different types of simulations have been developed.

In some types of *model-based games* the exercises are preceded by offering a written scenario with the supporting data and there are successive time periods to give a chance to correct the mistakes and improve the strategy. In *direct-access computer games* the players or the team make use of the computer keyboard themselves and they can see the result of their decisions almost immediately. Because of the immediate responses the interest of participants is maintained, hence the level of activity will grow. In *enquiry studies* the scenario - or manual - tells the players about the situation and gives them the opportunity to put questions to an Umpire or to a data bank. They can gain extra information about the game depending on the quality of their questioning.

This classification emphasises some of the main features of simulations. In the case of a more complex BS these characteristics can be built into one simulation. A BS really supports active learning if it is model-based and provides direct access (or interactive). If the Umpire has enough experience of the game and of the real business situation then enquiries about the game give the user the opportunity to learn more during the game.

After the widespread diffusion of computers nearly all business simulations are model-based and direct access (see Chapter 3). In order to ensure equal conditions Umpires would prefer not to give any unnecessary information.

Miller and Leroux-Demers (1992, p.266) grouped the games as general, functional, international and industry specific. Many business games are used to focus on a particular area such as marketing, production, finance. These games, concentrating on special areas, are functional games. However, there exists a broader perspective where the games concentrate on a firm as an entity, as with strategic games (an example is in Keys, Edge and Wells, 1992). Differentiating functional and general games is similar to the strategic planning process where the strategic framework differs from the strategic plan of particular areas (Ward, Griffiths, Whitmore, 1990, p. 38-39). International games comprise international connections; for instance currency ratios or the production possibilities in other countries. Industry specific games refer to special industries. One popular area is the motor industry where several games were developed.

2.1.4 Complexity

The designer is faced with the problem of complexity. If the game is simple, it is easy to master and would not challenge the participants sufficiently or retain their interest. If a BS is too complex, it will be difficult to become familiar with it. A too complex game could discourage some people. Discouraging participants can endanger the safety needs (Cryer, 1988) and this type of simulation may lose its ability to convey knowledge (Elgood, 1988 p. 55-56).

Deep-structure variables can be separated from irrelevant distractions (Thiagarajan, 1993, p. 1.) in order to reduce complexity. Experts are less likely to be distracted by irrelevant factors, hence one of the role of a BS is to teach the participant to distinguish the more important, deep-structure variables from the less important ones.

Complexity is not only a thing to confuse the learners, but a means to develop verisimilitude. Without a similarity to reality because of a low level of complexity, a BS triggers little involvement and motivation (Miller, Leroux-Demers 1992 p. 280).

Development of a simulation, that commences *simply* and gradually becomes more *complex,* provides a solution for the problem analysed above. The game should be easy to become acquainted with and to play. This is possible, if the designer of the simulation can keep a proper structure that promotes easy understanding and hides complexity at the beginning of the game.

2.2 Action Learning Approach to Simulation

Active participation is action learning (Korey and Bogorya, 1985, p. 9). Action learning constitutes a student-centered approach. In this approach participants become involved in solving real problems related to issues of concern to them in their day-to-day work (McMillen, Boyatzis and Swartz 1994, p. 218).

The traditional form of education (in Higher Education and Universities, including some elements of management development and education) is a *passive way of teaching and learning* as discussed in Section 2.1. Willmott (1994) summarises the differences between traditional management education and action learning. This summary is shown in Table 2-1 (from Willmott, 1994, p. 124). Table 2-1 sheds light on the significance of activity from the point of world view and modus operandi.

> "... action learning as a pedagogical format refers to adult educational programs based upon the idea that managers (as students) learn most effectively with and from other managers and teachers while all are engaged in the solution of actual, real-time problems occurring in their own work settings. It emphasizes learning by doing." (Raelin, 1994, p.304)

	Traditional Management Education	Action Learning
World View	The world is something to learn about	The world is somewhere to act and change
	Self-development is unimportant	Self-development is very important
	Some notion of correct management practice, established by research, defines the curriculum	Managers should be facilitated by a tutor to solve problems
	Managers should learn theories or models derived from research	Managers should be facilitated by a tutor to solve problems
Modus Operandi	Experts decide on what should be learnt, when and how much	Experts are viewed with caution
	Models, concepts, ideas are provided to offer tools for thinking and action	Models, concepts, ideas are developed in response to problems

TABLE 2-1 APPROACHES TO MANAGEMENT EDUCATION

This approach emphasises active learning from another aspect. Perry and Euler (1988) summarise the characteristics of *action learning* with the opinion of Lawrence. Participants deal with real situations and during this work they learn from each other, by a questioning process (not from teachers). They carry through the work to implementation, not just to a report or analysis, recommendation and planning (Perry and Euler 1988 p.177). They say that the learning is the sum of the programmed knowledge and questioning insight.

The simulation is not real work, but a BS might be a useful medium for capturing the essence of reality.

For designing an appropriate action learning Perry and Euler have five proposals (1988 pp. 178 - 182):

1. "Programmed knowledge required for a simulation must be provided in its manual, ...". The manual has to contain not only the information for managing the program but the knowledge and basic skills for decision making as well.

2. "...simulations should allow for increasing complexity." A good example for this is that the participants do not have to develop a strategy before the game, only after they have played some periods with the given game and gained experience. Participants necessarily need an appropriate vision about the topic to formulate a sufficient strategy.

3. "...structured experience be provided for participants to use while making decisions." By this they mean that appropriate tools, such as spreadsheets for different types of planning, are available.

4. "...to make team selection a crucial issue." The learning process is a social process. Participants can learn best from each other. High cohesion teams are better than low cohesion teams but it has not yet been clarified how to achieve the highest degree of cohesion. Self-selection is not always enough;

administrators are usually better at team selection (Perry and Euler, 1988, p, 181).

The size of team is determined by the screen of the computer. Three or four people can properly see the screen, and they are the most effective groups. A team of three is the smallest in which interpersonal discussion contributes so greatly to the learning process (Elgood, 1988, p. 140).

5."...the score must be clearly measurable and understood." This point refers to the output, the results of the game where the participants' performance should be equally evaluated.

2.3 Gaining Experience

Experience is an important factor in real life. It is the result of significant time and capital investment. The more costly a strategy is to follow, the lesser the opportunity to try it in real life. The danger of financial loss practically ceases in the case of computer simulation although it will not be a real life experience. This is because in gaining experience people would make mistakes and this would result in financial penalty. A BS can be quite close to the real life, depending on the quality of the simulation.

"They sought to show people "what it is going to be like" and allow them to practise the skills they had been taught as lessons or learnt as drill." (Elgood 1988, p.3)

It is possible to practise several times in the same environment to acclimatise people to similar situations.

2.4 Competition

A game is a competition in itself, against the computer (or rules) or against others. Game playing is an additional stimulation to activate the participants in the learning process. As a game, BS requires a sufficiently clear framework and a certain level of documentation and skills to operate it (Elgood 1988, p.9). A clear framework is as necessary as rules to follow. Documentation helps participants to clarify and understand these rules and use all the possibilities with the game.

2.5 Activity Simulation

Activity simulation, derived mainly from social sciences, has an entirely different starting point. Instead of the numerate dimensions they emphasise the personal interaction aspects during the game (Elgood 1988, p.87).

Recently, activity simulations have not been separated from simulations, using numerate dimensions of business. These endeavours stress the point that was shown as a separate group of games by Elgood. An example is the warm-ups game (Malseed, 1994). To apply activity simulation in a BS, the two kinds of activity can be mixed. This may be the task of the Umpire (see Section 2.1.1, the Role of Umpire). The learners have to divide tasks among themselves and during personal interaction they play the game. In the meantime the Umpire can ask for compulsory board meeting in the interest of maintaining and strengthening the personal connection among the team members.

Another method of activity simulation is to apply psychological tests to choose the appropriate people for functions of the game (Plan It Suite 1987). Psychometric tests have the objective of finding the appropriate profession for individuals. One of the most widely applied test is the *Myers-Briggs Type Indicator.*

> "In career counselling individual type is compared with the typical patterns of professional or business specialities-accountants, surgeons, counsellors, advertising executives, and so on - to see how the person

fits with the type that is dominant in that particular field. (Bridges, 1992, p. 95)

2.6 Case Study versus Business Simulation

If the researchers try to compare two methods on similar basis, they may get different results. Miles et al (1986) compared the case discussions with the business simulation method. They found that students rated case studies more highly than the BS's; see Table 2-2. In Table 2-2 "Preferred Significantly" means that the evaluation of subjects (BS, case studies) differed significantly in favour of one subject. In this example 6 (out of 28) differentiated the two subjects significantly, and all of them preferred case studies.

	Preferred Significantly	Preferred Non Significantly	Sum
BS	0	3	3
Case Studies	6	19	25
Sum	6	22	28

TABLE 2-2 CASE STUDIES VERSUS BS BY MILES ET AL.

This examination was repeated by Anderson and Lawton (1991). Their finding was in a direct contradiction to the results presented earlier. They employed questionnaires used by Miles et al., and the same business simulation, albeit the personal computer version. They examined 28 participants as well. Twenty of them felt significant differences between the two subjects, and 18 out of 20 preferred BS, see Table 2-3.

	Preferred Significantly	Preferred Non Significantly	Sum
BS	18	5	23
Case Studies	2	3	5
Sum	20	8	28

TABLE 2-3 CASE STUDIES VERSUS BS BY ANDERSON AND LAWTON

There might be several reasons for the different results; for instance the number of students who had previous experiences in both areas, or the personality of the Umpire, among other reasons, can cause differences. Anderson and Lawton could not reveal all differences between the two researches.

In the case of similar results the same problem would exist, albeit fewer people would think of it. Different results show direct contradiction between the two examinations. Similar results do not show contradiction, but the equal conditions of investigation are not guaranteed. Not considering mistakes: different simulations and case studies can cause different results also.

There is an obvious difference between the two methods. In the case of case studies the problem is given. Participants try to solve the problem and they work out alternatives, but there is no opportunity to put these alternatives into practice. On the other hand, in the case of BS they practically do the same at the beginning. However after this process they get the opportunity to try alternative strategies and to test their conceptions - according to the rules of that specific game.

Business simulations are often used with case discussions (Miller, Leroux-Demers 1992, p. 270). Of course the variety of the case studies could be much greater, but for the same problem the business simulation has this unquestionable advantage.

Miller and Leroux-Demers (1992) summarise the studies of comparing case studies with business simulations:

> "The literature ... suggests that simulations can be superior to case discussion for teaching skills in business skills and analyses, as well as clinical abilities" (Miller, Leroux-Demers 1992, p.271).

2.7 Black Box versus White Box

Machuca (1992 p.41) collected several problems in connection with BSs. In his view they have three common roots, namely the complex nature of business systems; inadequate training for difficult games; and the absence of suitable tools. The latter means that traditional management education is mainly analytical and frequently leaves interactions among subjects out of its consideration. He argued that the learner has to consider the *complex system as a whole, and reveal the structure of the system.* Accordingly it is better to use a *white box system* where it is possible to know the structure, the connection between the main variables and the causality within the model.

A black box is an "apparatus of unknown internal design" (The Concise Oxford Dictionary, 1982). Following this definition, a white box has to be an "apparatus of known internal design", so that the system will allow the participants to know its structure and methodology.

The general conclusion of the literature survey suggests that a BS is an appropriate educational tool for management studies. A question often arose is whether it is worth developing simulations? Miller and Leroux-Demers argue that it is worth the trouble and effort by stating that:

> "Management simulations ... require heavy investments in time and resources on the part of universities or training institutes. Management training institutes estimate that the development of clinical skills is worth the investments. However, many universities have difficulties justifying the investment in spite of the teaching effects of management games." (Miller, Leroux-Demers, 1992, p. 281)

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PART I - INTRODUCTION AND SURVEY

CHAPTER 3 - REVIEW OF EXISTING BUSINESS SIMULATIONS

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The purpose of this chapter is to evaluate and compare existing business simulations (BS). Seven simulations have been used for the evaluation. The seven business games were chosen based upon their popularity, access and degree of sophistication. The assessment of popularity was based on the widespread use of the simulations in other educational institutions. The assessment of access was based upon the availability of access to the software, manuals, independent reports and evaluations of the simulation games. The assessment of the degree of sophistication was based on the structure of the business games and of the environment that it attempted to simulate.

Developing simulation games requires a significant amount of investment and gaining access to them is not easy compared to gaining access to books or articles. Due to the huge investment cost of time and money, owners of simulation games are not prepared to release their simulations freely. Moreover, it would not have been possible to evaluate an exhaustive number of simulations in use due to the time and resources available. Similarities between simulations are obvious considering the similar function of production, marketing or accounting. Development of a simulation that has only the features used by other simulations would not be beneficial. An overview is necessary to ensure the possibility of the design of a business simulation that has unique and useful features.

The seven simulations were mainly used for illustration and comparative purposes. These games provide a framework for the design and construction of a new business simulation game.

3.1 General Overview of Business Games

The seven simulation games and their abbreviations are depicted in Table 3-1.

Abbreviation	Name	Year
M500	Management 500	1988
MMG	The Multinational Management Game	1992
Micro	Micromatic	1985
Plan It	Plan It	1986
Wise	Wise	1992
CTU	Simulator of Carnegie Tech Univ.	1978
BSIM	Business Simulator	1986

TABLE 3-1 BUSINESS SIMULATIONS AND THEIR ABBREVIATIONS

Ward, Griffiths and Whitmore (1990, p.38-39) mainly differentiated functional and general games, as discussed in Section 2.1.3, where the general games are similar to the strategic framework of a firm. The general games are frequently strategic games. Strategic games concentrate on the strategic issues within business life, whilst *functional games* deal with a narrower functional area. If a functional game attempts to embrace more functional areas and extend itself with strategic features, then the level of complexity can be much higher than in the case of the strategic games. "CTU" is a complex functional game, while the other models concentrate mainly on strategic issues.

The usage of *interactive games* is an accepted and useful form of business simulations, as discussed in Chapter 2. All games can be extended to an interactive game with the help of spreadsheet programs. Connections among data can be easily depicted and modelled by using spreadsheet programmes. The level of interactivity in this case is lower. If a program is interactive itself, it is easier to use.

All of these simulations start with an existing firm. An existing firm allows the students to become familiar with the level of advertisements and other parameters, along with resources for users. Starting a new firm needs a strategic concept, plan and the knowledge of external and internal environments.

Generally all of the simulations under study have a good quality manual and all of them can serve as a useful means for teaching some sort of skill. They all have marketing, production, finance and accounting areas to some extent. This chapter concentrates on functional areas. Comparisons of the main functional areas are presented in the next sections.

3.2 Marketing

Marketing modules used by the simulations chosen take the following variables into consideration: advertisements; other type of sales promotion (SP); quality; the number of markets; and the possibility of automatic forecasting. Table 3-2 depicts the comparison between various packages. The header of the table comprises the factors, enumerated before.

	Adver-tisement	**Other SP.**	**Quality**	**Various Markets**	**Automatic Forecast**
M500	Yes	No	No	Yes	No
MMG	Yes	Yes	Yes	Yes	No
Micro	Yes	Yes	Yes	Yes	Yes
Plan It	Yes	Yes	No	No	Yes
Wise	Yes	Yes	No	Yes	No
CTU	Yes	No	Yes	Yes	No
BSIM	Yes	Yes	Yes	Yes	No

TABLE 3-2 MARKETING VARIABLES IN DIFFERENT BUSINESS SIMULATIONS

"Various Markets" means a special market for a second product, or more - usually foreign markets - for these products.

All of the business simulations reviewed use advertising. This is the only type of sales promotion in "M500" and "CTU", but others contain more types of

SP. "Plan It" is the only game with only a single market, but "Plan It" and "Micro" have a possibility of automatic forecasting. Quality is one of the influential factors in four simulations. Other types of sales promotion are also frequent.

3.3 Production

The production or manufacturing part of simulation games usually confine themselves to producing a necessary amount of products. The production parts of the models compared use common elements in their simulations. The labour, material and equipment factors are general. Differences between the simulations are evident in other characteristics. The number of plants, product lines, brands and products can distinguish companies, and henceforth the strategies required to operate a firm. Table 3-3 demonstrates the summary of the differentiating factors. More details about these factors are discussed in Chapter 5.

	More products	More product lines	More equipment	Plants in more countries
M500	No	No	Yes	No
MMG	Yes	Yes	Yes	Yes
Micro	No	No	Yes	No
Plan It	No	No	No	No
Wise	Yes	No	No	Yes
CTU	Yes	No	Yes	No
BSIM	Yes	Yes	Yes	No

TABLE 3-3 PRODUCTION VARIABLES IN DIFFERENT BUSINESS SIMULATIONS

The existence of more products means that products can only be distinguished by relevance to quality or other intangible characteristics. The products tend to be differentiated, and can be considered as different products for satisfying the same needs in various ways. The existence of more product lines means products satisfying different needs within the same area. It can be a computer and printer or car and motorcycle. More equipment can increase the capacity in the company. Some simulations allow the participant to build new plants to enhance their capacity significantly.

"M500", "Micro" and "Plan It" allow for manufacturing only one product. "MMG" and "BSIM" have been designed to produce more product in a product line. The usage of multiple equipment is more common in business games. In all of the simulations, apart from "MMG" and "Wise", the manufacturing process takes place in the host country. "M500" is the only simulation that allows the user to maximise capacity by linear programming.

3.3.1 Materials

The importance of purchasing materials is not emphasised by either general functional or strategic simulation games. Table 3-4 depicts the comparison of material models. One kind of material only, is usual.

	More then one type of materials	**Simple model**
M500	No	No
MMG	No	No
Micro	No	Yes
Plan It	No	No
Wise	No	No
CTU	Yes	Yes
BSIM	No	No

TABLE 3-4 CHARACTERISTICS OF MATERIALS

The existence of more than one kind of materials indicates a more complex model, where the participants also have to care for the material composition of the product.

A simple material model is used when material ordering requirement of the products is not accomplished automatically. These models are usually based on price-value relationships. The firms often receive a price discount for large quantity orders.

For example, a discount of 10% for the material over 10.000. units.

3.3.2 Labour

Labour is not in the same subordinate position as is the case for materials in general purpose or strategic simulations. Table 3-5 describes the features of the labour modules in the simulations.

	Differen-tiated labour	**Managing labour (hire, fire)**	**Training**	**Over-time**
M500	No	Yes	Yes	No
MMG	No	Yes	Yes	Yes
Micro	Yes	Yes	No	Yes
Plan It	No	Yes	No	Yes
Wise	No	Yes	No	Yes
CTU	Yes	Yes	Yes	Yes
BSIM	No	No	No	Yes

TABLE 3-5 LABOUR FACTORS IN DIFFERENT SIMULATIONS

The labour composition part of a simulation is homogenous in most cases. In the case of "Micro" and "CTU" there are different kinds of manual workers, and in "CTU" the manual workers are distinguished from the management of the company.

Apart from "BSIM", the simulations allow the participant to manage labour. In three of the business games reviewed, participants could make decisions about training expenditure. Generally, training would nurture more productive employees. The facility for the manual workers to work overtime is nearly a standard feature of business simulations. "M500" is the only game that does not allow overtime.

3.3.3 Equipment

All the simulations allow for capacity expansion. Various types of applied production possibilities are depicted in Table 3-3. Capacity expansion can be accomplished in different ways as it is shown in Table 3-6.

	Gradual extension	New Equipment	New Plant(s)
M500	No	Yes	No
MMG	Yes	No	Yes
Micro	No	No	Yes
Plan It	Yes	Yes	No
Wise	Yes	No	Yes
CTU	No	Yes	No
BSIM	Yes	Yes	No

TABLE 3-6 CAPACITY EXPANSION POSSIBILITIES

Gradual expansion allows the participant to increase the capacity in small steps without buying new equipment. New plants or equipment allow for more stepwise increase in capacity. Business simulations use different models for capacity expansion. All the three possibilities, shown in Table 3-6, provide a reasonable model for simulation purposes.

3.4 Finance

Stock market activity is an accepted area in business games and five simulations apply it as shown in Table 3-7.

	Short term loan	Long term loan (bonds)	Issuing shares	Paying Dividends
M500	No	No*	No	No
MMG	Yes	Yes	Yes	Yes
Micro	Yes	Yes	Yes	Yes
Plan It	Yes	Yes	Yes	Yes
Wise	Yes	Yes	Yes**	Yes
CTU	Yes	Yes	No	No
BSIM	Yes	Yes	Yes	Yes

* It ensures a building lease.
** Can not be repurchased

TABLE 3-7 FINANCIAL POSSIBILITIES

In "CTU" only the usage of loans is permitted. "M500" does not make available additional financial resources. The other models allow the user to buy and issue their own shares. Dividends are general in these business games, and short and long term loans are used by these simulations. "M500" allows only building lease.

3.5 Accounting

Balance sheet, profit and loss account, cash-flow statement and financial ratios are the means of evaluating the position of a company. Business simulations use financial tables for evaluation as it is shown in Table 3-8.

	Balance Sheet	Profit & Loss Account	Cash Flow Statement	Financial Ratios
M500	Yes	Yes	Yes	No
MMG	Yes	Yes	No	Yes
Micro	Yes	Yes	Yes	No
Plan It	Yes	Yes	No*	No
Wise	Yes	Yes	Yes	Yes**
CTU	Yes	Yes	No	No
BSIM	Yes	Yes	No	Yes***

* Detailed data about cash movements
** Return on Equity
*** Earnings per Share

TABLE 3-8 FINANCIAL TABLES AND RATIOS

Balance sheets and profit and loss accounts are compulsory part of simulations. Cash flow data are always provided but not necessarily cash flow statements. Some of the games provide cash flow forecasts as well. "MMG" is the only example of a simulation that has financial ratios built into it.

3.6 Special Characteristics of the Simulations

The business games described in the previous sections have special characteristics. These features of models will be described in this section.

"Wise" contains market segmentation. Two kinds of buyers are modelled: "habitual" customers and shoppers. Market segmentation focuses on these two groups.

"MMG" has a strong international character. The model works with currency ratios and the possibility of building distribution centres and manufacturing operations overseas.

"BSIM" gives recommendations about the size of different marketing factors, such as price and advertisement at the first stage. The model has a special menu item for *News* where the participants can predict future changes. The competitor's data in the similar area can be seen automatically.

Some simulations compel the firm to give up the game if there is no more cash available ("BSIM", "Plan It"). Other games allow covering debts with short term loans that usually has a much higher interest rate than a normal short term loan ("Wise", "CTU", "MMG").

All the business simulation games analysed above have good learning objectives, and ensure an appropriate working environment for transferring the objectives to participants. The special features together with the functional modules provide tools to design and construct a framework for a new business simulation.

This framework was created by using the general features of the games relevant to the main objectives of the new simulation game. These features are:

- a marketing model with the basic marketing mix elements;
- a production model with one plant, more products, but one brand;
- an accounting model with application of balance sheet, profit and loss account, cash-flow statement and financial ratios;
- the use of stock market in the financial model;
- a simple capacity investment model;
- a simple labour model; and
- a simple material model.

Some technical details of different games are also applied, for example:

- product characteristics from "CTU";
- object hierarchy from "Wise";
- product line possibilities from "CTU".

Other, useful features are created for the new business simulation game to assure that the game will fulfil the main objectives. Really unique features will be developed. The benefits of using existing solutions are considerable, practically without drawbacks because these solutions have been filtered by the objectives; and new ideas developed. Chapter 4 provides a detailed insight into the new simulation model.

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PART II - A NEW BUSINESS SIMULATION MODEL

CHAPTER 4 - OUTLINE OF THE MODEL

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The purpose of this chapter is to discuss and examine the workings of the new Business Simulation Game (BSG). Chapter 2 and 3 provided an overview of the simulation literature and seven business simulations. The framework for the new simulation game was constructed from combining existing knowledge with new concepts of how the business environment operates. This chapter focuses on the general characteristics of the BSG including methods of using the simulation for teaching purposes, business processes and supplementary elements. The main physical and operational characteristics of the BSG are described in Section 4.1. The simulated working environment; the BSG as a program is reviewed in Section 4.2 - "Realisation of BSG: The menu system". The BSG is a game, consisting of a number of functional parts. The participants have to identify the components of the business game that are appropriate to their functional requirements. This makes it necessary for the participants to become familiar with the game. The chapter comprises the new operational elements of the BSG, as discussed in Sections 1.3.1 and 1.3.2:

- the special elements in the menu system (throughout the chapter);

- probable effect of the decisions of the participants (Section 4.2.4);
- playing methods (Section 4.1.3);
- two language simulation (Section 4.1.4.3);
- special accounting facilities (Section 4.1.4.3); and
- automatic evaluation of the performance of the firm (Section 4.1.2.6).

The chapter starts with an overview of the simulation and interaction of the functional parts of the business game. The features of the model are shown as a *general model* in a flow diagram format, in Figure 4-1.

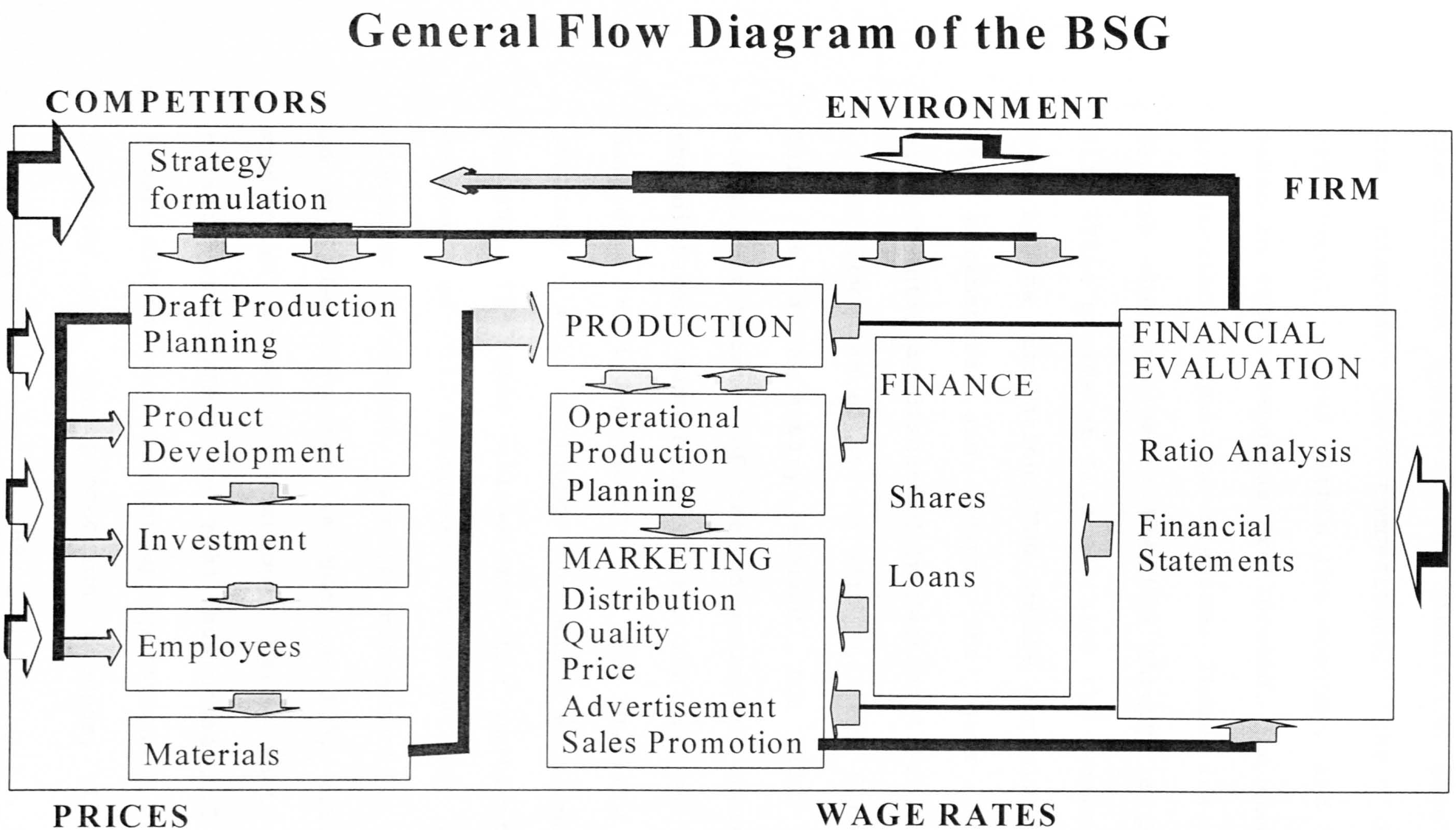

FIGURE 4-1 GENERAL STRUCTURE OF THE BSG

The flow diagram shows the relationship between the different parts of the simulation game. Around the diagram the competitors, the operating environment, prices within the economy, and the wage rates in other companies are located. The competitors are located around the diagram. These are external factors that influence the BSG through a parameter file. This parameter file contains the parameter set, used by the simulation. The Umpire can always change the parameters and adapt the game to other environments, as discussed in Section 4.1.1.3.

The flow diagram starts with strategy formulation. This is a necessary element for any business simulation because of the co-ordinated operation of the different functional areas. The applied strategy developed - independently of the quality of the strategy - will influence the whole workings of the company. The game allows for the participants to develop an ill-conceived strategy as well as effective strategies. Capacity management in the BSG, as will be discussed in Section 5.3, also has a number of adequate functional parts that reflects capacity management in real businesses. The shop-floor activities, including operational production planning and the production process, follow the capacity management activities. The BSG facilitates the understanding of the management of capacity, and the interactive production activity screen provides comprehensive presentation of the interrelated facets.

The marketing model comprises the marketing mix elements as market influential factors. This is further discussed in Chapter 6. Loans and shares can extend the financial capacity of the firm if the investment needs of the firm require additional resources. The financial accounting function records each transaction undertaken by the firm. Ratio analysis and financial statements are the means of evaluation that promotes the strategic control of the company, and provides the necessary figures to assess the financial position of the firm. If a business game attempts to simulate a real company, the activities have to be recorded and the financial tables exhibited to provide the necessary financial means for the management of the company.

The theoretical background of the three main functional parts - *Production, Marketing, Accounting and Finance* - will be discussed in greater details in Chapters 5, 6 and 7 respectively. The strategy formulation, the operational details of the functional parts, and the necessary supplementary elements of the BSG as a computer simulation are discussed in the rest of this chapter.

4.1 General Characteristics of the BSG

The number of products, markets, the amount of available capital, the number of workers, the types of material, and the equipment provide the physical framework of the BSG. The main features of the game are summarised in Section 4.1.1. Section 4.1.2 explains the business processes that are operating in this working environment. This section includes a brief description of the main functional parts, such as marketing, production, and accounting and finance. Furthermore, it describes the interrelationship of the two main processes - the marketing and production processes. The game can operate in two different modes: in practice mode, and in competitive mode, as will be discussed in Section 4.1.3. Supplementary elements of the BSG contain the utilities that provide the means for running, initialising and operating the game from the technical point of view. These are described in Section 4.1.4.

4.1.1 Basic Conditions

The BSG is not a strategic game, but a general interactive functional game. The general interactive functional game and the strategic game are intended to serve different purposes. The objective of the general interactive functional game is to focus on the mechanics of the functional part of a company.

The game has four key assumptions and conditions for play in either practice or competitive mode. These assumptions allow the participant to focus on the mechanics of the game and at the same time they allow the BSG to represent the business environment realistically. The basic assumptions are:

- Short term simulation;
- Simple structure but realistic game;
- Real life business processes; and
- Flexible simulation.

4.1.1.1 Short Term Simulation

A short time span has been used for the game, as it was felt that a shorter time span allows for more detailed activity. The BSG is set within a scenario which has a twelve month duration. The shorter time span is especially advantageous in the production model where the short run function allows for a deeper insight into the behaviour of economic theory.

4.1.1.2 Simple Structure of the Game

The company possesses one building as a fixed asset. This building is the factory where equipment and materials are situated. The single site assumption is realistic, because it represents the position of an overwhelming number of small end medium size enterprises not only in Hungary, but also in the western part of Europe. The majority of products are stored here, and the storage is free from the point of view of the firm. The maintenance costs for the building and equipment are fixed to avoid unnecessary details in the simulations. However, this presence alerts the participants to their existence and the need to cover these costs.

There are pre-defined, fixed number of white collar workers - administrators, managers - and a pre-defined but not constant number of blue collar workers, manual workers whose number can be changed during the game. The fixed number of white collar workers compels the participants to consider a fixed amount of cost that can influence the strategic decision of the firm. The number of manual workers has to be changed for operational reasons.

A simple but flexible model requires a limited number of products and production line possibilities. The BSG allows a maximum of three products and three product lines.

The BSG allows the participant to practise STP marketing. STP is the abbreviation for Segmentation, Targeting and Positioning. This will be further discussed in Section 6.2.1. For STP marketing more markets with different features have to be provided. The BSG allows the participant to distribute the products into a maximum of four markets. Each market has its special requirements for the products as described in Section 5.2.3. The existence of four markets with different characteristics allows for market segmentation. Furthermore, there are four different markets with varying levels of demand. The participants need to decide how much they wish to sell in each market and plan their marketing and distribution activities accordingly. The four existing distribution channels allow for the fighting type marketing activity (Hoványi, 1995) where the products cannot ignore the other products in the market, and they have to exist together at the same time.

4.1.1.3 Flexible Simulation

The parameter set comprises an initial estimated value of the firm, and this value is covered by shares, issued at the time the company was founded. The value of the company can change as the game is played. The parameter set ensures the flexibility of the BSG. The flexibility of the BSG allows the Umpire to create different business scenarios. This is accomplished through the initial valuation of shares issued against the company. For example, in order to simulate an attempted rescue of a failing company one would set initial share value at a low level. Conversely, to simulate growth for a successful company, one would set initial share values at a high level, and so on. After this initial valuation, the value of shares will fluctuate, depending upon the performance of the company, as do shares in a real business.

The starting conditions (values and numbers) can be arbitrarily changed in the starting parameter set by the Umpire. An example is shown in Figure 4-2, and further example is found in Chapter 7 (Table 7-26), and in Chapter 8 (Table 8-3). Figure 4-2 provides an example of the behaviour parameters of the developing market, necessary for the STP marketing.

-2	{ Developing Countries - Economic Index }
5	{ Developing Countries - Rate of Inflation }
15	{ Developing Countries - % from the whole market share }
7	{ Developing Countries - first optimal value of parameter }
7	{ Developing Countries - second optimal value of parameter }
7	{ Developing Countries - third optimal value of parameter }

FIGURE 4-2 EXAMPLE OF PARAMETER FILE OF BSG

The optimal values of the parameters are explained in Section 5.2.3. The flexibility of the program is ensured by the parameters set at the beginning of the game, because different parameter sets create different working environments for participants of the BSG. Modification of the parameters is the task of the Umpire.

The BSG allows the user to modify most of the parameters that are important from the viewpoint of the working environment. The text of the program can also be modified independently of the program. This feature of the BSG is unique, and allows the game to be played in any of two languages, without having to modify the program, This is further discussed in Section 4.1.4.3.

4.1.2 Processes

The theoretical background to the development of processes is described in separate chapters, but the processes of the operation of the functional parts are discussed in this section. Additionally the strategy and the evaluation process are explained and discussed here.

Before the game starts, the umpire can change the parameter set that ensures an appropriate environment for the companies. More details are provided in the Umpire's guidelines to the game, in Appendix X. The initialisation process loads the parameter file and set the important structural variables as to the

- type of the game (competitive or practice);
- number of companies;
- number of shares;
- the amount of cash available;
- the value of the firm;
- the number of managers and administrators; and
- the starting number of manual workers.

These structural variables determine the frame that constitutes the basis for the decision periods.

A report is generated from the parameter file that promotes the strategy building process. After product development, the decision on equipment can be made to provide sufficient information for the aggregate planning procedure. The aggregate production plan determines the amount of material required, and the equipment decision includes information regarding the number of manual workers required. If additional financial resources are needed, then the availability of short and long term loans and shares allow the participants to raise capital. The production activity screen provides the opportunity to determine the exact number of products, and to apply different production strategies.

The game's product distribution feature allows the participants to transfer the desired amount of the products to the different markets. The tasks, listed above, have to be accomplished in the first period. At the end of the period a "running" procedure compares the different groups, evaluates the decisions and reloads the necessary information to the companies' files. The running procedure is different, according to the playing method, as discussed in Section 4.1.4. At the beginning of the second period the products are in the market. The price, advertisement and sales promotion can be set for all products, and markets. In the meantime the production activity screen allows the refinement of the production plan, and the second, "running" procedure can take place. Managing and evaluating the working environment by using the financial tables is the basis for moving the participants from the third period to the next one. It is suggested to start the periods with the evaluation of the stocks to check the correct working of the company's strategy.

4.1.2.1 Real Life Business Processes

At the inauguration of the firm a predetermined number of shares are issued, according to the estimated value of the firm. A certain amount of cash is also available for the management. These values set the financial position of the firm, as will be discussed in Section 7.9.4.

The factors, listed above, constitute the basic conditions, and the BSG provides the framework for the business processes. The BSG has two parallel processes working simultaneously during the game. The first process is the production process, and the second is the marketing process. In the production process the factory *produces products and delivers them to existing warehouses* in different markets. The parallel process is to *sell the existing stock of products* in different markets from the warehouses.

Therefore, the market influential factors affect the level of stock in the warehouses, while the production process is directed to producing an amount of products that will be delivered to the warehouses at the end of the period. This parallel process is important in order to achieve a real life simulation of a company.

4.1.2.2 Strategy

Strategy formulation is only possible with an understanding of external and internal variables, such as market, production capacity and financial possibilities (Ward et al., 1990, p. 38). *Internal environment* comprises the relationship between the functional parts and the general inner characteristics. Participants become familiar with the main functional features under consideration by playing the game for several periods and building up experience. *External environment* is reflected in the *market report*. The report provides information about the *demand side* of markets, including the main features of the separate markets, economic indices. Additionally, the objectives that the firm has to follow, are also the part of this report. The objectives are discussed in more details in Section

4.1.2.6. These objectives are necessary for strategy formulation.

The results of a strategy building exercise are the generation of *objectives*. There are four key areas to concentrate upon, similar to Wise (1992); namely profit, return on investment, price of shares and market shares. The default value is equally 25 % for each because equal importance of the four factors is assumed. In the case of a market expansion strategy a firm can emphasise the market share instead of the other areas. An example for this strategy is Yamaha in the early 80's (Buzzel, Gale 1987, p. 9). The three other factors can dominate if the firm follows a profit-oriented strategy. However market share still has a large significance because market share and profitability are strongly related (Buzzel, Gale 1987, p. 8). Participants, whether experts in strategy or not, can benefit from the game to different extent because the BSG is a general functional game. This allows the participants to develop standalone function-based strategies.

The Umpire can change the default values of the parameter set of the objectives depicted in Figure 4-2, *before the start of the simulation*. The resulted figures of the main areas of the BSG constitute the basis of the *evaluation.* The main areas will be discussed in the following sections.

4.1.2.3 Production

The production model of the BSG includes product development, equipment, material, labour and the production process. *Product development* is the first step. The developed product provides information about the time required to produce one product. Each piece of 'equipment' has its capacity value in working hours. This value determines the number of products that can be produced with the equipment. This relationship is linear and places a constraint on the number of products that can be made. Participants can make investment decisions after the different sets of equipment are compared. In *detailed production planning* the correct number of products for each month can be fixed. The next step is to fill the production plan with the necessary number of *manual workers* and *material. Production process* can take place if the physical conditions are fulfilled.

According to the white box theory, detailed analysis of the production process will be demonstrated to help participants to follow the consequences of their decisions. The benefit of the detailed analysis is a deeper understanding of the functional processes.

4.1.2.4 Finance, Accounting

Financial resources can be extended by *short and/or long term loans,* or *shares.* The financial position of the company has to be permanently checked during the game. If the firm has run out of cash, additional resources are needed to avoid the necessity of taking out an immediate short term loan with high rate of interest, as discussed in Section 7.9.2. The necessary *financial tables, balance sheet, profit and loss account, cash flow statement and financial ratios* are appropriate means for this purpose. The accounting process is automatic; there is no need to record the different items manually. *"As if" type financial tables* are also available. The automatic process allows the participant to avoid dealing with the repetitive recording process of a firm. It means that the program collects all the changes and computes all the financial tables immediately on the basis of *current data.* Detailed description of the accounting and financial process is available to follow the probable effect of the decisions.

4.1.2.5 Marketing

The ratio, or the number of the products transferred into different markets can be directly determined. Products will be delivered automatically into the markets according to these ratios. The determination of the ratios is the only logistical element in the market processes; that means a simplified market model from this point of view. If there are products in stock, then the selling of these products is automatic according to the market influential factors described in Chapter 6.

The players control four factors: the quality of products, price, advertisement and other types of sales promotion. A fifth influential factor is the previous market share. This factor is the only one that is not under the control of the participants. The influential factors determine exactly the market share for the products. If there are more products than the market share allows to be sold, then the remaining products and the products delivered are stored together in the warehouses.

A "what if" analysis tells participants how many products would be sold if all the other variables remained constant. If participants change price, advertisement expenditure and sales promotions, according to the results of the "what if" analysis, a better decision can be made.

Detailed analysis of the marketing process is found within the marketing menu, where the opportunity is provided to participants to understand the correct behaviour of the market process, according to the white box theory.

4.1.2.6 Evaluation - Goodwill of the Firm

Evaluation and goodwill of the firm are based on common principles in the BSG. Goodwill is "the established reputation of a business" (The Concise Oxford Dictionary, 1990). The evaluation of the firm assumes that its reputation is a function of real factors within or about the company. Consequently, evaluation and goodwill have a common root in the BSG.

Goodwill is a compound of several factors that can be influenced by the company (Kotler, 1991, p. 644). The BSG applies six factors:

1. Hourly rate of wages;
2. Profit;
3. Price of Share;
4. Dividends;
5. Liquidity ratio; and

6.Market share.

The factors, listed above, allow for various points of view for the evaluation of the image of a company. In the case of share-transactions, goodwill influences the price of the shares either in a positive or in a negative direction depending on the current market situation (Hermanson et al., 1987, p. 580.). This price will be computed in the normal way (see Chapter 7, Financial Part) and after it the calculated values will be multiplied by the value of goodwill. This method can assure differentiation of firms. Table 4-1 comprises detailed computation of goodwill. The usage of goodwill within the BSG model is shown in Section 7.9.4.

```
01  .firm       94   .year    01.month

                      Own    Average Minimum Maximum %(Own/Avg) Weight  W%
Wages:               80.0     66.5    39.8    80.0     20.3      5.0    6.1
Profit (in Th.)       0.0      0.0     0.0     0.0      0.0     20.0    0.0
Value of Share    50000.0  49966.7 33300.0 66600.0      0.1     25.0    0.1
Dividends             0.0      0.0     0.0     0.0      0.0     15.0    0.0
Liquidity Ratio       0.0      0.0     0.0     0.0      0.0     20.0    0.0
Market Shares         0.0      0.0     0.0     0.0      0.0     15.0    0.0
                           ---------------------------
                                                       20.4             6.2
                                          Average       3.4             1.0
goodwill:  1.0000 *  1.0103 =  1.0103

1. goodwill:  1.0000 *  1.0103 =  1.0103
2. goodwill:  1.0000 *  0.8966 =  0.8966
3. goodwill:  1.0000 *  1.0931 =  1.0931
```

TABLE 4-1 GOODWILL COMPUTATION

Every factor has a minimum, maximum and average value to ensure comparability. Percentages will be computed as Own/Average; showing the relationship of the firm to the average. All factors have their own predetermined weight that helps to compute the final weight. The average of final weights will determine the multiplier for the previous goodwill, as shown in Table 4-1.

Goodwill plays a significant role in the evaluation process. The firm's own objectives can be set at the beginning of the game. The set of objectives adjusted by a weight system for the factors depicted in Table 4-2. The weights have to be between 5 and 50%. This system of weights allows the participants to emphasise the significance of factors, but not to totally neglect them. All groups are working according to their objectives during the game, as discussed earlier in Section 4.1.2.1. The performance of the firm depends on the divergence from the average performance, either positively or negatively. The size of the difference multiplied by the weights previously determined ensures the coefficient that is the basis of the evaluation. The computational process is the same as in the case of goodwill.

01 .firm	94 .year	01.month					
	Own	Average	Minimum	Maximum	%(Own/Avg)	Weight	W%
Profit (in Th.)	0.0	0.0	0.0	0.0	0.0	20.0	0.0
Value of Share	50000.0	49966.7	33300.0	66600.0	0.1	30.0	0.1
Liquidity Ratio	0.0	0.0	0.0	0.0	0.0	20.0	0.0
Market Shares	0.0	0.0	0.0	0.0	0.0	30.0	0.0
				ä	0.1		0.1
				Average	0.0		0.0
Evaluation : 3.50 * 1.001 = 3.50							

TABLE 4-2 EVALUATION OF THE GROUPS

The average value (3.5 in this example) is set in the starting parameter file. The resulted mark can be the basis of the final evaluation of the groups. The final evaluation is subjected to the quality of team work and reports made by the participants.

4.1.3 Playing Methods

The simulations reviewed in Chapter 3 allow the participant to start with existing firms. Continuing with an existing firm is good as a practice run, because there are pre-determined features to follow (given prices, advertisement budget and so on). A known structure can provide the participants with knowledge of the interactions and relationship in a firm. A new enterprise arises the question of more factors, such as the cost of initial investment, return on investment or return on capital. Loans or issuing shares are necessary to gain additional resources. These additional features can provide new experience for the participants and enhance their capability to consider the difficulties associated with the foundation of a new firm.

The BSG allows the participant to start a new enterprise or - similar to other simulation games - to continue with an existing company. Using an existing company offers the participants the opportunity to familiarise themselves with the behaviour and the characteristics of the simulated enterprise. Following this familiarisation it is easier for the participants to start a new enterprise.

The existing company provides the participants to start a new game with the knowledge of all of the main characteristics of the given enterprise. The learning effect is higher, if previously practised skills are applied because the managerial skills have been reinforced and provide deeper knowledge and experience.

Practice is promoted in other way as well. Participants can use the "*practice mode*" of the software. In this case they play against computer generated (artificial) competitors that can be considered as *practice mode*, as discussed in Chapter 1. In this case participants can play in their separate environment, because they are not connected to other players. The *competitive mode* allows the participant to play against real competitors, that are the other members of the groups. This playing method ensures a more realistic simulation environment because the human minds of the other members are also part of the simulation. The BSG permits the use of both playing methods.

4.1.4 Supplementary Elements

The BSG is a game which requires the participants to operate in a flexible environment where decisions have to be made before the game starts, and during the game. In the case of the BSG these *supplementary elements* enable the program to run.

4.1.4.1 Utilities

Initialisation and running are the utilities that are necessary for operating the BSG. The two playing methods - competitive and practice mode - require different operations. In practice mode initialisation is possible after each period in case of failure, or of the need to try a new strategy. In competitive mode the initialisation is restricted because the other groups in the competition could not continue the game.

In practice mode the "auto-running" menu-point ensures the transfer from one period to the next period, and is run automatically by the software. In competitive mode this function is divided into three parts. The first is the preparation, when the companies save their decisions. The second step is the market evaluation, selling procedure that determines the number of products sold and the position of the firm according to the competitors. The third step is the process of rebuilding the firm's accounting systems and evaluation files that ensures the continuos operation of the BSG.

4.1.4.2 Saving, Loading and Password

Saving and loading the current position of the company are necessary to prevent the damage caused by an accidental failure of the computer. Modifying a password is allowed if the participants want to protect the company's decision. The use of a password will allow the participants to restrict access to group members only. This gives the group a sense of security although the Umpire would still be able access the decisions.

4.1.4.3 Language and Accounting Method Change

The BSG is a two language simulation. The necessity of a two language simulation was discussed in Chapter 1. The program allows the participant to switch between the two languages. The two languages used in the construction are English and Hungarian. However, the program is flexible enough to allow the introduction of other languages without the need to modify the engine of the program.

The BSG provides the opportunity for making the accounting processes visible. The repetitive accounting process runs automatically, without appearing on the screen in the business simulations. The BSG operates in the same way, but displays the accounting records and calculations on request. If participants want to know details about the computational and accounting processes, then changing the method to "detailed computations" allows them to analyse all computational details. This part of the BSG can also be used in teaching of accounting. In the case of a business transaction, simulated by the BSG, the accounting process takes place immediately with the exception of some transactions, as discussed in detail in the Umpire's guidelines. The simulated transaction is displayed in parallel on the screen, providing the participants with a unique means of studying the accounting theory and practice.

4.2 Realisation of BSG; the Menu System

The general processes of the BSG are shown in Figure 4-1. The framework, presented in Figure 4-1 is overlaid by a menu system. The purpose of this section is to show the inter-relationships with each functional element of the game. This is accomplished through utilising a multi-level menu system.

The menu system of the BSG ensures an easy access to the functional areas. The BSG comprises a multilevel menu-system. SMALL CAPS mean elements of Main menu. **Boldface type** means second group elements under the main menu. Underlined fonts mean the third level and Times New Roman the forth level of the menu system. Table 4-3 provides an example.

MARKET:**Market decisions:** Market Research: Stock

TABLE 4-3 EXAMPLE OF THE TYPES OF FONTS

The example shows the participants where to check the level of stocks in the firm. Figure 4-3 depicts the main screen of the BSG.

```
B U S I N E S S   G A M E     MAIN MENU    1.firm        94.year    1.month     1
|| Marketing || Production || Finance || Labour || materiAl || Equipm. || Utilities ||




F1 Help F2 P&L F4 B.Sheet F6 Cash-Flow F8 Ratios F10 All
```

FIGURE 4-3 MAIN SCREEN OF THE BSG

4.2.1 Report

The report is an information source file that contains the external and internal information necessary for strategy formulation. The place of the report is:

MARKETING:**Report**

Table 4-4 depicts some elements of the report. The complete output of the report file is provided in Appendix V.

```
 General information about the firm:

!  Number of firms                               3 !
!  The Value of Building of Factory    100000000 !
!  Estimated value of the firm          50000000 !
!  Number of Shares                         1000 !
!  Interest of Long term credit,  %/year       6 !
!  Expiry of Long term credit, month          36 !

...

 Results of Market Research

!  The maximum capacity of all markets    600000 !
...
 The Objectives of your firm :

!  Return on Investment as strategic obj.     20 !
!  Value of Shares as strategic objective     30 !
!  Profit as strategic objective              20 !
!  Market Share as strategic objective        30 !
```

TABLE 4-4 PARTS FROM *REPORT*

4.2.2 Production

The R&D activity, product development, aggregate production planning, the production screen and the production details appear under the *Production* menu. Labour, material and equipment are in different parts of the main menu as shown in Table 4-5. The production activity screen, product development and aggregate production planning control with the production process are under one menu-part. Labour, material and equipment are the physical components of the production process, and are separated into different menu-points.

Functions	**Place**
Production Planning	PRODUCTION:Production Planning
Product Development	PRODUCTION:Choice, Development
Production Details	PRODUCTION:Details
Production	PRODUCTION:Production
Employees	MANPOWER
Material	MATERIAL
Equipment	EQUIP.

TABLE 4-5 PRODUCTION FUNCTIONS AND PLACES

The theoretical background of production is discussed in detail in Chapter 5.

4.2.3 Finance, Accounting

The financial tools of the BSG are under the main menu-point of *Finance:Loans, Shares.* The operation of loans, shares and dividends are available from this menu-point. Two additional menu-points supply further facilities. They allow for the listing of shares and loans. Table 4-6 depicts the list of the finance menu. Grouping the financial activities under one common menu-point facilitates the location of the related activities.

Functions	Place
Short term Loans	FINANCE:Loans,Shares:Short term Loans
Long term Loans	FINANCE:Loans,Shares:Long term Loans
Issue of Shares	FINANCE:Loans,Shares:Issue of shares
Buying(own)Shares	FINANCE:Loans,Shares:Buying(own)share
Dividends	FINANCE:Loans,Shares:Dividends
List of Loans	FINANCE:Loans,Shares:List of Loans
List of Shares	FINANCE:Loans,Shares:List of Shares

TABLE 4-6 FINANCE FUNCTIONS AND PLACES

Section 7.9 provides more details about the financial possibilities of the BSG.

Accounting elements are also under the menu point of *Finance*. According to the white box theory, a number of functions ensure that the details of the accounting events can be followed. More details are provided in Chapter 7. The accounting tools and their places are shown in Table 4-7.

Functions	Place
Income Statement	FINANCE:Balance Sheet
Balance Sheet	FINANCE:Income Statement
Cash-Flow	FINANCE:Cash-Flow
Financial Ratios	FINANCE:Financial Ratios
Accounting Details	FINANCE:Accounting Details
Accounts	FINANCE:Accounts
Detailed Data	FINANCE:Detailed Data
Detailed Accounts	FINANCE:Detailed Accounts
Accounting Items	FINANCE:Accounting Items

TABLE 4-7 FINANCIAL FUNCTIONS AND PLACES

Accounting details comprise all accounting items that were recorded in the last period. *Detailed accounts* contain the last group of accounting activities that occurred. An example is the *Material* part of the BSG where the recorded events in connection with material ordering are listed. Participants can see the accounts in the general ledger under the menu point of *Accounts*. This will allow the participants to trace where figures are coming from. *Detailed data* provides the details of building up the financial tables and ratios. In this part of the accounting model every rule and line of entry is visible to the participants. Chapter 7 provides the details of accounting processes.

4.2.4 Marketing

The marketing mix elements can be found in the *Market decisions* screen. Table 4-8 describes the sub menu-points of market decisions.

Functions	**Place**
Distribution	MARKET:Market Decisions:Distribution
Price	MARKET:Market Decisions:Price
Advertisement	MARKET:Market Decisions:Advertisement
Sales Promotion	MARKET:Market Decisions:Sales Promotion
Quality	MARKET:Market Decisions:Quality
Trial	MARKET:Market Decisions:Trials
Market Research	MARKET:Market Decisions:Market Research

TABLE 4-8 MAIN MARKETING FUNCTIONS AND PLACES

The products are distributed amongst the markets in different percentages. Price, advertisement, sales promotion, quality and distribution are all the elements of marketing mix. This is the reason for placing them under a common menu-point. However, the distribution process is related primarily to the production process, while the others are related to the marketing process, as discussed in Section 4.1.2.1.

The *Trial* menu point is specially designed for this BSG. The role of *Trial* menu is to predict the expected number of product sold. It provides the participants with the opportunity to test the *probable effect* of different market influential tools, such as price, advertisement expenditure, sales promotion and quality. If every other condition is constant, then the effect of change in one factor can be assessed by the *Trial* screen. Furthermore, this menu point supports the decision making process and the level of the marketing mix elements can be estimated

Market research provides up to date information about the other companies' data, including estimation of prices, advertisements, sales promotion, market shares and even the stocks. Additionally, the BSG allows the participants to set competitor data and test the probable effects of the predicted decisions.

These standalone possibilities provide the participants with additional means to study the behaviour of the markets, according to the white box theory, discussed in Section 1.2.9. Table 4-9 depicts the types of data provided by market research. The place column in Table 4-9 starts with the third level menu point of Market Research, that means in this case: MARKET:**Market decisions**:Market Research:.

Functions	**Place**
Price	Market Research:Price
Advertisement	Market Research:Advertisement
Sales Promotion	Market Research:Sales Promotion
Quality	Market Research:Quality
Sales	Market Research: Sales
Market Shares	Market Research:Market Shares
Remainder	Market Research:Remainder
Stock	Market Research:Stock

TABLE 4-9 MARKET RESEARCH FUNCTIONS AND PLACES

The *Sale* comprises the sales in units. *Market share* is reported in percentages. *Remainder* contains the stock left after the selling process while the *Stock* data shows the additional amount of the product produced in the current period.

4.2.5 Supplementary Elements

The summary of utilities is depicted in Table 4-10. Evaluation and goodwill are parts of this section that are separated from the main functional areas of the firm. The main functional processes of the business life - production, marketing, accounting and finance - are also the main part of the BSG, and take up the five main menu points, as shown in Figure 4-3. All the other activities, not connected to the functional areas, are separated into a utility menu-point.

Functions	**Place**
Preparing	UTILITIES:Preparing
Renewing	UTILITIES:Renewing
Running	UTILITIES:Running
Auto-running	UTILITIES:Auto-running
Saving Data	UTILITIES:Save
Reloading Data	UTILITIES:Load
Initialisation	UTILITIES:Initialise
Modify Password	UTILITIES:Password
Accounting Method	UTILITIES:Accounting
Language Change	UTILITIES:Language
Goodwill	UTILITIES:Goodwill
Evaluation	UTILITIES:Evaluation

TABLE 4-10 GOODWILL AND EVALUATION

The menu system ensures the accessibility of the functional parts of the BSG and provides a special menu point for detailed explanation of the functional parts. Moreover, the menu system enhances the opportunity to use the BSG as an effective learning tool.

4.3 References

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PART II - A NEW BUSINESS SIMULATION MODEL

CHAPTER 5 - PRODUCTION MODEL

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The main purpose of this chapter is to introduce the production model used in the development of the BSG. A concise overview of the role of production will enable the user to understand the interactions between the different parts of production, such as production planning, research and development (R&D), material, labour and equipment. All parts of the production model will be illustrated by the use of examples.

The production model has three unique features. Firstly, the model, as an interactive tool, enables the participants to understand the meaning and interaction of such theoretical notions as marginal and average production and cost functions. Sections 5.3.5 and 5.3.6 describes the theoretical background and the applications of the marginal and average production and cost functions and their usage. Secondly, the production activity control for the BSG takes place on one screen, collecting all the important information about the shop floor activities and presenting the participant with a single input screen for their decisions, as discussed in Sections 5.3.7. Thirdly, a unique capacity planning screen provides an interactive tool that enables the participants to follow the consequence of their decisions, as shown in Section 5.3.1.1.

The BSG allows the introduction of concepts new to the user. This is especially useful for learners in countries with a transition economy, as discussed in Chapter 1. It promotes the participants to enhance their learning by giving them a platform to apply and test their knowledge. At the end of each section a paragraph will explain the use of the theory in the BSG.

The discussion of the role of production in Section 5.1 provides a frame for the important production parts including production design, capacity management and production process. The BSG contains these necessary elements to some extent, but not all the details are modelled in the game. However, the knowledge of the production theory facilitates the understanding of the production model of the BSG.

The following issues are discussed in this chapter:

- *The role of production in the company*
- *Product design* (R&D activity)
- *Capacity management*
  Long range planning
    Resource capacity planning

Medium range planning

Aggregate production planning

Master production scheduling

Rough-cut capacity planning

Short range planning

Material and capacity requirements planning

Implementation

Production activity control

Purchase planning and control

The inputs and outputs to the production model of the BSG are listed below.

Research and development

Input values:

- Values of the three quality parameters;

Output values:

- Development cost;
- A product, recorded in the product file;
- Amount of materials that is necessary for producing one product; and
- Production time of one product.

Aggregate planning part

Input values:

- Number of products in every month, based on the company's planning activity;

Output table:

- Aggregate production plan;

Production process:

Input values:

- Quantity of ordered materials (material part);
- Number of hired workers, fired workers and their hourly rate (labour part);
- Type of equipment investment; and
- Number of products produced by the equipment.

Output values:

- Amount of material used;
- Remaining material;
- Amount of working hours used;
- Remaining working hours;
- Equipment, recorded in the equipment file;
- Short run production function;
- Short run cost function;
- Global production function;
- Global cost function;
- Detailed analysis of the production process.

5.1 The Role of Production in the Company

Riggs (1987, p.7) defines the production system as a design process that contains processes and activities.

> "A production system comprises the processes and activities required to transform elements into useful products and services. " (Riggs, 1987, p.19)

Chase and Aquilano (1985, p. 6.) presented a chart to illustrate the role of production system. This chart is shown in Figure 5-1.

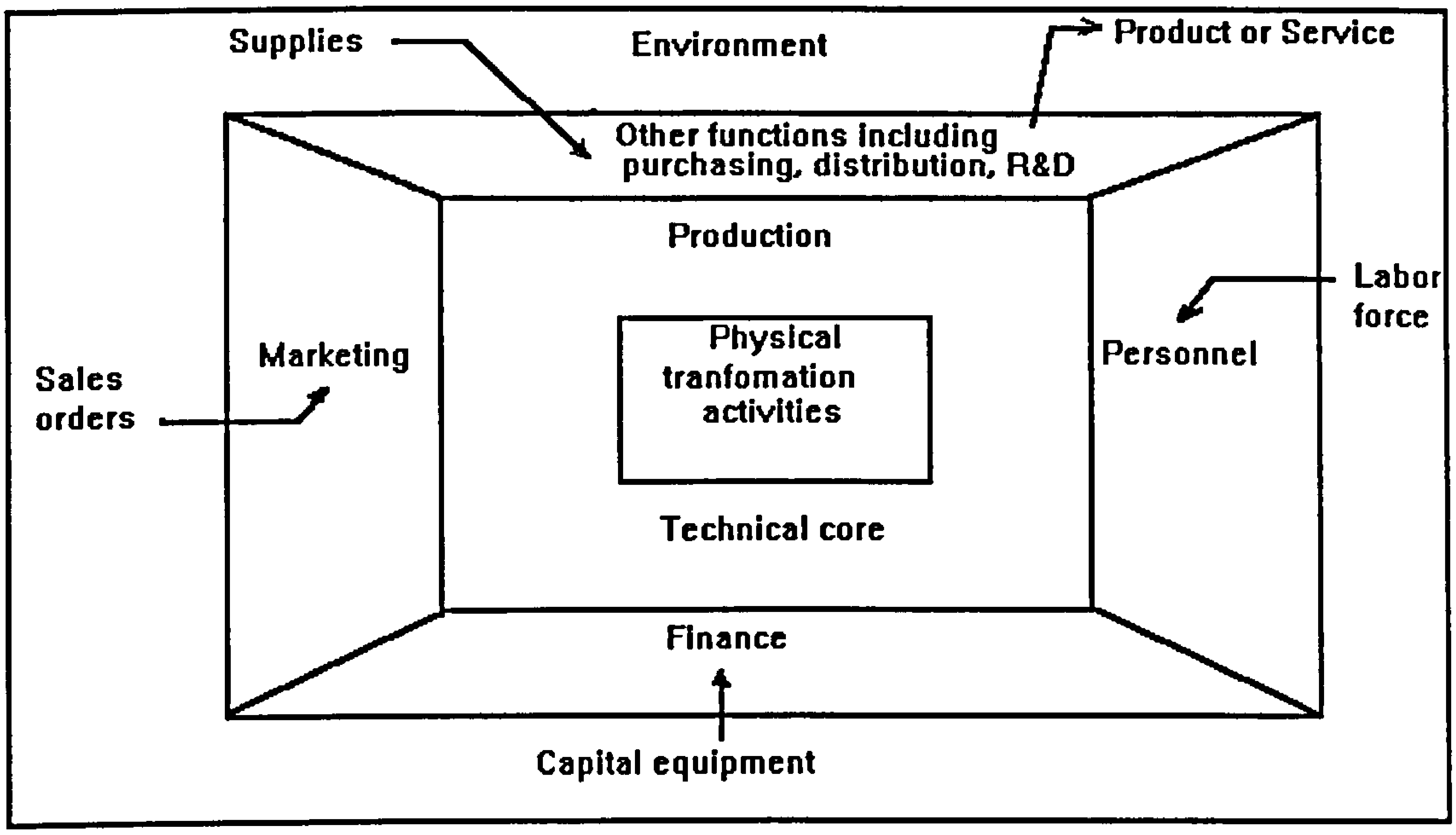

FIGURE 5-1 RELATIONSHIP BETWEEN PRODUCTION FUNCTION, OTHER ORGANISATION FUNCTION AND THE ENVIRONMENT

According to Figure 5-1, the sales department receives orders. Supplies and raw materials are obtained through the purchasing function. Finance function ensures that there is sufficient capital for equipment. Labour force is obtained through the personnel function and the distribution function ensures the delivery of products (Chase and Aquilano, 1985, p. 6.).

One of the key decisions in the life of production system is *product design* (Chase and Aquilano, 1985,

p. 13). The importance of the production design is supported by Waterman (1994, p. 192-194). Procter and Gamble (P&G) spent an equivalent of three percent of the global sale on R&D, in 1992. Motorola spent even more, ten percent of its sales on R&D. John Smale and Ed Artzt, the chairman and chief executives of Procter and Gamble deeply believe that "the company's commitment to research and development is central to its 150 year history of success." (Waterman, 1994, p. 193). The product design issues are discussed more fully in Section 5.2.

After the final production design there is process selection, and the downstream production decisions, including *capacity planning, production planning, and scheduling* (Chase and Aquilano, 1985, p. 29).

> Each individual product, model, or unique item a company produces may require a unique set of materials and components and a unique series of work tasks." (Dilworth, 1992, p.303)

Design, planning, operation and control of operation systems constitute operations management. Perhaps the most important and difficult task of operation management is the effective management of capacity, that is to match or balance the level of operations to the level of demand (Wild, 1980). Manufacturing operations are processes that transform some material input into some material output (Chase and Aquilano, 1985, p. 34).

The main parts of production, the *product design* and *capacity management* including the *production process,* will be discussed in the following sections.

5.2 Product Design (R&D Activity)

A comprehensive overview of research and development is not necessary because the BSG is not primarily focused on this area. However, the importance of R&D in a business supports the inclusion of product development into a business simulation. Product quality is an important factor of marketing success, as discussed in Section 6.2.1. This provides further arguments for the inclusion of facets of R&D in the simulation. A product development has additional features that are necessary for a simulation. An example facilitates the understanding of the product design in the BSG, described in Section 5.2.3.

5.2.1 Importance of R&D, a Survey

Section 5.2.1 alludes to the importance of R&D as a means of maintaining a competitive strategic edge. Riggs defines research and development as follows:

> " ... most of the advances were originated by teams of scientists and engineers devoted to seeking knowledge. This effort is broadly classified as **research and development (R&D)**. " (Riggs, 1987, p.34)

The importance of R&D activity in business simulations is reinforced by Mergen and Pray (1992), Pray and Methé (1991), and Thavikulwat (1992). Mergen and Pray (1992) argue that the quality improvement process must be steered towards excellence by top management. Pray and Methé (1991, p.23) differentiate three possible behaviours in the area of R&D. First, a firm may choose to not engage in applied research. Second, a firm may choose to be the "prime mover" in the industry. This is a realistic proposition, because the BSG models an oligopolistic market. Third, a firm bears only a moderate level of applied research and is waiting for the moment to move in as a "fast second" to take advantage of the market opportunity presented by somebody else's innovation. Managers and students can not experience innovations on a daily basis, and participants "need the opportunity to experience the various types of technological environments" (Pray and Methé, 1991, p. 280). The BSG follows the second method where the firm is a "prime mover" because of the oligopolistic market where the firms in the competition are the only participants. Thavikulwat (1992, p. 434) argues from the marketing point of view: "If the market is modelled, then a model accounting for product quality is required; if it is real, then a procedure is required".

Section 5.1 quoted a 150 year history of success of Procter and Gamble. Procter and Gamble's basic products, that make the company profitable, were real innovations (Waterman, 1994, p.193). Merck, Motorola and Rubbermaid maintain a strategic edge also through raw innovation (Waterman, 1994). Being at a strategic edge can result in financial reward. Managers have to put more quality into what they do, and it must cost money (Waterman, 1994, p.229).

> "A firm engages in R&D to maintain or improve its competitive position. Discoveries may lead to products, improved products, better production processes, and refined technical services. " (Riggs, 1987, p.40)

Total quality investment at Motorola yielded $3.2 billion between 1987 and 1992 (Waterman, 1994, p.229). Motorola and similar multinational firms can afford significant research and development activities, but research and development activities need a certain company size because of their considerable capital requirements.

> "About 85 percent of all R&D scientists and engineers are employed by firms with more than 5000 employees. The majority of all R&D funds are spent by five industries: aircraft and missiles, electrical equipment and communications, chemical and allied products, machinery, and motor vehicles. " (Riggs, 1987, p.37)

R&D activity has to focus on the consumer to ensure the strategic edge for the product. Peters and Waterman argue that product ideas come mainly from listening to the customer (Peters and Waterman, 1982). "For years P&G has charged its R&D people with the responsibility for understanding the consumer" (Waterman, 1994, p. 203). The expectations of the consumer constitute the main features of a developed product. A product's specifications are the critical output of the product design from the production manager's point of view (Chase and Aquilano, 1985, p. 30). The BSG provides a tool for product development that facilitates the understanding of the environment that influences the quality of the product. Facets of the products that the students can specify are discussed below.

5.2.2 The Product Design Model of the BSG

The main characteristics of the product in BSG (product's specification) can be specified using several parameters. Each is discussed in the following paragraph. These are:

- *Three main properties*

  Quality has a decisive importance as discussed in Section 5.2.1. The opinion of Procter and Gamble's researchers about the success of P&G is that "much of their progress depends on how well they can measure what they are trying to achieve." Quality can be measured for simulation purposes. This measurement can only be accomplished by a simplified model. Three parameters were used in a simulation game of Carnegie Tech University (1978) to express the three main properties. The BSG also models the main features of the product, with three parameters. Depending on the learning objective, the Umpire can either specify, or not specify the precise nature of the three quality parameters. These parameters define the quality level of the product. The decision to use a few parameters to describe the prominent features of the product are supported by factor analysis. In the BSG the participants make decisions about product quality when they determine the three product parameters.

- *Hours, needed to produce the product*

  Increased productivity is one of the basic objectives of the firm's efforts. A pure reason for the automation of factory is the attainment of greater productivity (Chase and Aquilano, 1985, p. 771). Greater productivity results in production of more products per unit of time. The productivity motivation of the firm supports that every successive product needs less time to be produced. The production time is automatically determined by the program. One unit of the second product needs less time to produce than one piece of the first product, and the third product is more productive than the second one. An example of this can be found in Section 5.2.3.

- *Composition of material in the product*

  A product design has to fulfil the customer's needs. Customer's satisfaction is dependent upon quality, as defined from the customer's point of view. The continuous improvement of quality can also be accomplished by improving the quality of raw materials (Mergen and Pray, 1992, p. 277). Better quality materials imply better quality product. The BSG assumes that the higher the quality of the product, the better quality materials the product uses. Two types of materials are allowed in the BSG for expressing the difference between the products: better and average quality materials. The quality of the product determines the material composition of the product in the BSG, as shown in Section 5.2.3

- *Development cost*

  Managers have to put more quality into what they do, as discussed is Section 5.2.1. The BSG assumes that more quality implies more effort and more cost. The development cost is higher in the case of better quality product, and also determined by the quality of the product. The participants always know the R&D cost of quality, as it is shown at the bottom of Table 5-1

Other business simulations allow for diversity of products and product range, as summarised in Table 3-3. The BSG permits one range, but three different types of products. The three products that are allowed in the BSG can serve similar purposes, like three types of soaps, cars or computers. The type of product is not predetermined because the market features can be changed in the parameter file of the BSG according to the type chosen.

Production development needs time. Carnegie Tech Simulation used one time period lag to put the product into production. However the intention of the acceleration of the simulation process is also explainable. The BSG reduced the development time to just below one period. The time reduction allows the participants to put the product into production at the same period when the product was developed. This time reduction has the benefit of faster production activity, hence the opportunity of accomplishing the planned strategies.

5.2.3 Product Design - Example

Table 5-1 shows the product development screen of the BSG. "Material" means the material types, as shown in the material section later. The "Quality" part consists of three parameters, as discussed in Section 5.2.2., while "Hour/pieces" is the productivity feature, the necessary hours for producing a product.

Products, Production Development							1.firm		94.year	6.month	1
	Material						Quality			Hour/
	A	B	C	D	E	F	1.PAR.	2.PAR.	3.PAR.	pieces
1 product:	10.00	0.00	0.00	10.00	0.00	0.00	5.00	5.00	5.00	0.480
2 product:	19.00	0.00	0.00	1.00	0.00	0.00	9.00	10.00	9.00	0.456
							Cost of Development :			4470118

TABLE 5-1 PRODUCT DEVELOPMENT SCREEN OF THE BSG

The three quality parameters can be classified from 0 to 10. The development cost is higher in the case of a better quality product, and is also determined by the quality of the product. The calculation of the total value is also derived from the Carnegie Tech Simulation, that stresses the importance of the second parameter. The total value of a developed parameter can be determined by the following equation:

$$VD = p_1 + 2 * p_2 + p_3$$

where

VD = total value of developed product

p_x = parameters, where x is the serial number of parameters from 1 to 3.

The first product of the company is an average product with average parameters (with parameter values of 5, 5, 5). The total value of the first product is:

$$VD_1 = 5 + 2 * 5 + 5 = 20$$

The final value of the product in one specific market will be different from the original value of the product. The expected parameter values of the various markets are given in the parameter list of the game. The difference between the two parameter sets will alter the total values. This example illustrates the final value of the average product in the developing market. The expected values of this market are 7, 7, 7 for the three parameters as illustrated in Section 4.1.1.3, in Figure 4-2. The differences of the parameters will be deducted from the total values.

Differences:

$$Dif_{ij} = abs(EP_{1j}-P_{1i})+abs(EP_{2j}-P_{2i})+abs(EP_{3j}-P_{3i})$$

$$FD_{ij} = VD_i-Dif_{ij}$$

where

i = product

j = market

Dif_{ij} = Difference at the market j at the product i

FD_{ij} = Final value of the quality of the product in the specific market

EP_{xj} = Expected parameter value in the specific market

Example

$Dif_{11}=(7-5)+(7-5)+(7-5) = 6$

$FD_{11} = 20 - 6 = 14$

The product needs equal amounts of both types of materials. The total amount of materials used are fixed. The amount required for producing 1 unit of product is 20 units of materials. The amount of the better quality material is calculated at first on the basis of the following equation:

BQM = ROUND (VD / 2)

AQM = 20 - BQM

where

BQM = amount of better quality material

AQM = amount of average quality material

ROUND makes round of VD/2.

The second product has higher parameter values, and it needs better quality materials ("A" material is from the better quality materials.) and less from the other type of material ("D" is from the average quality materials). The amount of materials can be calculated as:

VD = 9 + 2 * 10 + 9 = 38

BQM = ROUND (38 / 2) = 19

$$AQM = 20 - BQM = 20 - 19 = 1$$

More details about the materials can be found in the material section of this chapter.

The development cost of the second product is shown at the bottom of Table 5-1. The development cost is determined by the total value of the developed product (VD), that was calculated earlier in this section.

$$CD = EXP(VD/10) * 100000$$

The ratio of VD/10 measures the relative quality that is stressed by the exponential form. This adjustment is accomplished by the multiplication of 100000. The development cost of product 2 is:

$$CD = EXP(38 / 10) * 100000 = 44.70118 * 100000$$
$$= 447018$$

The working hours needed for the production is calculated in the program by the equation of:

$$WH = 0.504 - SN * 0.024$$

where

WH = amount of working hours needed for one product an hour

SN = serial number of the new product

WH for the second product is calculated as

$$WH = 0.504 - 2 * 0.024 = 0.456$$

In the product design of the BSG the participants only make decisions about the parameters to set for the level of quality of the product. The composition of materials is determined by three parameters; while the working hours needed for one unit of product is calculated by the program.

5.3 Capacity Management

The effective management of capacity is achieved by matching or balancing the level of operations to the level of demand, as shown in Section 5.1. Aggregate planning, material, labour and equipment are connected with capacity, and capacity management co-ordinates the different subparts that are concerned with capacity. Capacity planning includes long, short and medium range planning differentiated by a time dimension (Chase and Aquilano, 1985, p. 411). Long range planning has to determine the organisations' objectives and goals for the next two to ten years. Medium range planning focuses on the output requirements up to 18 months into the future. Medium range is the means for balancing the input and the output side of production. Short range planning covers the period from one day to a few months and

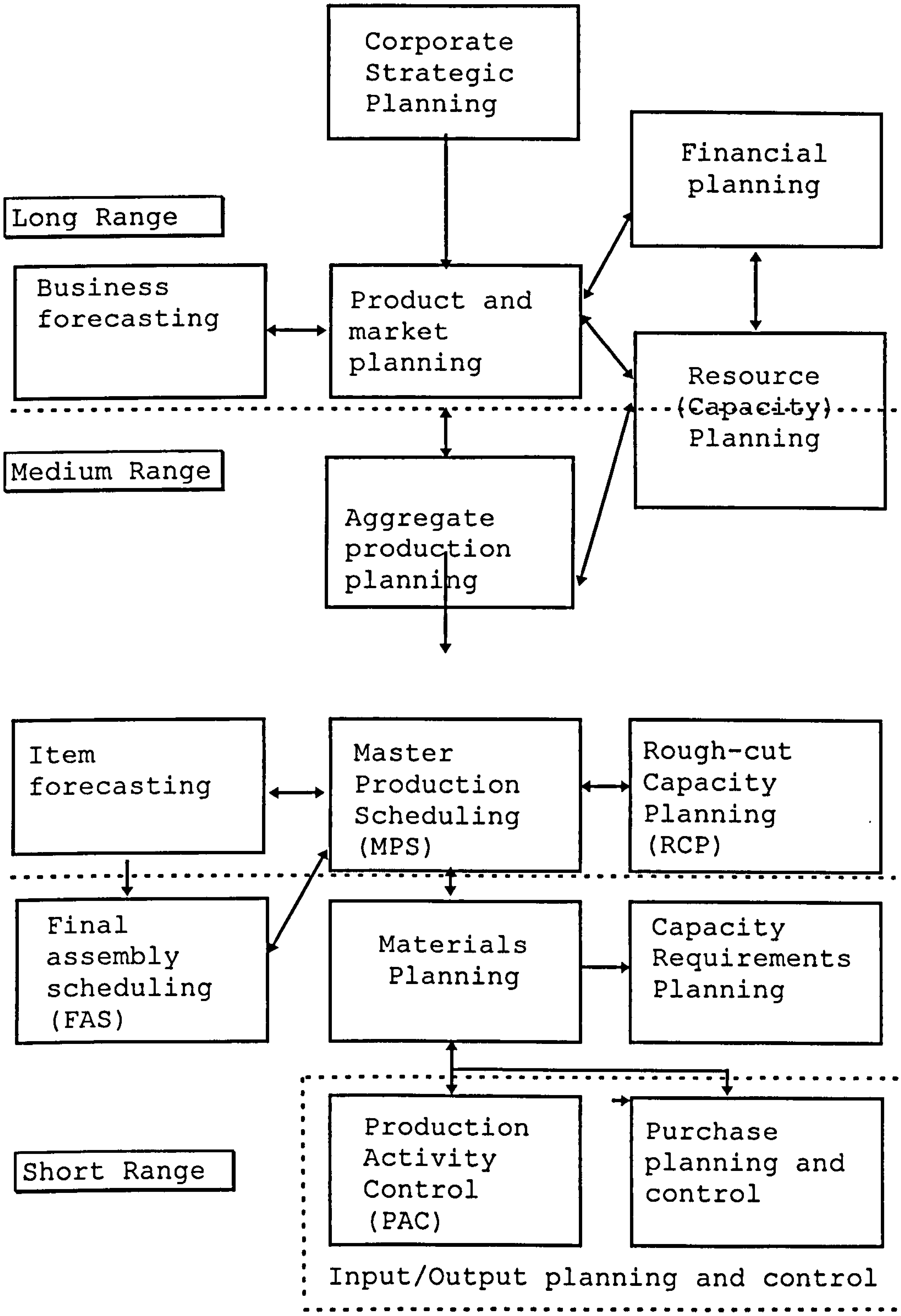

FIGURE 5-2 AN OVERVIEW OF MANUFACTURING PLANNING ACTIVITIES
(From Chase and Aquilano, 1985, p. 411).

its primary task is scheduling (Chase and Aquilano, 1985, pp. 410-413). Management is really involved in long and medium range planning activities. Moreover, Wild (1980, p. 12) argues that capacity management is a medium to long term problem area. Figure 5-2 depicts an overview of capacity management.

Two important processes are shown in this figure. The first is the co-ordination process; the process that co-ordinates the available and the planned resources. The second is the implementation process that deals with the execution of the accepted plan. The co-ordination process includes the three parts of the implementation process - long, medium and short range planning. The implementation process will be discussed later in this chapter.

5.3.1 Long Range Planning

The main role of long range planning is to set goals and objectives. Corporate strategic planning "articulates how these objectives and goals are to be achieved" (Chase and Aquilano, 1985, p. 411). The long time range allows new equipment to be brought into the production process. Capital investment decisions are long term decisions in a business firm's activity.

> "Capital investment decisions normally represent the most important decisions that an organization makes, since they commit a substantial proportion of a firm's resources to actions that are likely to be irreversible." (Drury, 1992, p. 353)

Investment in production equipment and machinery is one of the key investment decision of a firm. This decision is a strategic decision of a firm when estimated demand is revealed from the market research report, or from previous experiences. The investment decision can be supported by business forecasting.

The BSG allows the student to make the long term capital investment on the basis of a market research report that depict the current situation of the firm and the forecasted market demand. Decisions, made by students in the product development phase (Section 5.2.2.) determine the time requirement for production of the product. This information should be utilised by the participants to choose the necessary equipment for the production. The equipment and the product(s) can determine the upper limit of the production possibility that is the basis of rough-cut capacity planning. Consequently, the BSG enables the students to understand the relationship between new product design and future capacity requirements.

5.3.1.1 Investment - Example

Table 5-2 comprises the initial information file that contains relevant information about the firm and about the market. The information file is available to the participants. The information file supplements additional information that helps the investment decision of the firm. The relevant information in Table 5-2 is the 20 million of cash and the 50 million that is also cash, derived from issuing shares based on the estimated value of the firm. The other part of the file contains the global market demand.

°	The Value of Building of Factory and Stock	:	100000000	°
°	The sum of Starting money	:	20000000	°
°	Estimated value of the firm	:	50000000	°
°	Number of Shares	:	1000	°
°	Interest of Long term credit, %/year	:	6	°
°	Expiry of Long term credit, month	:	36	°

TABLE 5-2 PART OF THE INITIAL INFORMATION FILE

The investment screen in Figure 5-3 comprises *unique capacity planning features*. Figure 5-3 depicts the main features of five sets of equipment to choose from. The differences between the sets of equipment are only in capacity, price and working force requirement. The other technical parameters, such as reliability and maintenance cost are the same.

Machines, investment decisions 1.firm 94.year 10.month 1

	Place	Capacity	Gross Value	Acummulated depreciationt	Type of depr.	Optimal workers
Own :	1	80000	26000000	4333333	1	400
	2	50000	18000000	0		270
	Σ	130000	44000000	4333333		670
You can produce		277777	< 0.468 hour / pieces >			
Choice :	A	80000	26000000	0		400
	B	120000	50000000	0		550
	C	50000	18000000	0		270
	D	70000	18000000	0		370
	E	60000	18000000	0		330

Press Esc to Quit ! Num-Lock Overwrite

FIGURE 5-3 EQUIPMENT INVESTMENT

The upper part of the equipment screen shows the characteristics of equipment already owned by the firm. "Place" means the serial number of place that an equipment occupies. "Capacity" comprises the working hours capacity of the set of equipment in one period. Gross value shows the price of the equipment. The type of depreciation used can be linear or double-declining-balance method (Samuelson, 1985). Both types allow the student to evaluate the expected consequences of the depreciation forms.

The upper part of the screen in Figure 5-3 is the place for analysis. The "Own" part in the row "Place 1" shows the firm's existing set of equipment. The second row, "Place 2" shows the set of equipment that the participants have already chosen. This example depicts the features of a set that has a capacity of

50000 hours. The summary line (Σ) comprises the compound features of the consequence of a presumed machine investment, including the whole production capability of this equipment. The next row indicates a "what if" analysis that calculates the number of products that the firm could produce.

The lower part of the screen shows the choice of the equipment set from which participants can choose. According to their choice, the upper analysis screen constantly provides the possible global situation.

The long range planning process contains parts that can be accomplished by the participants mostly in written form. The results of the calculations provide the basis for the firms' decisions that are the inputs for the BSG. These inputs are a developed product and an investment decision as necessary components for medium range planning.

5.3.2 Medium Range Planning

Chase and Aquilano (1985, p. 412) define aggregate planning as a medium range technique. Aggregate planning has a decisive importance in production processes because "aggregate planning deals with translating annual business and marketing plans into a production plan for all products." (Chase and

Aquilano, 1985, p.410). After the aggregate production planning, the item forecasting, master scheduling process, and rough-cut capacity planning determine the final number of products produced in the medium range as shown in Figure 5-2. The BSG allows the user to input the final number of product into the simulation but it does not promote the medium range planning process in an interactive way. The input process is illustrated by an example in Section 5.3.2.3.

5.3.2.1 Aggregate Production Planning

Aggregate production planning combines similar products into product group (Fogarty et al., 1991, p.121, Vörös, 1991, p. 37). A combined group facilitates an improved planning process because the level of complexity decreases. A simplification is also useful for modelling purposes that allows the usage of mathematical models. Chase and Aquilano (1985, p. 415) formulate a formal statement of the aggregate planning problem.

> "...given the demand forecast F_t for each period t in the planning horizon that extends over T periods, determine the production level P_t, inventory level I_t, and work force level W_t for periods t = 1,2, ...,T that minimize

the relevent costs over the planning horizon." (Chase and Aquilano, 1985, p. 415).

The more prominent methods of aggregate planning include the following (Fogarty et al., 1991, p. 58)

- Trial and error or heuristic methods;
- Linear programming cost minimisation (LP);
- Linear decision rules;
- Search decision rules (SDR);
- Goal programming (GP); and
- Simulation.

Trial and error approach are the most commonly used method, because nearly all organisations have developed planning rules based on their experience. Other methods have slowly gained greater acceptance. Trial and error methods consist of the following steps (Fogarty et al., 1991, pp. 58-59):

1. Initial production plan;
2. Determine the plan within capacity constrains;
3. Cost the plan;
4. Prepare another plan to know cost, and compare them;
5. Repeat the process from Step 2 to Step 4 until a satisfactory plan is derived; and
6. Perform sensitivity analysis to cost rate, cost of hiring and demand.

The trial and error methods result in an aggregate production plan. Figure 5-2 indicates that the aggregate plan will be accomplished by item forecasting, master production scheduling (MPS) and rough-cut capacity planning (RCCP). The methods above refine the aggregate production plan. The next section will discuss the item forecasting, MPS and RCCP.

5.3.2.2 Item Forecasting, Master Scheduling Process and Rough-Cut Capacity Planning

Estimation of the amount of a specific product is accomplished by item forecasting that become the output requirement for the master production schedule (Chase and Aquilano, 1985, p. 412). Master scheduling (MS) provides the supply to meet the demand. MS is a means that divides the products and services at specific work centres (Fogarty et al., 1991, p. 121). The primary output of MS process is the master production schedule (MPS). MP is a planned capacity utilisation and specifies the end items the organisation anticipates manufacturing each period (Fogarty et al., 1991, p. 122). The plan refers to every time period within a year. Rough-cut capacity planning "reviews the MPS to make sure that there are no obvious capacity constraints that would require the schedule to be changed." (Chase and Aquilano, 1985, p.

412). The validation process that co-ordinates the available and planned resources has been termed rough-cut capacity planning (RCCP) (Fogarty et al., 1991, p. 404). The BSG participants have to accomplish the three elements of aggregate planning. The final result is the input for the BSG. This will be illustrated in the next section.

5.3.2.3 Medium Range Planning - an Example

Product development determines the working hours needed for one product, as discussed in Section 5.2.3. Long range investment decision determines the capacity of a set of equipment in working hour, as illustrated in Figure 5-3. The BSG pre-estimates the maximum number of products that can be produced in a time period. Figure 5-4 depicts the planning screen of the BSG.

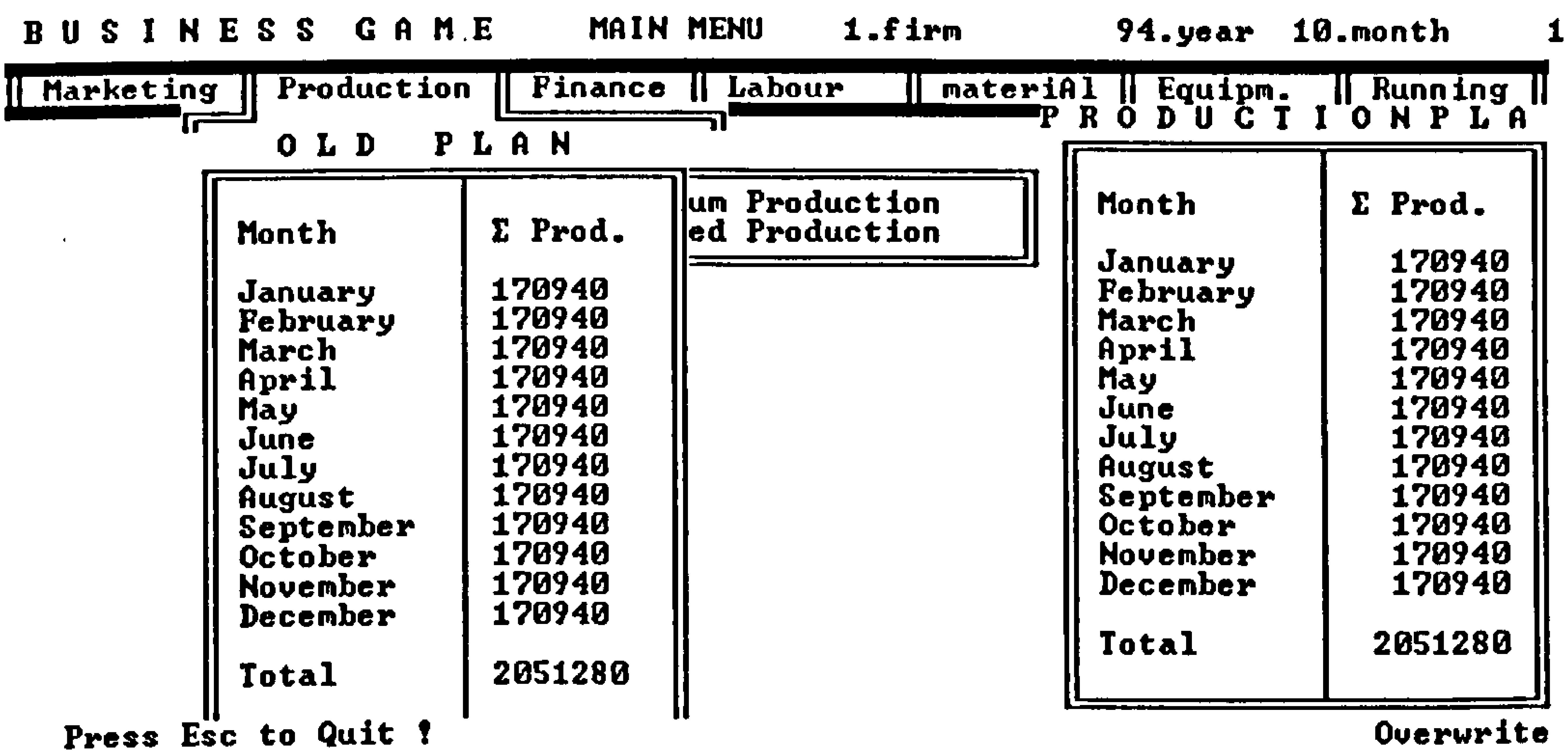

FIGURE 5-4 SCREEN OF ROUGH-CUT CAPACITY PLANNING

There are pre-estimated capacity values on the screen. However, a maximum and a reduced value can be chosen before getting to this screen. The reduced values are 80% of the maximum production capacity. The pre-set values can be modified according to the medium range planning process, accomplished by the participants. Data, derived from the rough-cut capacity planning process, facilitate the ordering of material (in Section 5.3.7.1.1) in the material model and provide a basis for the short range planning activities in the production activity control process. The short range planning activities are promoted by the BSG interactively. This process is further discussed in Section 5.3.3 and 5.3.7.

5.3.3 Short Range Processes

Figure 5-2 indicates that the short range planning methods include final assembly scheduling, material requirement planning and capacity requirements planning, as co-ordinated processes. The final assembly scheduling "provides the operations required to put the product in its final form." (Chase and Aquilano, 1985, p. 412). This feature of short range planning is missing from the BSG because this function cannot be modelled properly within a business simulation. Capacity requirement planning (CRP) "is a process of determining how much labour and machine resources are required to accomplish the tasks of production." (Fogarty et al., 1991, p. 430). The machine resource part of the CRP was discussed in Section 5.3.1.1, because the investment decisions refer to the long range, and determine the limit of machine resources. The labour part of the CRP will be discussed within the range of short term decisions in the implementation section in Section 5.3.4 and Section 5.3.7.1.1.

The implementation processes (production activity control and purchase planning and control) are separated from the co-ordination processes and are discussed separately.

The BSG provides the same interactive tools for the short range co-ordination and implementation decisions for either the material, or the labour factor. Both the labour and the material component are described in the implementation section.

5.3.3.1 Short Range Planning of Capacity and Material

CRP and Material Requirements Planning (MRP) have the same role in short range planning. RCCP co-ordinates the planned and the available resources in medium range techniques, as discussed in Section 5.3.2.2.

> "Capacity Requirement Planning is a detailed comparison of the capacity required by the material requirements plan (MRP) and by orders currently in progress versus available capacity. CRP verifies that there is sufficient capacity to process all orders due to be released within the planning horizon. This verification generally constitutes a final acceptance of the master production schedule (MPS)." (Fogarty et al., 1991, p. 430)

Material is of vital importance in the production system. MRP can be interpreted as material requirement planning, closed-loop MRP and manufacturing resource planning (Fogarty et al., 1991, p. 334). Figure 5-3 depicts the connections between MRP, MRP-I and MRP-II.

The planning process has to be repeated until the available capacity plan provides a satisfactory plan, as shown in Figure 5-5.

The BSG applies either CRP or MRP. Section 5.3.2.3 described the calculation of the aggregate number of products. The ratio and the amount of the materials used for one product is known from the product development in Section 5.2.3. The amount of the two groups of material can be calculated from the figures available. Investment decision determined the capacity in working hours in Section 5.3.1. A fixed working hours per period is applied in the case of the labour. On the basis of these two factors the number of workers can be calculated. Section 5.3.3.2 provides examples for the automated short term planning of CRP and MRP.

5.3.3.2 CRP and MRP - Examples

The examples use the data of previous examples in Section 5.3.1 and Section 5.3.3.2. Two developed products in Table 5-1 have the following parameters:

Necessary working hours to produce the products:

Product 1 = 0.48
Product 2 = 0.456

Material requirements (in units):

Product 1, group 1 (better quality material) = 10
Product 1, group 2 (average quality material) = 10

Product 2, group 1 (better quality material) = 19
Product 2, group 2 (average quality material) = 1

Figure 5-3 provides the capacity of the applied equipment.

Capacity of equipment in working hour: 80000 hour

Average working hours for the products:

(0.48+0.456)/2 = 0.936/2 = 0.468 hour/product

Assuming equal amount of products from both types:

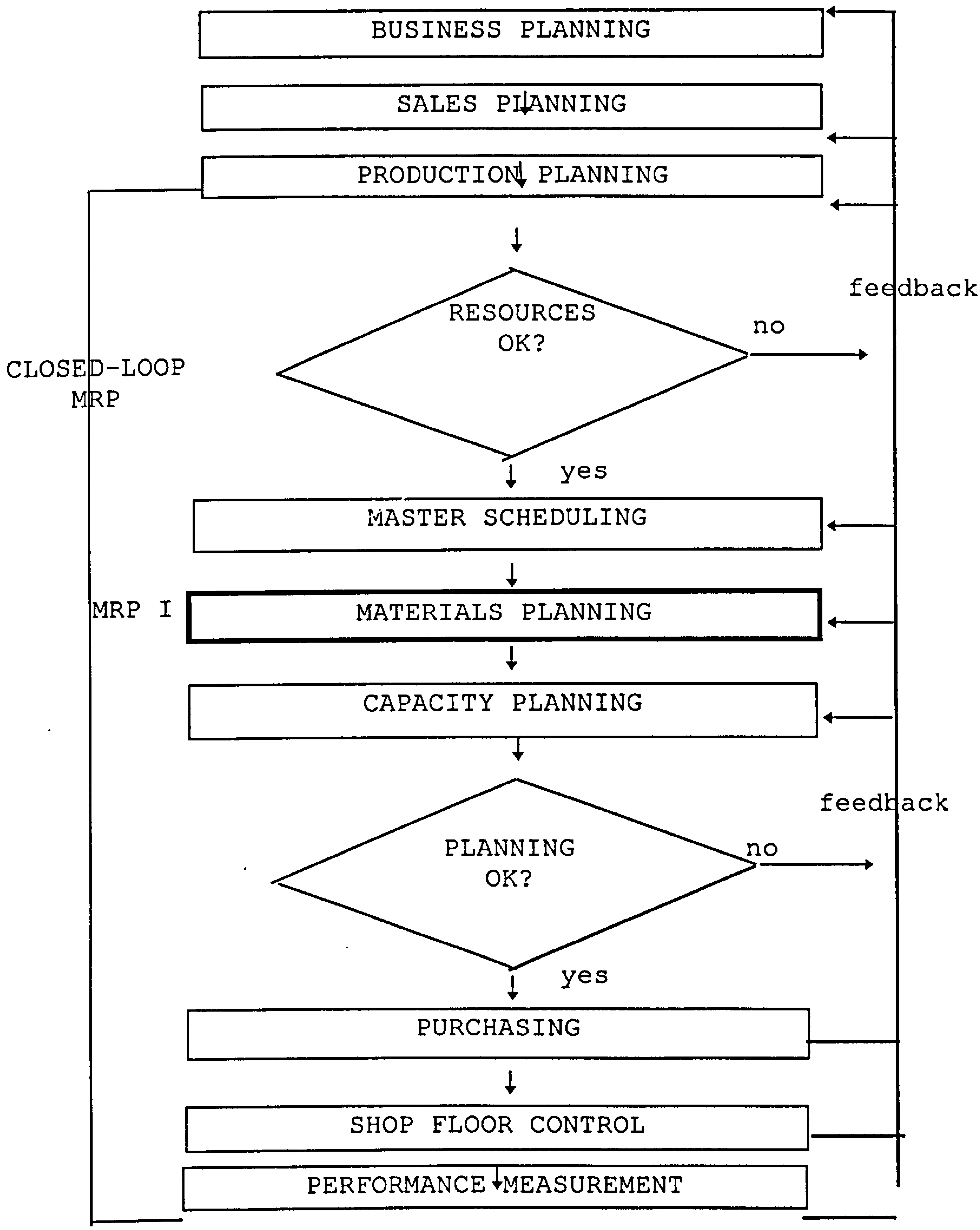

FIGURE 5-5 AN OVERVIEW OF MRP II, INCLUDING CLOSED-LOOP MRP AND MRP I

(From Fogarty et al., 1991, p. 335).

The number of products can be calculated as

80000/0.468 = 170940 pieces

This example assumes that the capacity of equipment (80000 hours) is used equally between the two products. The material requirement of 170940 product is:

Group 1: (170940/2) * 10 + (170940/2) * 19

= 854700 + 1623930 = 2478630

Group 2: (170940/2) * 10 + (170940/2) * 1

= 854700 + 85470 = 940170

Examples above described the automated way of calculations. However, the two types of products can be mixed in an arbitrary way, and the results of the automated methods can be superimposed by the calculated numbers.

5.3.4 Implementation Processes

Production activity control or shop floor control (SFC) together with the purchase planning and control are the final function in capacity management.

> "The time arrives when plans must be executed,. when material reqirements planning and capacity requirements planning have been completed and the detailed purhasing and production schedules must be determined and released for execution. The function of production activity control (PAC) ... is to have activities performed as

planned to report on operating results, and to revise plans as required to achieve desired results." (Fogarty et al., 1991, p. 448)

The implementation process is based on sound microeconomics theory. A concise overview of the theory enables the participants to understand the elements of the production process and the shop floor control. Finally, the material and labour elements of the implementation will be overviewed and illustrated by examples.

The BSG enables students to gain a better understanding of such theoretical notions as marginal and average production and cost functions as well as clearer view of interaction of these notions. The main screen of production allows the user to observe the behaviour of the different elements in a complex situation that promotes the production activity control.

5.3.4.1 Production Process

Production curves describe the relationship between the inputs used by the production process and the outputs (goods or services) produced (Vörös, 1991, p. 38; Gold and Pray, 1989). A general form of production curve is (Lipsey, 1978, p. 209):

$$q = q(f_1, \ldots, f_m)$$

where

q = production

$f1, \ldots, fm$ = quantities of m different factors, used in production

The most common factors are capital, material and labour. The generalised production curve of these three factors (Gold, 1992):

$$Q = f(K, L, M)$$

where

Q = quantity produced (unit)

K = capital equipment (number)

L = labour (hours)

M = materials (pounds)

If the period is long enough for the inputs of all factors of production to be varied, then the production curve is a long-run curve. If one (or more) of the input factors are fixed, then the production curve is a short-run curve. The theoretical overview of this chapter only discusses the short-run curves because the BSG is designed for use in the short term.

A different notation is applied in some cases during the overview according to the references. However, all the elements used for the model building of the BSG use constant notation structure.

The review of the short run production and cost curve allows the participants to estimate these curves from reasonable assumptions. The assumptions applied here are that the maximum capacity of a unit of equipment and the related number of workers can be determined. The examples explain the application of methodology in detail.

5.3.5 Short-Run Production Curve

Capital investment is a long term decision. In short term the capital (K) can be considered as a fixed element, in contrast to labour and material. Labour and material are variable inputs. If only the labour is variable cost, then the equation is:

$$Q = f(x) \tag{5.1}$$

where

x = labour

Q = production

A short-run production curve can be described by a third degree polynomial (Vörös, 1991, p. 38)

$$Q = f(x) = ax + bx^2 - cx^3 \tag{5.2}$$

where

a, b, c > 0

Figure 5-6 depicts the shape of the short term production curve.

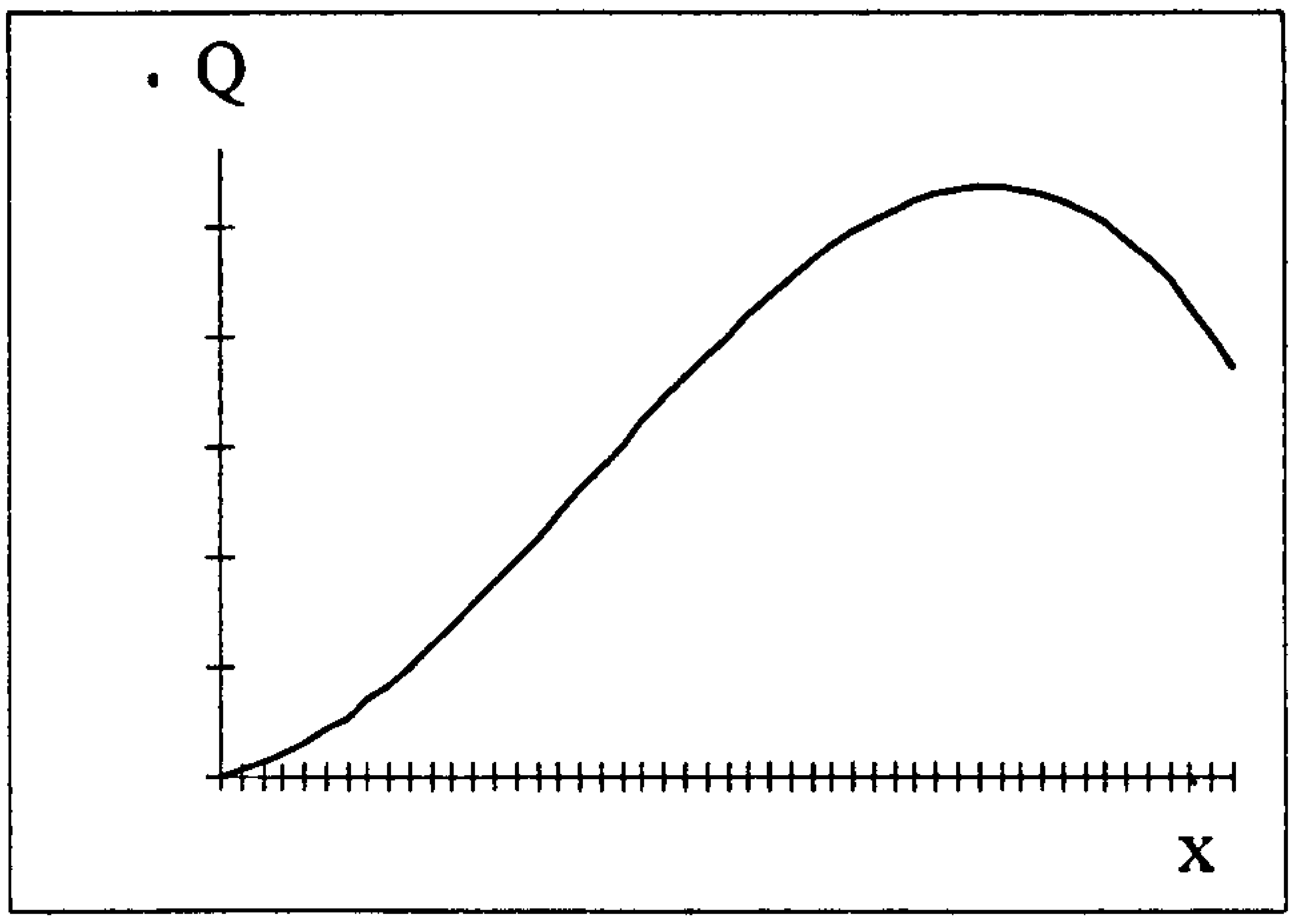

FIGURE 5-6 A THIRD DEGREE PRODUCTION CURVE

Marginal and average productivity can be derived from Equation 5.2. Average product (AP) can be derived from total product (TP), produced during a period:

$AP = TP / L$

where

L is labour, expressed in working hour.

Marginal product (incremental product) is "the change in total product resulting from the use of one more (or one less) unit of the variable factor". (Lipsey, 1978, p. 212)

$MP = \Delta TP / \Delta L$

Assuming a third degree polynomial shape production curve (5.2), the average and marginal production curves are

$$AP(x) = \frac{f(x)}{x} = a + bx - cx^2 \qquad 5.3$$

and

$$MP(x) = f'(x) = a + 2bx - 3cx^2 \qquad 5.4$$

Figure 5-7 illustrates that maximum average productivity exists when the average and marginal production curves are equal. This is the "point of diminishing average productivity" (Lipsey, 1978, p. 211). The maximum marginal production exists when the marginal production function reaches its maximum. This is the "point of diminishing marginal returns" (Lipsey, 1978, p. 211).

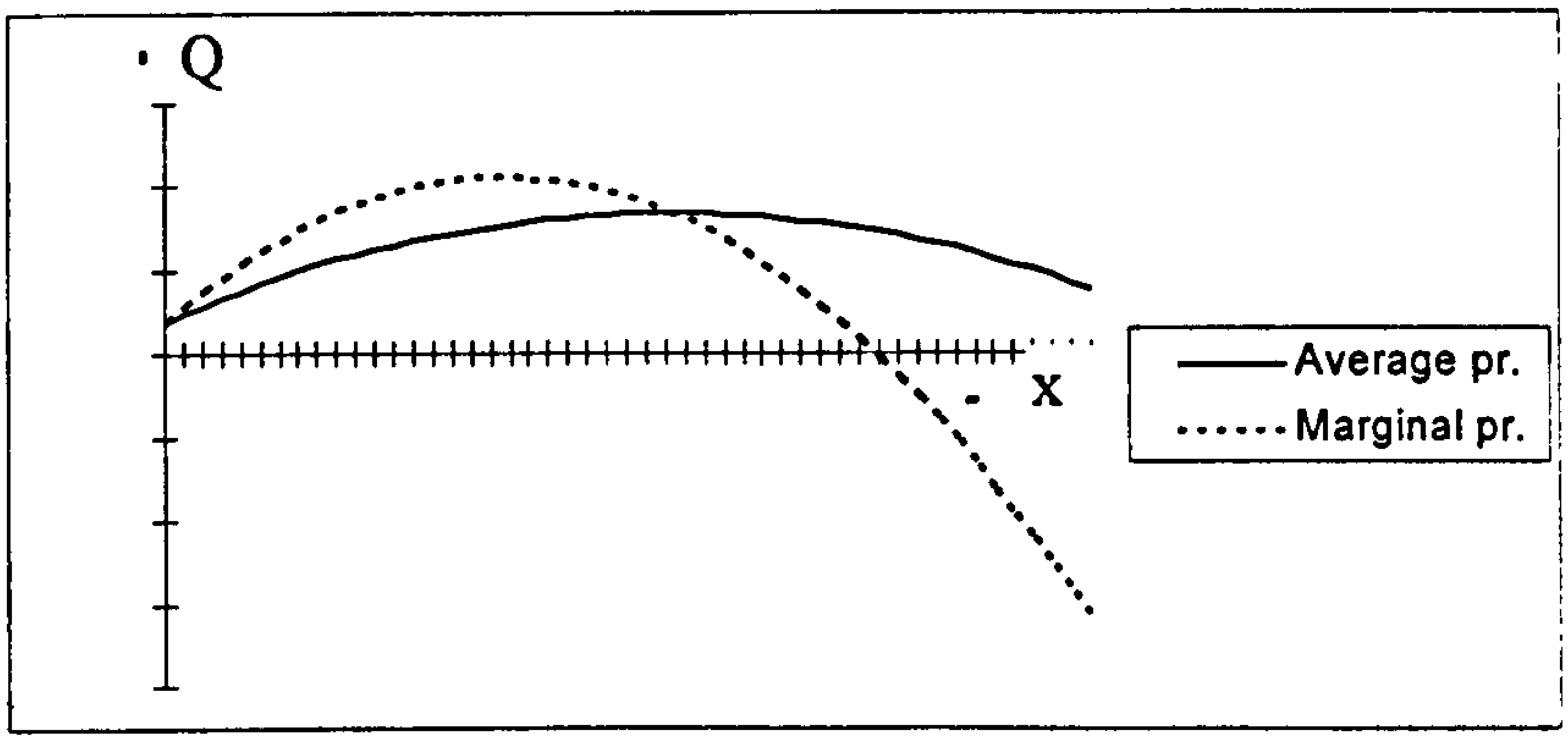

FIGURE 5-7 AVERAGE AND MARGINAL PRODUCTION CURVE

Gold and Pray (1989) recommended another type of production curve, where the number of variable inputs is three:

$$Q = a1U^{(a2-a3U)}S^{(a4-a5S)}K^{(a6-a7K)}$$

where

Q = maximum output

U = unskilled labour

S = skilled labour

K = capital

ai = parameters

An appropriate and easy method calculates the parameters of *a*, *b* and *c* in (5.2), on the basis of Bessenyei, Kiss (1996).

The equation of production curve is:

$$Q = f(x) = ax + bx^2 - cx^3$$

and the derivative is (5.4):

$$MP(x) = f'(x) = a + 2bx - 3cx^2$$

Initial assumptions are listed below:

1. The derivative of the production curve at the origin is zero, because the marginal product at zero input level is zero, such that

   $a = 0$

2. The production quantity at technical maximum (Q_0) and the number of workers at this point (X_0) are known:

$$ax_0 + bx_0^2 - cx_0^3 = Q_0 \qquad 5.5$$

3. The derivative of the production curve at the technical maximum is zero.

$$a + 2bx_0 - 3cx_0^2 = 0 \qquad 5.6$$

From (5.5) if $a = 0$

$$b = \frac{Q_0 + cx_0^3}{x_0^2}$$

and from (5.6) if a = 0,

$$b = \frac{3cx_0^2}{2x_0} = 1.5cx_0$$

The two right hand side are equal to each other

$$1.5cx_0 = \frac{Q_0 + cx_0^3}{x_0^2} \qquad 5.7$$

The solution of (5.7) for c is

$$c = \frac{2Q_0}{x_0^3} \qquad 5.8$$

and for b, substituting into 5.5

$$b = \frac{3Q_0}{x_0^2} \qquad 5.9$$

5.3.6 Short-Run Cost Curve

Total cost (TC) is the cost of "producing any given rate of output" (Lipsey, 1978, p. 215) Total cost consists of total fixed (TFC) and total variable cost (TVC). Fixed cost do not vary with output (Lipsey, 1978, p. 215). The theory applied contains only one variable input, the labour, similar to the production function. The inclusion of material price will be discussed in Section 5.3.7.1.

$$TC = TFC + TVC \qquad 5.10$$

where

TFC = rK, capital

TVC = wL, labour

r = price of capital

w = price of labour

Marginal cost (MC) or incremental cost is

$$MC = \Delta TC / \Delta q \qquad 5.11$$

If Q = f(x) (5.1) then

$$x = f^{-1}(Q) \qquad 5.12$$

where x (variable cost) is the inverse function of the production curve (Bessenyei, Kiss 1996). The curve can be approximated by a third degree polynomial (Vörös, 1991, p. 43).

$$TVC(Q) = \alpha Q - \beta Q^2 + \tau Q^3 \qquad 5.13$$

where

$$\alpha, \beta, \tau > 0, \ \beta^2 \leq 3\alpha\tau$$

The shape of this curve is depicted in Figure 5-8:

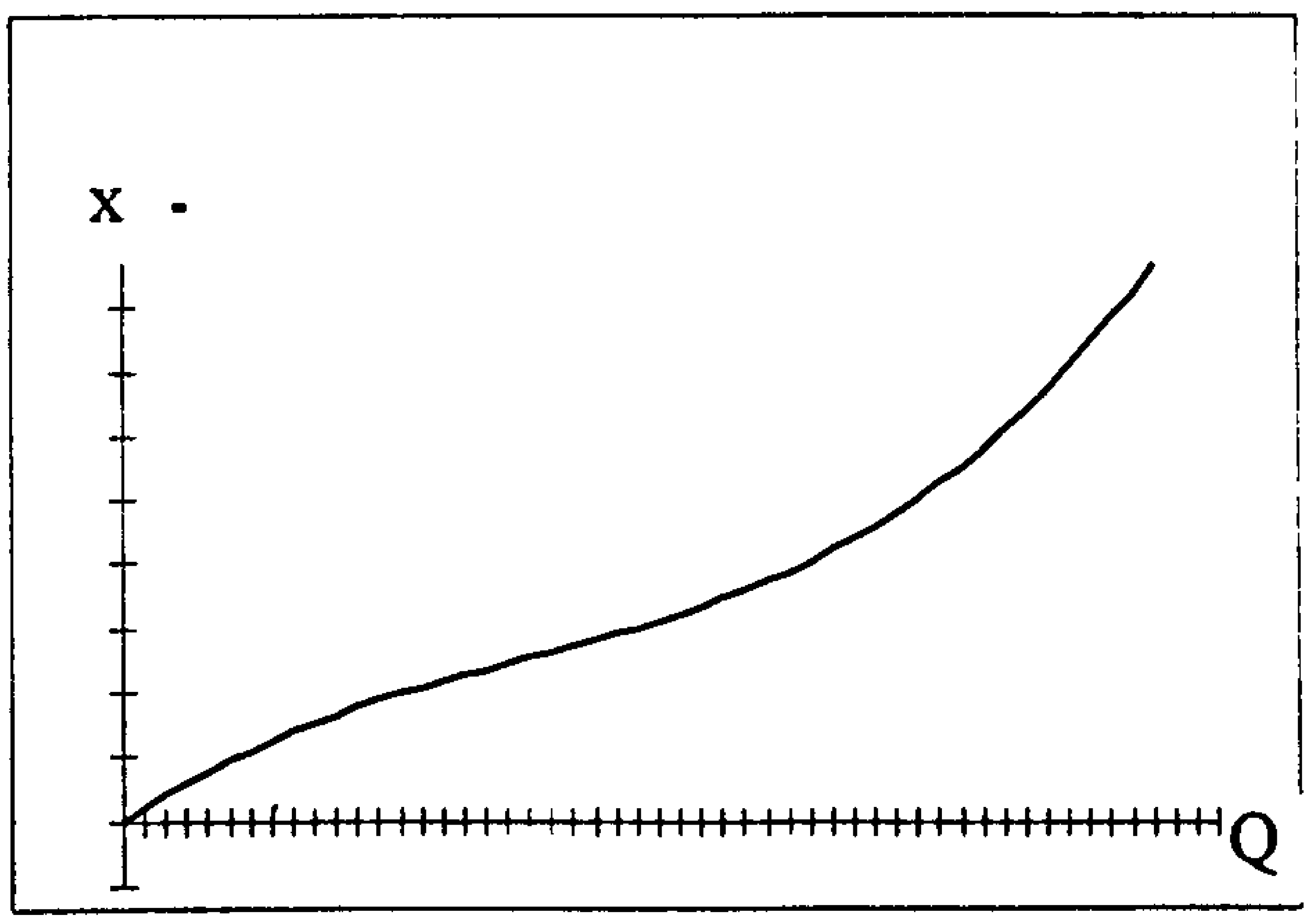

FIGURE 5-8 A THIRD DEGREE COST CURVE

Marginal cost (MC) and average variable cost (AVC) can be derived from (5.13). TVC(Q) has the same slope as TC(Q), such that

$$MC = TC'(Q) = TVC'(Q)$$

or

$$MC = \alpha - 2\beta Q + 3\tau Q^2 \qquad 5.14$$

and

$$AVC(Q) = TVC(Q) / Q = \alpha - \beta Q + \tau Q^2 \qquad 5.15$$

and

$$ATC(Q) = \frac{TFC}{Q} + AVC(Q) \qquad 5.16$$

The output elasticity (E) is measured by the ratio of short-run AVC to MC (Gold, 1992), such that

$$E = AVC/MC$$

If E > 1 (low level of output) then increasing return, if E < 1 (high level of output) then decreasing return of the input exists. (Gold, 1992). If E = 1 then constant return of the variable input exists.

Figure 5-9 shows that minimal average variable cost exists where MC and AVC (or TC) are equal to each other.

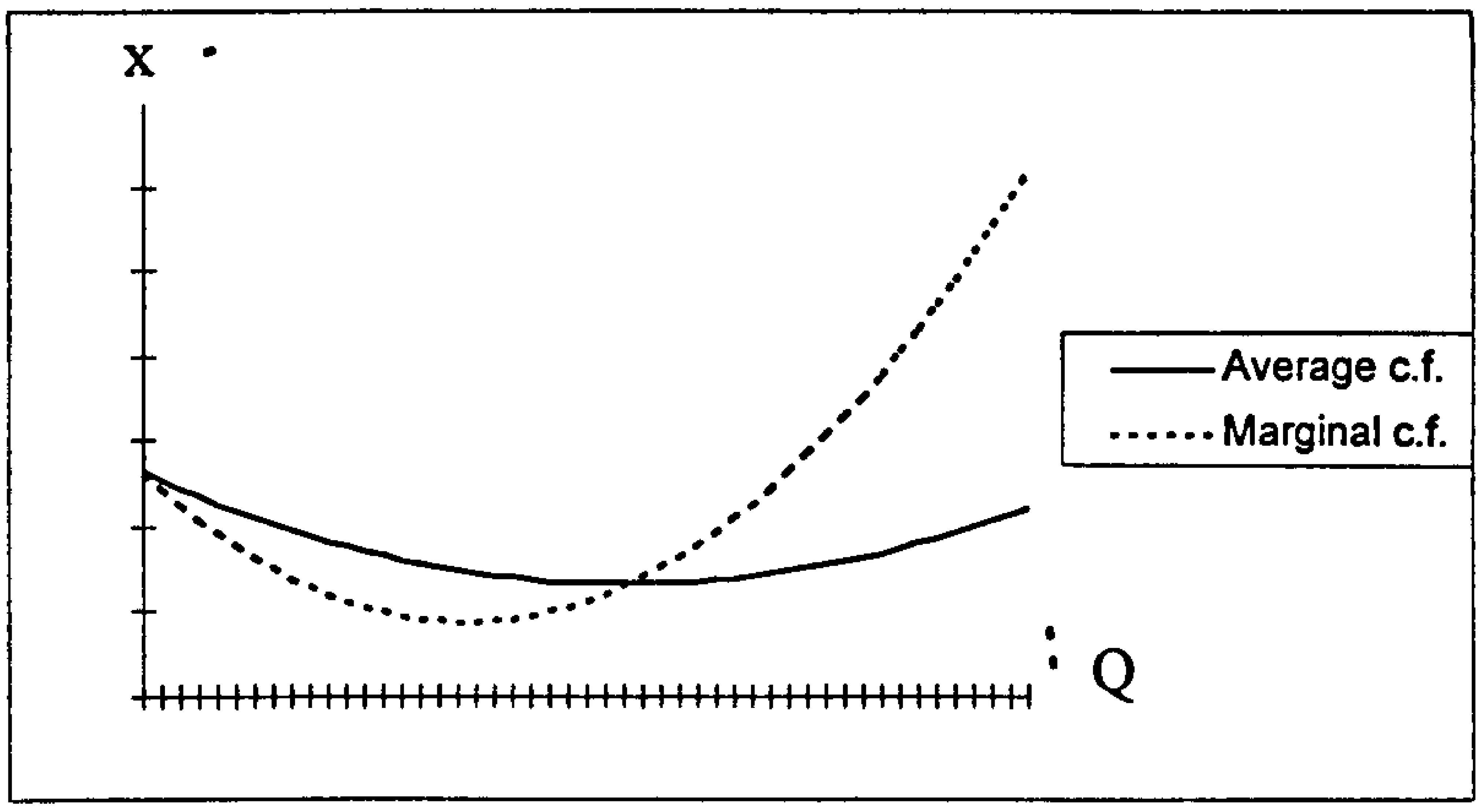

FIGURE 5-9 AVERAGE AND MARGINAL COST CURVE

Variable cost is the inverse function of the production curve, and the curve can be approximated by a third degree polynomial. A function fitting procedure (Komlósi, 1994, p. 265-269) is appropriate, if some values of the function are known. Bessenyei, Kiss (1996) suggests the Hermit interpolation (Móricz, 1980, p. 104) that needs only few assumptions.

The variable and marginal cost curves are as in (5.13 and 5.14):

$$TVC(Q) = \alpha Q - \beta Q^2 + \tau Q^3$$

$$MC = \alpha - 2\beta Q + 3\tau Q^2$$

Initial assumptions are listed below:

1. The cost curve is the inverse of the production curve, calculated in the previous section.

2. Parameters, previously estimated for the production function are available.

3. The number of workers (X_0) at technical maximum (Q_0) is known:

$$\alpha Q_0 - \beta Q_0^2 + \tau Q_0^3 = x_0 \quad 5.17$$

The estimation procedure is different from the production function estimation procedure. Cost curve estimation uses three points of production curve designated with x_1, x_2 and x_3: in the middle of the curve (x_2) and one-one point from the upper (x_1) and lower (x_3) part from the curve in minimal distance from the middle point.

$x_1 = (x_0/8)*3.99$

$x_2 = (x_0/8)*4.00$

$x_3 = (x_0/8)*4.01$

Three quantity values (Q_1, Q_2 and Q_3) are estimated for these points with the help of the pre-estimated parameters of *a*, *b* and *c* in (5.8) and (5.9).

$$ax_1 + bx_1^2 - cx_1^3 = Q_1$$

$$ax_2 + bx_2^2 - cx_2^3 = Q_2$$

$$ax_3 + bx_3^2 - cx_3^3 = Q_3$$

Four auxiliary values (au_1, au_2, au_3, and au_4) can be created that will help to estimate the cost curve parameters.

$au_1 = (Q_1Q_2^2 - Q_1^2Q_2)\ (x_3Q_1 - x_1Q_3)$

$au_2 = (Q_1Q_3^2 - Q_1^2Q_3)\ (x_2Q_1 - x_1Q_2)$

$au_3 = (Q_1^3Q_2 - Q_1Q_2^3)\ (Q_1Q_3^2 - Q_1^2Q_3)$

$au_4 = (Q_1^3Q_3 - Q_1Q_3^3)\ (Q_1Q_2^2 - Q_1^2Q_2)$

Two distance measurement values (dm_1, dm_2) can be formulated from these auxiliary parameters.

$dm_1 = au_1 + abs(au_2)$	if $au_1 < 0$
$dm_1 = au_1 - au_2$	if $au_1 >= 0$
$dm_2 = au_3 + abs(au_4)$	if $au_3 < 0$
$dm_2 = au_3 - au_4$	if $au_3 >= 0$

These distance values are appropriate for estimation of parameter γ. With the help of γ, parameter β can be estimated, and the third, α parameter is estimated by γ and β.

$$\gamma = dm_1/dm_2 \qquad 5.18$$

$$\beta = \frac{x_2Q_1 - x_1Q_2 + \gamma(Q_1^3Q_2 - Q_1Q_2^3)}{Q_1Q_2^2 - Q_1^2Q_2} \qquad 5.19$$

$$\alpha = \frac{x_1 - \beta Q_1^2 - \gamma Q_1^3}{Q_1} \qquad 5.20$$

5.3.7 Production Activity Control

The main screen of the production process (Figure 5-10) can fulfil the role of production activity control. The screen comprises relevant information of the production elements. Participants have an effective learning tool for different production strategies, such as maximal production, minimal cost. Each additional worker can raise the production until the point of diminishing marginal production, as discussed in relation with Figure 5-7. The minimal cost strategy exists when the average and marginal cost are equal to each other, as shown on Figure 5-9.

```
Production                                 1.firm        94.year  10.month     1
          Machine-1 Machine-2 Machine-3   Total    Mat.  Stock      Remainder
Prod. 1.    71000                         71000
Prod. 2.    99936                         99936     A    2562703        53838
Prod. 3.                                            B          0            0
Total      170936                        170937     C          0            0
Workers       400                           400     D .   911040         1166
                                                    E          0            0
Rem.Cap.      348                           349     F          0            0

Marg.Pr.     -0.0                          -0.0
Aver.Pr.    427.4                         427.4              Total  Remainder
Marg.Co.     89.2                          89.2    Workin    80400        403
Aver.Co.     53.5                          53.5

                          Material                        Quality          Hour/
              A      B      C     D      E      F   1.PAR. 2.PAR. 3.PAR.  Pieces
  1.Product  10      0      0    10 .    0      0      5      5      5    0.480

  1.Mch. Cap.:      80000 Gr.V.:  26000000 Deprec.:   4333333 Opt.Work:  400

  Prod. fn.: 3.2E+00X^2-5.34E-03X^3           Σ: 3.2E+00X^2-5.34E-03X^3
  Cost fn. : -2.7E-08Q^2+1.07E-13Q^3          Σ: -2.7E-08Q^2+1.07E-13Q^3
                                               Num-Lock               Overwrite
```

FIGURE 5-10 MAIN SCREEN OF PRODUCTION PROCESS

The left hand upper corner of the screen shows the actual production section. Two products are produced on Machine 1, with 400 workers. The total production is 170936 and the capacity, not used is 348 hour. The rough-cut capacity plan is 170940, as discussed in Section 5.3.2.3. According to the theoretical part, the average and marginal values are shown for machines separately and altogether. The production is on its technical maximum, because the marginal productivity is 0.0.

The upper right corner of the screen allows for the participants to control the stock of material and the amount of material used in the production process. Below the material part, the working hours of manual workers are shown. The total and remainder hours convey information about the number of active workers. The following part of the screen, below the labour and short-run function part, the product characteristics and the properties of machines are shown.

5.3.7.1 Production and Cost Curves - Example

This example shows the calculation of the production and average cost curve. The parameters of production curve (from 5.8 and 5.9):

Q_0 = Capacity in hours / (average hours/piece) =

80000 / 0.468 = 170940

X_0 = 400 (Number of manual workers)

$$c = \frac{2Q_0}{{x_0}^3} = \frac{2*170940}{400^3} = \frac{341880}{64000000} = 0.00534$$

$$b = \frac{Q_0 + c{x_0}^3}{{x_0}^2} = \frac{170940 + 0.00534*400^3}{400^2} = \frac{512700}{160000} = 3.204$$

The production curve is:

$Q = 3{,}204x^2 - 0.00534x^3$

The parameters for variable cost curve are calculated on the basis of the three quantity points and the derived auxiliary variables:

$x_1 = (x_0/8)*3.99 = (400/8)*3.99 = 199.5$

$x_2 = (x_0/8)*4.00 = (400/8)*4.00 = 200.0$

$x_3 = (x_0/8)*4.01 = (400/8)*4.01 = 200.5$

$Q_1 = ax_1 + bx_1^2 - cx_1^3 = 0*199.5+3.205*(199.5)^2- 0.00534*(199.5)^3 = 0\ 127559.8 - 42400.4 = 85159.4$

$Q_2 = ax_2 + bx_2^2 - cx_2^3 = 0*200+3.205*(200)^2- 0.00534*(200)^3 = 0+ 128200 - 42720 = 85480$

$Q_3 = ax_3 + bx_3^2 - cx_3^3 = 0*200.5+3.205*(200.5)^2- 0.00534*(200.5)^3 = 0+ 128841.8 - 43041.2= 85800.6$

$au_1=(85159.4*85480^2-85159.4^2*85480)* (200.5*85159.4- 199.5*85800.6)=2333783819160*42760= -9.979259610728e+16$

$au_2=(85159.4*85800.6^2-85159.4^2*85800.6)* (200*85159.4- 199.5*85480) = 4685073747170 * -21380 = -1.001668767145e+17$

$au_3=(85159.4^3*85480-85159.4*85480^3)* (85159.4*85800.6^2- 85159.4^2*85800.6)= -3.98235470627e+17 * 4686546095800 = -1.866348890076e+30$

$au_4=(85159.4^3*85800.6-85159.4*85800.6^3)* (85159.4*85480^2- 85159.4^2*85480) =$

-8.00960207816e+17 * 2333783819200 =

-1.869267972824e+30

au_1 =-9.979259610728e+16 < 0,

dm_1 = au_1 + abs(au_2) = -9.979259610728e+16 +

1.001668767145e+17 = 3.7428060722e+14

au_3 =-1.866348890076e+30 < 0,

dm_2 = au_3 + abs(au_4) = -1.866348890076e+30 +

1.869267972824e+30 = 2.919082748e+27

γ=3.7428060722e+14/2.919082748e+27=1.282185671086e-13

$$\beta = \frac{x_2Q_1 - x_1Q_2 + \gamma(Q_1^3Q_2 - Q_1Q_2^3)}{Q_1Q_2^2 - Q_1^2Q_2} =$$

$$\frac{200*85159.4 - 199.5*85480 + 1.282185671E-13*(85159.4^3*85480 - 85159.4*85450^3)}{85159.4*85480^2 - 85159.4^2*85480}$$

$$\frac{17031880 - 17053260 - 43883}{6.218086038785E14 - 6.19115089466E14} =$$

$$\frac{-65263}{2693514412500} = -2.4229682862E-8$$

$$\alpha = \frac{x_1 - \beta Q_1^2 - \gamma Q_1^3}{Q_1} = \frac{199.5 - (-2.4229683E-8)*85159.4^2 - 1.282185671E-13*85159.4^3}{85159.4}$$

$$\frac{199.5 + 175.71666 - 79.186}{85159.4} = \frac{296}{85159.4} = 0.0034762$$

However, the exact calculation requires the computer's accuracy. An example is the quantity of Q_1, that is 85159.4 in this example, but using the accurate production function parameters the correct value is 85149.6. Using the computer's parameter estimation for α, β and γ, the following parameters are calculated:

α = 0.0039

β = -2.7378277E-8

γ = 1.06775293E-13

The accurate variable cost curve is:

$x=0.0039\ Q-2.7378277E-8\ Q^2+1.06775293e-13\ Q^3$

The necessary number of workers in the case of maximum production (170940):

$x=0.0039*170940-2.7378277E-8*170940^2+1.06775293e-13$
$*170940^3=666.66-800+533.33=400$

The production function results in products, while the cost function results in currency. The marginal cost curve can be derived from the variable cost curve. Figure 5-10 shows a value of 89.2 at the row of the marginal cost ("Marg.Co"), that is in monetary term. The x value in the last equation in the case of the cost curve designates the labour, as the variable input is the production. The BSG accumulates the total amount of the variable costs, and calculates the labour variable (x) by the ratio of the labour cost. The multiplication of x (labour) by the unit amount of variable cost results in the marginal and average costs in monetary term.

A separate program part promotes the understanding of the short-run production curve. In the case of production function the variable input is the labour. Marginal product means the incremental product of one additional worker. The number of workers can be changed on the screen. If the participants vary the number of workers one by one, then they are able to recognise the effect of one incremental worker on the production and can experience the meaning of the theory. This production screen allows the user to recall the aggregate production plan and the variable cost for products.

The interactive production activity control screen provides a standalone tool to participants. If the production changes, all the derived data including the stock of materials and the working hours, change. Participants can control their production activities on one screen. In the case of any discrepancies in labour or material the participants are allowed to modify the order of material and to fire or hire workers. The description of the material and labour part is to be found in the last part of this chapter.

5.3.7.1.1 Material - Example

The simplified material requirement planning of the BSG applies a system, where the participants have to order materials only one term before the actual production in bulk. Figure 5-11 depicts the screen of the material section of BSG.

1.firm 94.year 10.month

ORDERING MATERIALS

Materials :	'A'	'B'	'C'	'D'	'E'	'F'
Opening Stock:	46003	0	0	1040	0	0
Price of each:	2.80	2.90	3.10	3.00	3.10	3.20
Average Price:	2.80	0.00	0.00	3.00	0.00	0.00
Ordered Quan.:	2516700	0	0	910000	0	0
Total Cost :	7046760	0	0	2730000	0	0
Total Stock :	2562703	0	0	911040	0	0
Prev. Used :	2508865	0	0	909873	0	0
Plan needs :	2412278	0	0	1008770	0	0

← → ↑ ↓ Esc Overwrite

FIGURE 5-11 MATERIALS IN BSG

The composition of materials allows for the differentiation between different quality products. Consequently different quality materials have to be involved in the production process. The BSG comprises six types of materials ('A', 'B', 'C', 'D', 'E', 'F') where the first three are high and the second three are average quality materials. The product development process determines the ratio between the two types of materials because of the quality of the product, as discussed in Section 5.2. The materials can be mixed amongst each other in both groups separately, but the ratio has to be always the same between the two groups. The prices are not identical; each type of material has a different price which can change, depending on the quantity. In the case of 'A' material: above 3.5 million kg there is 10 % discount. In the case of 'B' and 'D' material there is no discount; in the case of 'C' material between 2.5 - 3 million kg there is 10% discount; above 3 million kg there is 11 % discount. In the case of 'E' material above 3.5 million kg there is 10%; and finally in the case of 'F' material, above 2.3 million kg there is 5 % discount and by every 3,5 million kg there is additional 1 % discount. There is a final storing capacity of 9 million kg of material. Every additional kg results in 0.05 further cost.

In the material table the "Prev. Used" shows the used quantity of the previous term. The "Plan needs" means that the volume of aggregate plan requires this amount of material. Before ordering materials the total value of order can help to calculate the most economical materials for the process. The composition of materials in a product and the unit price of materials can be modified during the game, individually.

The material section of the BSG allows the students to understand a universally applicable feature of purchasing: buying in bulk can result in reduction in price. Furthermore, the material model reinforces for the participants the need for constant monitoring of the purchasing decision, because different price reductions can be achieved in case of different amount of materials ordered. It also shows that overordering carries cost.

5.3.7.2 Labour

A homogeneous labour staff with standard hours allows simple input side from the viewpoint of labour. The homogeneous work force is a condition of applying the theoretical models of Sections 5.3.5 and 5.3.6. Because the wage of managers (white collar workers) constitutes fixed cost, the real production factors are manual workers.

5.3.7.2.1 Labour - Example

The labour factor of the BSG applies a fixed number of officers and homogeneous manual workers with standard working hours per capita. The BSG does not allow overtime because of the simplification of this part of the model. The homogeneous property of labour allows the BSG to compute a standard short run production function, where the capital is fixed and the labour is the variable input factor.

```
Manual Workers hire, fire                1.firm       94.year  10.month     1

Office workers                 :  100

               number          :  436        ( Close :  437 )
               hire            :    4
Manual         quit            :    3
workers        fire            :    0
               day off         :   35      You need for equipment with
               currently work:  402     ( maximum capacity :  400 )
               hourly rate     : 80.0

Cost of work. office           : 2000000       Add.: 00000000
                manual         : 6992000       Add.: 00000000
Cost of fireing                :       0

          ←  →  ↑  ↓  Esc
                                                              Overwrite
```

FIGURE 5-12 LABOUR SCREEN OF BSG

Three values can be changed by the participants on this screen: the number of hired and fired manual workers and the hourly rate. The first two values provide a means to balance the working hours that are necessary for the production. The hourly rate of workers is set to the minimum. (See Figure 5-12). The number of managers is predetermined and constant during the game.

Country regulations can determine compulsory payable amount based on the wages of workers. This characteristic of the BSG is necessary because of the Hungarian regulation. Version in other languages or content can apply different parameters, even zero. The opening number of workers will determine the closing number of them. The number of currently working manual workers determines the working hours of labour on the production activity control screen.

In Chapter 3 the summary of the main features of the different games reviewed was depicted in Tables 3-3, 3-4, 3-5, and 3-6. These tables are completed by the characteristics of the BSG, as they are depicted Tables 5-3, 5-4, 5-5, and 5-6.

	More products	**More product lines**	**More equipment**	**Plants in more countrie s**
M500	No	No	Yes	No
MMG	Yes	Yes	Yes	Yes
Micro	No	No	Yes	No
Plan It	No	No	No	No
Wise	Yes	No	No	Yes
CTU	Yes	No	Yes	No
BSIM	Yes	Yes	Yes	No
BSG	Yes	No	Yes	No

TABLE 5-3 PRODUCTION VARIABLES IN DIFFERENT BUSINESS SIMULATIONS

	More then one type of materials	**Simple model**
M500	No	No
MMG	No	No
Micro	No	Yes
Plan It	No	No
Wise	No	No
CTU	Yes	Yes
BSIM	No	No
BSG	Yes	Yes

TABLE 5-4 CHARACTERISTICS OF MATERIALS

	Differen-tiated labour	Managing labour (hire, fire)	Training	Over-time
M500	No	Yes	Yes	No
MMG	No	Yes	Yes	Yes
Micro	Yes	Yes	No	Yes
Plan It	No	Yes	No	Yes
Wise	No	Yes	No	Yes
CTU	Yes	Yes	Yes	Yes
BSIM	No	No	No	Yes
BSG	No*	Yes	No	No

* Only white and blue collar workers

TABLE 5-5 LABOUR FACTORS IN DIFFERENT SIMULATIONS

	Gradual extension	New Equipment	New Plant(s)
M500	No	Yes	No
MMG	Yes	No	Yes
Micro	No	No	Yes
Plan It	Yes	Yes	No
Wise	Yes	No	Yes
CTU	No	Yes	No
BSIM	Yes	Yes	No
BSG	No	Yes	No

TABLE 5-6 CAPACITY EXPANSION POSSIBILITIES

The production model is seemingly less broad than the other games on the basis of Tables 5-3, 5-4, 5-5 and 5-6. However, there is a difference between the approach adopted in different production models. BSG concentrates on the theoretical issues within the production model, by emphasising the presentation of short run cost and production function. Consequently, it needs homogenous labour (in Table 5-5), simple capacity structure (in Table 5-6), and simple production characteristics (in Table 5-3). The material model (in Table 5-4) is also simple; however, comparing it to the other models, it is sufficiently broad. This viewpoint of the design of BSG allows for the participants to concentrate on the production strategies, that is to say production with maximum efficiency or with minimum cost.

The production part of the BSG provides the user with a device that has proved to be especially effective in the case of countries seeking to develop competitive economies. The theory and practice of short-run functions facilitate the understanding of the economic theory. The different notions of the management of capacity (CRP, MRP, RCCP) provide some insight into the production theory of the western economies.

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PART II - A NEW BUSINESS SIMULATION MODEL

CHAPTER 6 – MARKETING

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The majority of market models attempt to describe the behaviour of the market, market elements and the effect of market elements on sales. The primary objective of this chapter is to develop a new market simulation model. A concise overview is necessary to reveal the role of the marketing function. After a brief description of the elements of the marketing mix, the *aggregate market response model* will be exhibited.

The existing models emphasise the following characteristics:

- dynamic effect;
- aggregate models;
- linearity in parameters ;
- nonlinearity in variables;
- both stochastic and deterministic models; and
- response models.

These models were used as a basis upon which to develop a new market model for BSG. The model developed is a combined, extended and modified version of previous models. Combining the product sales model with the general attraction model, a mixed model that makes economic sense was developed. Dynamic effect on the basis of Koyck's models made it possible to develop a new market model that is mathematically correct (see Equations (6.13) and (6.14) in Section 6.4.5, and Equation (6.16) in Section 6.5.7). The model is economically sound, because it is based on such existing models, that are developed on real economic problems. Lilien et al. have devoted a book to this topic (1992). A number of papers are published for modelling economic factors, among them Rao et al. (1972), Thavikulwat (1989), Saunders (1987), Montgomery et al. (1986).

The market model requires input data from participants, and calculates output values. The input data are the following:

- Price;
- Advertisement Cost;
- (Other) sales promotion;
- The competitor's similar data in the "what if" analysis; and
- Distribution of product to different markets.

Outputs:

- Market share;
- Stock;
- Sales;
- Remainder Stock;
- The competitor's similar data; and

• Detailed analysis of the market process.

The values of the competitors' activity are randomly changed.

6.1 The Role of Marketing in the Company

An accepted definition of marketing is the following:

> "Marketing is a social and managerial process by which individuals and groups obtain what they need and want through creating, offering, and exchanging products of value with others." (Kotler, 1991 p. 4)

Kohli and Jaworski (1993) examined the needs for marketing. Some authors state, that in a competitive environment or in turbulent technical environment, marketing has an important role, but in a less turbulent market, where the variability of prices is small, marketing does not have a significant role (Kohli, Jaworski 1993. p. 54). Kohli and Jaworski did not find significant relationship between the firms of turbulent and stable environment.

> "... the linkage between a market orientation and performance appears to be robust across contents characterized by varying levels of market turbulence, competitive intensity, and technological turbulence." (Kohli, Jaworski 1993. p. 64).

The success of a marketing policy may depend on a lot of factors. Hanssens et al. (1990) argue that marketing strategy has a key role in corporate success. Consequently, marketing has to have an important role in a business simulation.

> "Apart from the overall quality of a company's management, its skill in production, finance, and the implementation of policy, or even plain luck, the key ingredient of corporate success is marketing strategy: the right products being sold to the right customers at the right time. This is more basic, hence strategic, to a product's success than tactical concerns like price, promotion, or distribution. Thus, to a very real extent, marketing strategy dominates marketing tactics." (Hanssens, Parsons, Schultz, 1990. p. 14)

The "right customers at the right time" can be modelled. Right customers can be approximated with the help of *market segmentation*. "Each buyer is potentially a separate market because of unique needs and wants." (Kotler, 1991. p. 263) "Right time" is modelled by Teach (1991) who included the time variable into a simulation. Successive time periods can fulfil this modelling role, where a series of observations can justify the relationships over time. Different weights for market demand can emphasise the role of certain time periods. Long term demand trend is properly modelled by Carvalho (1992) who included time periods into his model.

Marketing management has to solve appropriate *tasks* to fulfil the primary role of marketing, that is to introduce, plan, allocate and control a product.

> "The primary tasks of marketing management are development and introduction of new products, and planning, allocation, and control for established products". (Hanssens, Parsons and Schmaltz, 1990, p. 14)

In this process marketing management has the elements of *marketing mix*. Demand can be influenced by these tools. Dozens of marketing-mix tools were classified by McCarthy into four groups, called the four Ps: *product, price, place and promotion* (Kotler, 1991). Figure 6-1 depicts the four Ps of marketing.

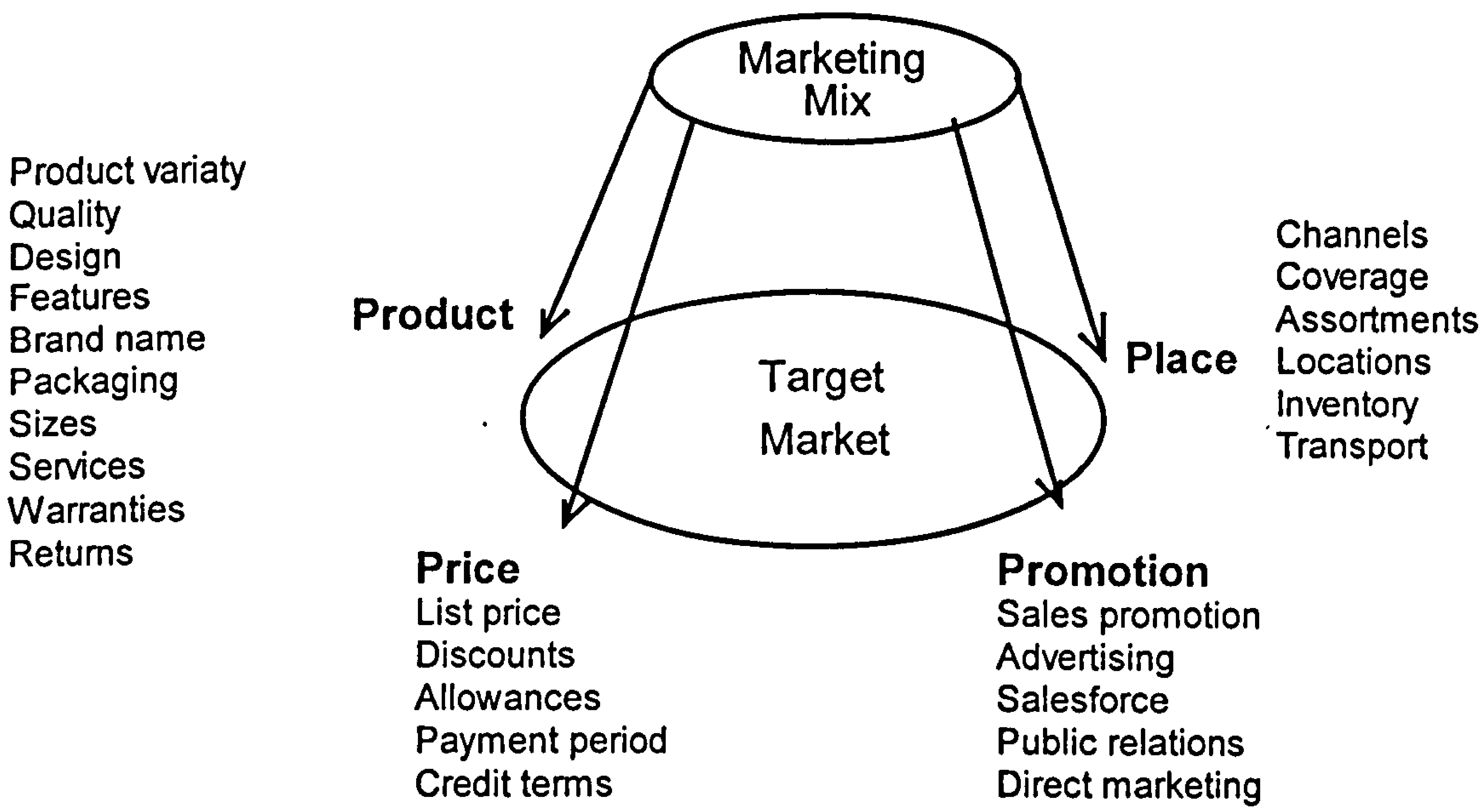

FIGURE 6-1 THE FOUR PS OF THE MARKETING MIX.

Source: Kotler (1991, p. 68).

For modelling purposes it is unnecessary to use all the elements identified in Figure 6-1. Lilien, Kotler, and Moorthy (1992) stress only some of factors. These included: sales, product, advertising, promotion, sales force and distribution. Faria and Dickinson (1992) in the LAPTOP simulation differentiated between the push and pull strategy. The push strategy is mainly directed towards intermediaries to buy the product and sell it to the end users, while the pull strategies focus on inducing the end users to ask the intermediaries for the products (Rekettye, 1995 p. 323). The "LAPTOP" simulation categorises the three promotion elements into push and pull elements.

Push elements:

- Sales promotion
- Personal selling

Pull element

- Advertisement

The following sections will present details of the elements of the marketing mix tools in the BSG's marketing model.

6.2 Marketing Tools

Product, sales, advertising, sales promotion, sales force and distribution are the key elements of marketing tools. The following sections are devoted to describing the function of these tools, and their roles in the BSG.

6.2.1 Product

The first P in the marketing-mix is the product. Product is the most important element of the marketing mix (Kotler, 1991, p.429)

> "A *Product* is anything that can be offered to a market for attention, acquisition, use, or consumption that might satisfy a want or need." (Lilien et al. 1992 p. 218)

The market can be too dispersed to satisfy all needs with one type of product. STP marketing - STP is the abbreviation of segmentation, targeting and positioning - provides a means to "narrow" the market; to find the right consumers. Identification of market segment is followed by the selection of the target market. The positioning concept is a necessary element of STP marketing, when one seeks to enter the market. After successful market segmentation, targeting and market positioning, the launch of the product can take place (Kotler, 1991, p. 311).

The consumer will pay less if there is a gap between the required and offered characteristics of the product. The advertising campaign tries to harmonise the offered and required characteristics of the product (Lilien et al. 1992, p.219). The quality of the product can have more effect than advertising. Once tried, satisfied customers may continue to consume the product (Saunders, 1987. p. 24).

Products can be classified in many ways (Rekettye 1994, Kotler 1991 pp. 433-435, Lilien et al. 1992 pp. 220-221).

a./by product levels

1. *Core benefit;* contains the fundamental service or benefit
2. *Generic product;* the basic product that includes the core benefit
3. *Expected product;* a set of attributes and conditions that are expected from a product
4. *Augmented product;* the product that includes special services and benefits to distinguish the product from the other products
5. *Potential product;* all the augmentations that a product might undergo in the future

b./ by durability/tangibility

1. *Non-durable goods*
2. *Durable goods*
3. *Services*

c./ by consumer/industrial

1. *Consumer products*
   - Convenience products (frequently bought goods and services)
   - Shopping products (consumer is willing to spend considerable time and effort in

collecting information regarding these products)
- Speciality products have special attributes

2. *Industrial products*
   - Accessory equipment
   - Business services
   - Installations
   - Parts
   - Raw materials
   - Semi-manufactured goods
   - Supplies

A product line is a group of products that have a certain functional coherence. A brand is "the name that can be associated with one or more items in the product line" (Kotler, 1991, p. 431). Heterogeneous preferences can be satisfied with the elements of product line, because the manufacturer can tailor his products to consumers' preferences (Lilien et al. 1992, p.228). Differentiated products can also have a major role in the case of a few competitors, each with significant market share (oligopolistic industries).

Lilien et al. used multiple attributes for modelling purposes. The performance of multiple attributes describes the product (Lilien et al. 1992 p.222). These attributes can be represented as $(r_1, r_2, .., r_n)$ then the brand can be captured by a *utility function:* $u(r_1, r_2, .., r_n) = u(r_1), u(r_2), ..,$

$u(r_n)$. This function expresses that the utility of a brand (in the left hand side) is explained by the utilities of attributes in the right hand side.

A survey, conducted for a given product, can provide data for regression analysis to estimate the coefficients for the attributes (Urban, 1975). Factor analysis can reduce the number of main attributes, if the product has many characteristics.

The BSG simulates an oligopolistic market, and the developed products are differentiated products. The BSG applies production development, as discussed in Chapter 5. An augmented, consumer product can be developed to distinguish the product from the other products. The product can be durable or non-durable, depending on the initial parameter file, discussed in Chapter 4. A reduced number of main attributes are applied in the product development process. Conditions for the application of STP concepts are created by providing four markets with different features. This allows the participants to segment, target and position their products in different markets. Positioning is not exclusive, the participants do not have to position the product into one market, because the production capacity is large enough to serve all of the markets. However, the number of the products delivered to the markets can be different depending on the characteristic of the market.

6.2.2 Price

Pricing directly determines the revenue and also affects costs because of the quantity sold. Price, in contrast to the other elements of marketing mix is the only factor that produces revenue. (Kotler, 1991. p. 474) Lilien et al. (1992) suggested that the price is the most important tool of the marketing-mix from this point of view. Price influences the level of demand for the product (Allen 1962, Goosen, Kusel 1992).

$$Q = f(P) = a - bP \qquad (6.1)$$

where

Q = quantity sold
P = price
a = constant
b = constant denoting the slope of the demand curve.

A non-linear form can express a similar relationship (Lilien et al. p. 174):

$$Q = f(P) = aP^{-b} \qquad (6.2)$$

where b has a different meaning to the parameter b in equation (6.1)

b = constant price elasticity

Price elasticity can be expressed by the following formula (Kotler 1991, p. 479):

$$\text{Price elasticity of demand} = \frac{\%\ \text{Change in quantity demanded}}{\%\ \text{Change in price}}$$

Elasticity (b in 6.2) means that if the price changes by one per cent, the quantity demanded will change by b percent. The effect of price on demand can be elastic or inelastic. If demand hardly changes with a small change of price then the demand is inelastic, and otherwise it is elastic.

The product curve applied in the BSG is elastic and the quantity sold decreases if the price is increased. Price elasticity of demand in the BSG is constant, and cannot be modified by the participants, or the Umpire. More details about the price model of the BSG are provided in Section 6.5.1.

6.2.3 Sales Promotion and Sales Force

The ratio of sales promotion budget to advertising budget is 68 % (in 1987) and it arose faster (12% a year from 1977) while the advertising arose only by 10% (Lilien et al. 1992, p. 324).

> "Sales Promotion consists of a diverse collection of incentive tools, mostly short-term, designed to stimulate quicker and/or greater purchase of particular

products/services by consumers or the trade." (Kotler, 1991. p. 631)

Sales promotion also has intermediate and long term effects (Blattberg and Neslin, 1989). Figure 6-2 exhibits the different types of promotions.

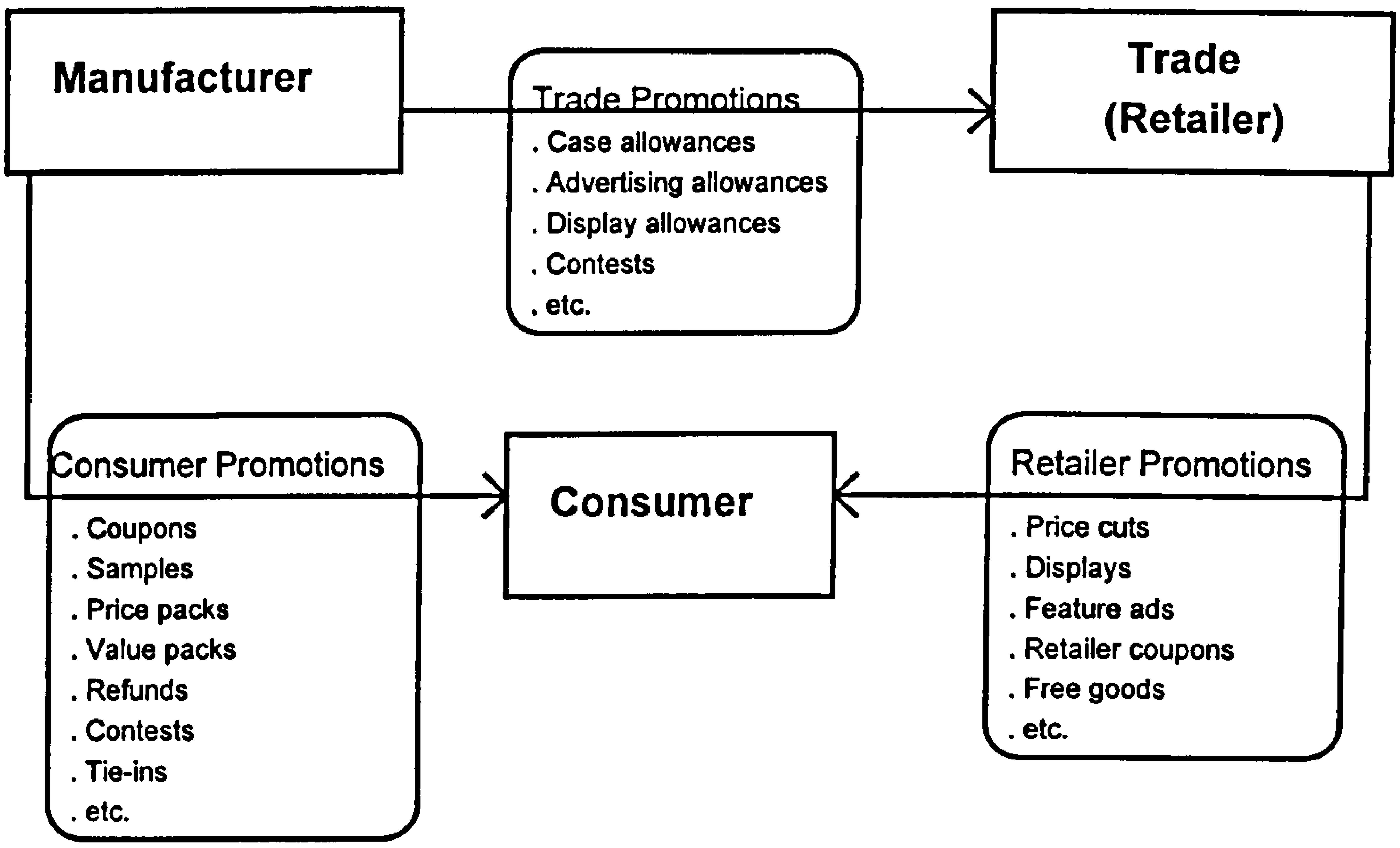

FIGURE 6-2 PROMOTIONAL TYPES.
Source: Lilien et al. 1992, p. 325

Promotions can be coupons, free goods for suppliers, premiums, gifts, discounts and so on. A free sample stimulates consumer trial; a free management-advisory service can establish a long-term relationship with a retailer. (Kotler, 1991. p. 632)

An aggregate model can express the incremental sales gained (Lilien et al. 1992, p. 336).

$$V = P*R*S*G \qquad (6.3)$$

where

V = Incremental sales gained

P = Promotion potential. The number of individuals who can participate in promotion.
R = Promotion reach. The more outlets the brand has, the bigger is the value of R because the consumers can reach the product more easily.
S = Promotion strength. The more attractive the promotion, the bigger the effect.
G = *Cg* where C = the number of customers and g = the average quantity purchased by customer during the promotional period.

The promotional strength (S) is a function of the promotional characteristics and the time: $S = K(x, t)$. The K is said to be S-shaped in characteristics and decreasing in time because the novelty diminishes (Lilien et al. 1992, p. 335). However, the effect of promotion is not necessarily S-shaped. Rao and Lilien (1972) used an aggregate model for the *gasoline industry*. Their final response function had a concave shape, showing decreasing returns.

The main role of sales force is to sell the product. The selling process also needs specific requirements concerning the sales persons. The necessary requirements are the following (on the basis of Lilien et al. 1992, p. 362).

- *Represents and transacts.* The salesperson charged with representing his or her organisations' and the consumer's organisation needs.

- *Buffers.* The salesperson has to smooth the irregularities in the deliveries.
- *Processes information and monitors.* He or she provides a continual information flow.
- *Links and co-ordinates.* Co-ordination between the client and producing firms.

An example for modelling the sales force-sizing problem is a linear model (Lilien et al. 1992, p.366):

$$\text{Maximise } Z = P{*}Q(X) - C_1(Q) - C_2(X) \quad (6.4)$$

where

Z = profit
P = selling price
$Q(X)$ = number of units sold as function of selling effort
$C_1(Q)$ = total cost of producing and merchandising Q units
$C_2(X)$ = total cost of selling effort of level X

The sales response function can be influenced by team selling, other marketing mixes elements and variability in productivity effort (Lilien et al. 1992, 397).

The BSG applies the first model of this section, where the promotion strength is S-shaped, and the effect is diminishing in time.

$$S=K(x,f)$$

where

x= amount of time

t= time

This model is relevant to all the markets and all the products separately in the BSG. Participants have to make decisions about the amount of sales promotion in each case. Promotion and sales forces are combined in the BSG, and the amount refers to both types of sale promotion. Greater details regarding the sales promotion are provided in Section 6.5.3.

Apart from advertising, the BSG applies other types of sales promotion in one block for the markets and the products separately. The application of a combined value is a simplification, but the model has the advantage of easier understanding.

6.2.4 Advertising

The fourth element of marketing mix is advertising. Advertising has a number of purposes: long-term build up of a particular brand, corporate image, information dissemination about a sale, service or event. (Kotler, 1991. p. 596). The major media types used for advertising are telephone, newspapers, television, direct mail, radio, and magazines. (Kotler, 1991. p. 608)

> " We define *advertising* as any paid form of nonpersonal presentation and promotion of ideas, goods, or services by an identified sponsor." (Kotler, 1991. p. 596)

Advertising supports the sales communication and presents information to potential buyers. The marketing objectives, product characteristics and the other elements of marketing mix influence the effectiveness of advertising to a great extent (Lilien et al. 1992, p. 263-264).

The marketers' dream is to measure consumer response to advertisements. Several technical advances permit marketers to test the sales impact of advertisement. The advances include:

- universal code on packages;
- optical scanners; and
- electronic cash registers, smart cards, cable television, television viewing monitors (Kotler 1991, p. 112).

The advertising response could have several shapes. Mahajan and Muller (1986) assume an S-shaped advertising function and some papers (e.g. Eastlack and Rao, 1986) find that the S-shaped response function is widely applied. Deriving an advertising-response coefficient from each of the numbers of sales district, the individual coefficients can be combined for a general sales-response function (Lilien, Kotler 1983, p. 496). One part of products shows S-shaped responses, while others show concave responses. Theories support the view that an advertising campaign first raises the level of demand, but later it reverts back to its original level. Other authors (Hanssens, Parsons, Schmaltz, 1990, and Saunders 1987) do not believe in the S-shaped function. This is a controversial area. However, there is a general agreement that any accepted response function can be used with the appropriate theoretical background.

The BSG uses an S-shaped response function for measuring the effect of advertisement. Similarly to sales promotion, advertisement decisions have to be made separately for each market and each product. The advertisement function is fixed, like the sales promotion function, and the position will be influenced by the amount of advertisement. The function will be discussed more fully in Section 6.5.2.

6.2.5 Distribution

In today's economy a host of marketing intermediaries exists between the producers and final users. Kotler observed:

> "A distribution system ... is a key *external* resource. Normally it takes years to build, and it is not easily changed. It ranks in importance with key *internal*

resources such as manufacturing, research, engineering, and field sales personnel and facilities." (Kotler, 1991. p. 507)

The conventional distribution system consists of four *independent* elements: manufacturer - wholesaler - retailer - consumer. The recent developments include the concept of *vertical marketing system (VMS)* where the elements of the distribution channels are the same, but they operate in a unified system. There are three broad types of VMS (Kotler 1991, pp. 525-526) and these are discussed below.

- *Corporate channels:* Production and distribution are under a single ownership.
- *Administrated channels:* Because of the power of one of the parties (e.g. a strong brand) there is a co-ordinated system, similar to corporate channels.
- *Contractual channels:* Contracts between the distribution and production system achieve more economies or impact. This type has expanded the most in the recent years.

The number of outlets is an important factor. Empirical studies have shown that there is a non-linear relationship between outlet share and market share, and the response function is generally S-shaped (Lilien et al. 1992, p. 435).

There are four markets in the BSG, as discussed in Section 6.2.1. These markets are the outlets. The BSG employs these outlets and VMS with contractual channels. The contracts have already been signed when the participants start the business simulation. This is a reasonable simplification and does not detract from the main objectives of the game. Participants have to make decisions about the ratio of the products to deliver to four outlets, markets.

6.3 Aggregate Market Response Models

This section discusses the components of the aggregate market response model. The discussion is necessary because the BSG applies a model that contains the elements described in this section.

Several approaches are worked out to develop an empirical *response model*. Characteristically, response model means that one variable depends on one or more other variables. The dependent variable may be the market share, company sales, etc. Marketing mix elements influence the size of the market. Consequently the elements of the marketing mix tools can be independent variables in a response model.

Hanssens et al. (1990) classify the different models into three main groups, see Table 6-1.

Econometrics	Time Series Analysis	ETS*
Focus on relations between variables (interstructure)	Focus on relations within variables over time (intrastructure)	Recognises relations between variables and within variables over time
Easily applied to theory building and marketing planning	Often superior forecasting performance	Uses econometric or time series techniques depending on the modelling task
Time series data and cross-section data	Time series data only	Accommodates forecasting and marketing planning objectives

TABLE 6-1 MODELLING APPROACHES

* *ETS is a combination of Time Series Analysis and Econometric Methods.*

Source: (Hanssens, Parsons, Schultz, 1990, p. 11)

Multivariate analysis can be used to show the *interstructure* among the variables, if more than one independent variables are available. More than one independent variables are necessary for multivariate analysis, because in the case of one dependent and one independent variable a two variable analysis is available. If the independent variables are time series then the equation is called an ETS model and the *intrastructure* can also be investigated.

Another way of characterising the different marketing models is by using the "forms" of Lilien et al. (1992, p. 651). This paper follows their classification. They used five groups: *mathematical form*, *static/dynamic*, *deterministic/probabilistic*, *aggregate/individual*, and *level of demand*. Table 6-2. exhibits these forms.

Dimension	*Examples*
1. Mathematical Form	
Linear in parameters and variables	$Q = a_0 + a_1 X$
Non-linear in variables, linear in parameters	$Q = a_0 + a_1 X + a_2 X^2$
Non-linear in parameters, can be taken linear	$Q = a_0 X_1^{a_1} X_2^{a_2}$
Inherently non-linear	$Q = a_0 (1 - e^{-a_1 x})$
2. Dynamic Effects	
Discrete time	$Q_1 = a_0 + a_1 X_t + \lambda Q_{t-1}$
Continuous time	$\frac{dQ}{dt} = \frac{rX(V-Q)}{V} - \lambda Q$
3. Uncertainty	
Deterministic	$Q = a_0 + a_1 X$
Deterministic with stochastic error	$Q = a_0 + a_1 X + \varepsilon$
Inherently stochastic	$p = f$ (past purchase behaviour)
4. Level of Aggregation	
Individual	$p = f$ (past behaviour, marketing variables)
Segment or market	$Q = a_0 + a_1 X$
5. Level of Demand	
Product class	$V = f$
Brand sales	$Q = SV$
Market share	$S = \frac{us}{us + them}$

TABLE 6-2 DIMENSIONS OF MODEL DEVELOPMENT

Source: (Lilien et al. 1992, p. 655)

6.3.1 Mathematical Form

Usually the dependent variable is the quantity sold (Q). The shape of the equation determines the independent variables and the connections among them. *Simple linear functions* are the most popular (Lilien et al. 1992, p. 653). Linear forms have several appealing characteristics:

- Parameters of classical econometric methods can be estimated;
- Easily visualisable and understandable; and
- It can approximate many more complicated functions as well.

However some disadvantages arise in the case of linear functions, e.g. they have no upper bounds for Q.

Power series model (independent variables are the power series of one variable) is appropriate to depict any shape but outside the data range it behaves badly (Lilien et al. p. 657).

A number of attempts have been made to approximate the more difficult forms that can behave well outside the data range, and have realistic explanation and shape (e.g. *exponential, log reciprocal, modified exponential, logistic, Gompertz, ADBUDG models).* Summaries of these kinds of models are in Lilien et al. (1992, p. 653-660), Saunders (1987), Hanssens et al. (1990).

6.3.2 Dynamic Effects

The effect of a marketing campaign does not take place immediately and will remain perceptible for some time (Lilien et al. 1992, p. 661). "Lag effect", or "carry over effect" is the general term for the influence of current expenditure on sales in future periods (Lilien, Kotler 1983, p. 80).

Customers and competitors anticipate and react to the firm's actions, and therefore there is an adjustment process (Hanssens et al. 1990. p. 48) that is dynamic in nature. In the case of d*iscrete-time models* these delayed effects can be followed by d*istributed lag models.* The *geometric distributed lag model* is one of the most commonly used tools in marketing (Hanssens et al. 1990, p.51). Lilien et al. (1992. pp. 662-665), Koyck (1956), Kiss (1985, 1986), Sipos and Kiss (1995), Saunders (1987), Hanssen et al. (1990), among others deal with these types of functions. Some of them allow more difficult distribution of the effects of past data. Almon uses the *pascal distribution* for this purpose (see Kiss (1986)). *Koyck* assumes a *geometrically declining* effect of past data. Koyck differentiates two types. In the first type this decline starts from the second year. The second type starts the decline from the third year. Dynamic effect is important because of a realistic model. The geometrically declining effect has to be the part of the aggregate model of the BSG. Koyck's model, perhaps the simplest of these sets of models, is described below (on the basis of Lilien et al. 1992, pp. 663-665)

If X is a marketing variable (e.g. advertisement) and Q is the quantity sold, the linear equation can be written as:

$$Q_t = a_0 + a_1 X_t + a_2 X_{t-1} + a_3 X_{t-2} + \dots$$

Assuming an equally declining effect, this equation can be rewritten as:

$$Q_t = a_0 + a_1 X_t + a_1 \lambda X_{t-1} + a_1 \lambda^2 X_{t-2} + \dots \qquad (6.5)$$

where λ is the ratio of the subsequent coefficients of dependent variables. The previous period (t-1) multiplying by λ can be described as:

$$\lambda Q_{t-1} = \lambda a_0 + a_1 \lambda X_{t-1} + a_1 \lambda^2 X_{t-2} + a_1 \lambda^3 X_{t-3} + \dots \qquad (6.6)$$

Polynomials can be deducted from each other (Allen, 1962, p. 128) and it results in the next equation:

$$Q_t - \lambda Q_{t-1} = a_0 (1-\lambda) + a_1 X_t$$

or

$$Q_t = a_0 (1-\lambda) + \lambda Q_{t-1} + a_1 X_t \qquad (6.7)$$

The short term effect is a_1 (see 6.5). Now assume that the effect of sale and the marketing tool employed is equal over a long time and the time factor can be eliminated, then

$$Q = a_0 (1-\lambda) + \lambda Q + a_1 X$$

from this equation:

$$Q = a_0 + \frac{a_1}{1-\lambda} X \qquad (6.8)$$

$a_1/(1-\lambda)$ is the long-term effect of marketing tool X.

6.3.3 Uncertainty: Stochastic/Deterministic

The way uncertainty is handled is an important consideration. A model can be stochastic or deterministic. The level of uncertainty determines the characteristics of the model. Stochastic means that "determined by a random distribution or probability" (The Concise Oxford Dictionary, 1990). A behaviour can be stochastic or non stochastic, however, a deterministic model can approximate stochastic behaviour. A stochastic model exists if the parameters of the model are random variables. The way uncertainty is handled in BSG is described more fully in Section 6.4.6.

6.3.4 Level of Aggregation: Individual/Aggregate Models

In the case of individual model a market response model estimates the market behaviour directly. If the model estimates indirectly, that is to say, it aggregates through individual behaviour models, then it is an aggregate model (Lilien et al. 1992, p. 672). The BSG uses an aggregate model, because the elements of marketing mix all affect the market behaviour. The model will be fully explained in Section 6.4.

6.3.5 Level of Demand

Response models can be distinguished by the way they handle demand (Naert and Leeflay 1978, Chapter 8): *product-class sales, brand sales and market share models.* They are related as

$$Q = S * V \tag{6.9}$$

where

Q = brand sales
V = product-class sales
S = market share

Brand sale models can be expressed as the product of the two other factors. In marketing, most *product-class sales models* are based on time-series' models, and explain demand by environmental variables and aggregate values of marketing variables (Lilien et al. p. 666). Lilien et al. (1992, p. 669) applied a model for the market share:

$$S_{1t} = \lambda_1 S_{1t-1} + g_1 \frac{X_{1t}}{X_{1t} + X_{2t}}$$

Generalisation of this model result in the following figures:

$$S_{it} = \lambda_i S_{it-1} + g_i \frac{X_{it}}{\sum_i X_{it}} \tag{6.10}$$

where

S_{it}= market share of brand *I* at time *t*
X_{it}= advertising spending of brand *I* at time *t*

A desirable property of market share models is their logical consistency. (Hanssens et al. 1990. p.185) Parameter estimation for the different brands does not assure that the sum of different market shares is one. Because of this problem this model does not satisfy the conditions of model consistency, that is the whole market share has to be 100%.

A general attraction model solves the problem of model consistency and ensures that the parameters sum up to one.

$$S_i = \frac{A_i}{\sum_{j=1}^{I} A_{ij}} \qquad (6.11)$$

where

I = the number of brands in the market
A_i = The attraction of the brand, where A_i is made up of the components of that brands marketing mix
S_i = Market share of that brands marketing mix

For nonnegative A_i the value of S_i is greater than zero and $\sum S_i = 1$. The features of the level of demand, discussed above will be build into the BSG's marketing model in Section 6.4.3 and 6.4.5.

6.3.6 Simulations

Simulation can be defined as the "use of a process to model a process" (Hanssens et al. 1990, p. 274). Usage of regression coefficients is suggested as a prior estimate to be adjusted by the manager's own judgement (Lambin models, Hanssens et al. 1990, p. 275). A new factor can be integrated into the model on the basis of the pre-estimated elasticity of competitive advertising, total market demand and so on.

In the case of a business simulation the problem is the same as estimating sales or market shares for decision making purposes. Therefore, using pre-estimated regression coefficients in the market model is an appropriate way of modelling a competitive market. The BSG estimates regression coefficients, as it will be discussed in Section 6.4.4.

6.4 Market Model for the BSG

In this section a new dynamic market model for the BSG will be developed. The new market model has the following characteristics:

- The variables used allow for the linearity in parameters;
- The model utilises non-linear variables;
- The dependent variable of the model is the market share;
- The model uses pre-estimated parameters, based on the PIMS data;

- The model is a dynamic model;
- The model is an aggregate model; and
- The model is both deterministic and stochastic.

The BSG model is unique because:

- it uses the PIMS data to pre-estimate the parameters; and
- The combined elements used makes this a unique simulation model.

6.4.1 Nonlinearity in Variables

As it was shown before, the different parts of the marketing mix do not necessarily behave in a linear form. The most useful and popular solutions frequently have non-linear forms. Examples are given in Sections 6.2.2, 6.2.3, and 6.2.4 in the discussion of price, sales promotion and advertisement. The BSG uses a model that is non-linear in variables.

6.4.2 Linearity in Parameters.

The linearity in parameters is a generally used form. The non-linear types may be more accurate but the price paid in terms of the level of difficulties frequently outweighs this advantage (Lilien, Kotler 1983, p.75). The BSG uses additive model, that is linear in parameters.

6.4.3 Dependent Variable is Market Share.

Equation (6.9) gives a relationship amongst brand sale, product-class sale, and market share. Product-class sale must be estimated in real-life, but in the case of a business simulation this sale may be an *environmental variable,* predetermined by previous empirical studies, estimations, or arbitrarily by the Umpire. Market share has been used as a measure of business performance. Kohli and Jaworski (1993, p. 60) used the dollar share of the served market as an objective measure. In the equation (6.9) the brand sale depends on the market share and the product-class share. The product class sale is determined by the industry demand; see Section 6.5.1.1. Each market for each product has a market share value that allows for the calculation of brand sale; see Section 6.5.6.

6.4.4 Pre-estimated Parameters from PIMS Database.

The market model of a business simulation can use two types of parameters. If it has previous data (there is an existing firm) then it can use the existing parameters. An alternative possibility is using *pre-estimated, or arbitrary* parameters. See Figure 6-3.

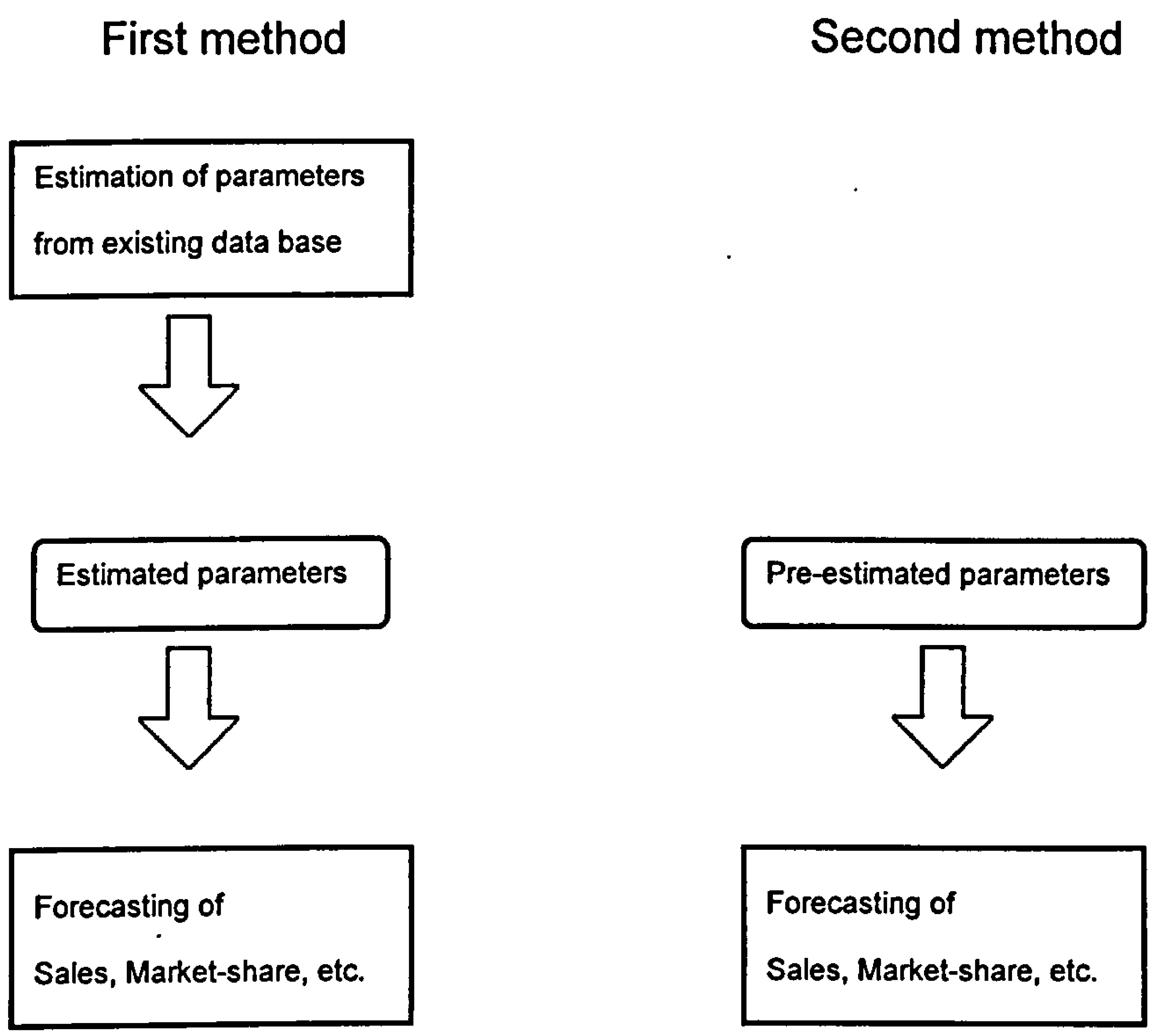

FIGURE 6-3 TWO TYPES OF FORECASTS

The *validity* of the BSG requires appropriate pre-estimated parameters. By using the data from PIMS database, as discussed in Chapter 8, the parameters of the appropriate marketing mix element were determined with the help of multivariate regression coefficients. The BSG uses pre-estimated parameters for the different marketing mix elements.

6.4.5 Dynamic and Aggregate Model

In Equation (6.10) the market share model estimated the market share by different factors. The model has the disadvantage of the inconsistency of the sum of market shares. The BSG solved this problem by introducing a ratio parameter of γ:

$$\gamma = \frac{100}{\sum_i OS_i} \tag{6.12}$$

where

OS_i = market share in percentage

Multiplying the market shares with this ratio the market shares will sum up to one:

$$S_i = \gamma OS_i$$

where

S_i = modified market share in percentage

Example

In the case of two products the market share for product 1 is 20%; for product 2 is 60 %. γ =100 / (20+60) = 1.25. Modified market shares are: 20%*1.25=25%; 60%*1.25=75% respectively.

Equation (6.10) introduced a model, where the market share was explained by the previous market share and the effect of the ratio of the advertisement cost of brand i. The advertisement effect can be replaced by the effect of any attraction of a product:

$$S_{it} = aS_{it-1} + bA_{it}$$

where

A_{it} = ratio of the attraction of the product to the attraction of all products; later: ratio of attraction.

A_{it}, the ratio of attraction can be divided into more parts, according to the elements of marketing mix, e.g.:

$$S_{it} = aS_{it-1} + bAD_{it} + cSP_{it} + dQU_{it} + eP_{it} \qquad (6.13)$$

where

i = product
t = time
S = ratio of market share
AD= ratio of advertisement
SP= ratio of sales promotion
QU= ratio of product quality
P = ratio of price

The model has a *dynamic effect* because of the previous value of market share.

It was shown before that the deduction of Equation (6.6) from (6.5) resulted in the dynamic model of (6.7). Let us assume that there are two explanatory variables, X and Z. They lose equally constant proportion (λ) of their influence in each time period. Adding a new independent variable to Equation(6.5):

$$Q_t = a_0 + a_1X_t + a_1\lambda X_{t-1} + a_1\lambda^2X_{t-2} ... + b_1Z_t + b_1\lambda Z_{t-1} + b_1\lambda^2Z_{t-2} + ...$$

The equation above is modified as well, similar to (6.6):

$$\lambda Q_{t-1} = \lambda a_0 + a_1\lambda X_{t-1} + a_1\lambda^2X_{t-2} ... + b_1\lambda Z_{t-1} + b_1\lambda^2Z_{t-2} + ...$$

A new modified dynamic market model is:

$$Q_t - \lambda Q_{t-1} = a_0(1-\lambda) + a_1X_t + b_1Z_t$$

Assuming that the dependent variable is the market share, there is a dynamic market model, using the marketing mix elements:

$$S_t = a_0(1-\lambda) + \lambda S_{t-1} + a_1 AD_t + b_1 SP_t + c_1 QU_t + d_1 P_t \qquad (6.14)$$

that is mainly the same as (6.13) with an extension of the constant term. Additional variables can be useful, because with the increasing number of variables the quality of a market share model can be improved (Saunders, 1987). Although there is little evidence to support geometric lag, many model builders have found that the applications of lagged variables contribute significantly to the performance of models (Saunders, 1987, p. 36).

Parameter expresses the short-term effect. In the case of stable marketing expenditures and market shares an appropriate form for S is:

$$S = a_0 + \frac{a_1}{1-\lambda}AD + \frac{b_1}{1-\lambda}SP + \frac{c_1}{1-\lambda}QU + \frac{d_1}{1-\lambda}P$$

or

$$S = a_0 + \frac{1}{1-\lambda}(a_1 AD + b_1 SP + c_1 QU + d_1 P)$$

where $1/(1-\lambda)$ can be called the long-run marketing-expenditure multiplier.

The BSG uses (6.14), as a dynamic aggregate model, introducing the ratio parameter of γ in 6.12.

6.4.6 Deterministic and Stochastic Model

According to the white box theory, a deterministic model is better for participants because they are more readily able to understand the behaviour of the model. From another viewpoint a stochastic model can be more realistic. The new market model of the BSG will be deterministic as far as the firm is concerned. The firm - in its own authority - handles a deterministic model and will determine a *relative market share*. The market will add a stochastic element because of other firms' decisions, that are unknown to the decision making firm. Thavikulwat developed a business simulation, where the demand is independent across firms (Thavikulwat, 1989). This unknown factor is a *probabilistic element* (see Section 6.3.3) that makes the model *stochastic*.

6.5 Individual Models

Equation (6.14) represents a regression model, where the independent variables are the elements of marketing mix with the exclusion of distribution. Distribution plays a decisive role in this simulation, but it has been separated from the other elements of marketing mix. Therefore distribution will not feature in this equation. The other independent variables will be discussed in this section.

Because the purpose of the market model is to determine the market share (in percent for the relative market share and in quantity later), the traditional element of demand function, Q will be replaced by S, market share everywhere in individual models (see Section 6.4.3). The substitution is justified in Section 6.4.3.

6.5.1 Price

A declining demand curve can be expressed by an exponential function (Percze, 1991, p. 54)

$$S = a_0 e^{a_1 P} + \gamma \qquad (6.16)$$

where

$a_0 > 0, a_1 < 0$

a_0, a_1, γ = parameters

P = price

If P=0 (it does not have a meaning in business), the market share is $a_0 + \gamma$. The greater the value of P, the lower is the market share which asymptotes to zero. If a_0=1 and γ=0 (because the relative market share is 1); a_1=-1 (this coefficient gives a proper shape), then (6.16) has a more simple form:

$$S = e^{-P}$$

This value for S will be modified by appropriate a_0 and γ to get simulated market share for different prices.

The shape of the function is depicted in Figure 6-4.

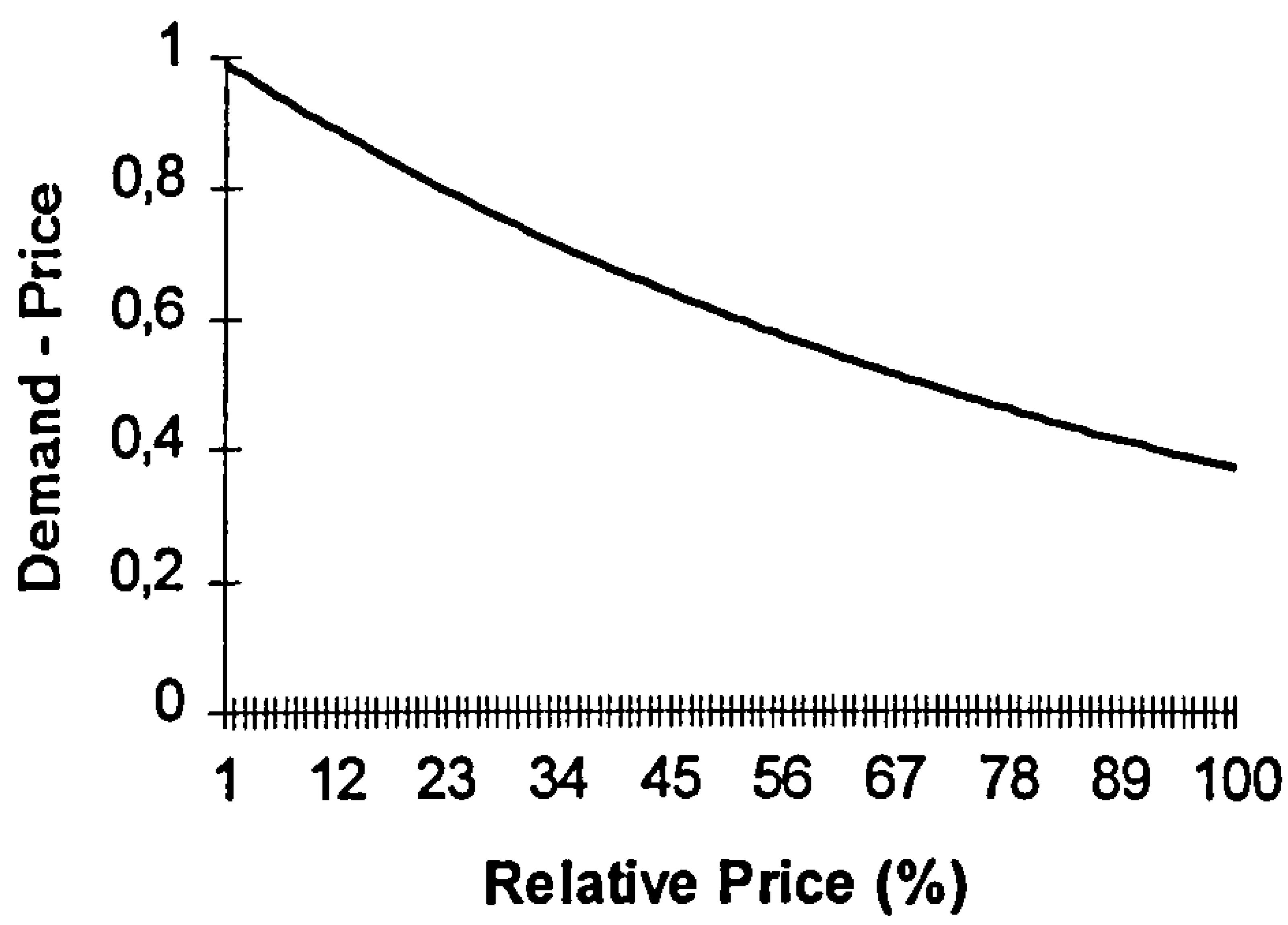

FIGURE 6-4 PRICE EFFECT ON MARKET SHARE

In the BSG this price function has been applied twice.

- It modifies the pre-determined industry demand, according to industry average prices.
- It determines the market share for one product in one market.

The Umpire also can determine the size of the market and the maximum allowable product price.

In the case of significant excess of the average price, there is deduction of penalty points.

6.5.1.1 Example - Industry Demand

This part of the model is uncertain from the viewpoint of the firm, because it contains the prices of other firms (in average industry prices the other firms' prices are independent from the given firm's decision).

ID = Industry demand - predetermined

IP_A = Average industry price

P_M = Maximum price - predetermined

ID_F = Final industry demand

EI = Economic index of industry - predetermined

P = The difference between the industry average price and the predetermined average price, in percent

t = time, the long term effect

$P = (IP_A - P_M/2)/(P_M/2)$ if $P_A > P_M/2$, otherwise 0.

$ID_F = (ID * EI^t) * e^{-P}$

Parameters of example

t = 1

ID = 90.000.-

EI = 0.98

P_A = 200.-

P_M = 360.-

$P = (200 - (360/2))/(360/2) = 20/180 = 0.111$

$e^{-0.111} = 0.895$

$ID_F = (90.000*0.98)*0.895 = 78939$

6.5.1.2 Example - Product Demand

Calculation of the production demand needs an additional element, the product price.

PD = Relative product demand

P_P = product price

$$PD = e^{-(P_P / P_M)}$$

Parameters of example

P_M = 360.-

P_P = 200.-

$P_P/P_M = 200/360 = 0.555$

$PD = e^{-0.555} = 0.574$

6.5.1.3 Example - Penalty

A penalty is given, if the company sets its product price too high. The measure of penalty depends on the significance of price (predetermined). If the effect of price is 40%, then the penalty free zone is 40/2=20% of the price.

Penalty is not applied because of low prices, only the upper zone can be taken into consideration.

N = Penalty points

NP = Penalty points for 1% excess price

G_{PC} = Significance of price (predetermined), in %

Z_U = Upper penalty free zone, in %

Z_P = Final penalty zone, in %

$Z_U = (100 - G_{PC})/2$

$Z_P (\%) = ((P_P/(P_M/2))-1-(Z_U/100)) * 100$

$N = NP * Z_P$

Parameters of example

$G_{PC} = 40 (\%)$

$P_P = 252.-$

$P_M = 360.-$

$NP = 1.$

$Z_U = (100 - 40)/2 = 30$

$Z_P (\%) = ((252/(360/2))-1-30/100) * 100 =$

$(1.4 - 1 - 0.3) * 100 = 10$

$N = 1 * 10 = 10$

6.5.2 Advertising

Figure 6-5 depicts the shape of advertising function asymptotes to an upper bound (a_0). The function is (Percze, 1991, p. 56):

$$S = a_0(1 - e^{-a_1 A})$$

where

$a_0 > 0$

a_0, a_1 = parameters

A = advertisement

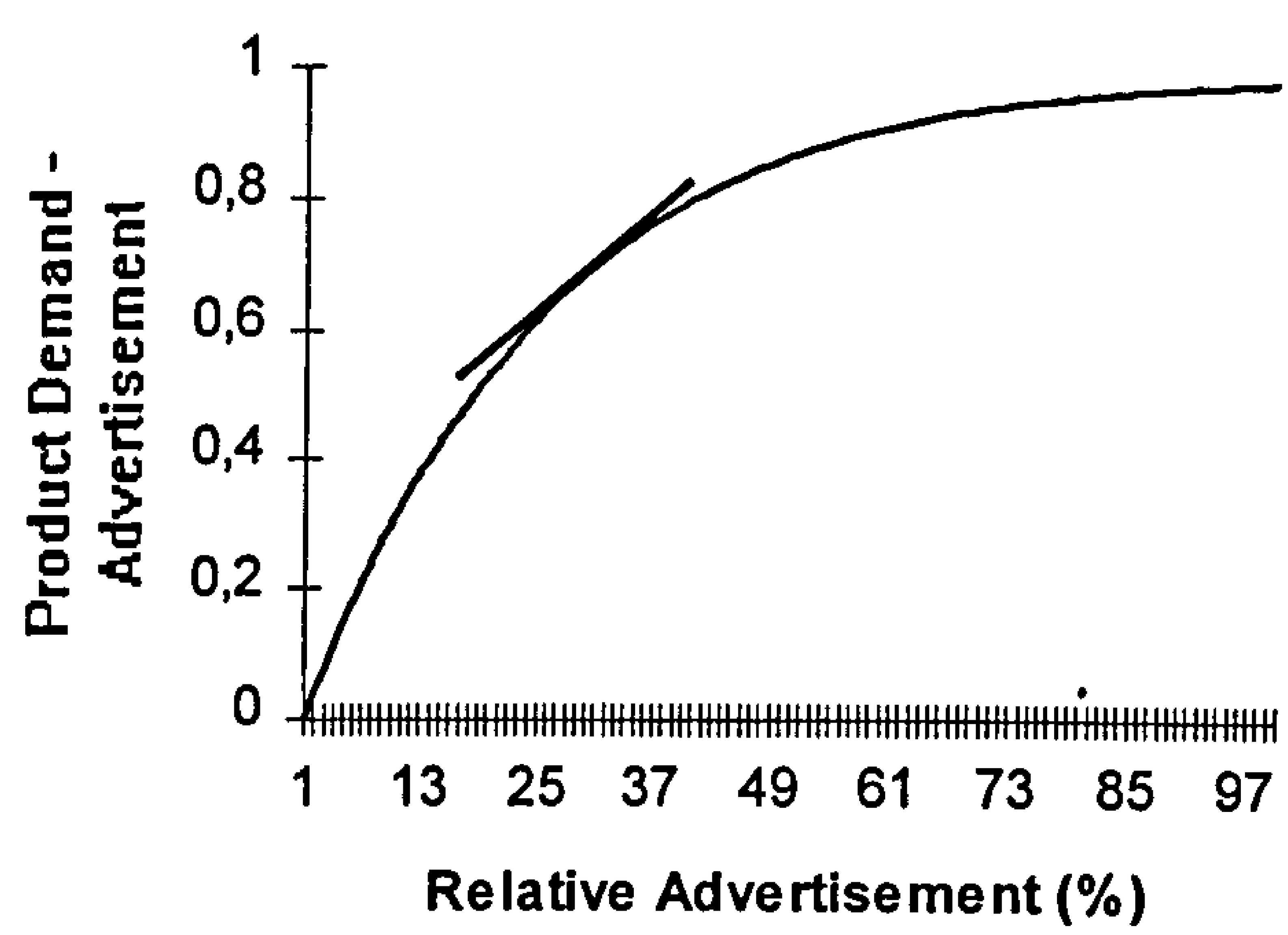

FIGURE 6-5 ADVERTISING EFFECT ON MARKET SHARE

The upper level of this market share is 1 (100%), so that the function can be made simple:

$$S = 1 - e^{-a_1 A}$$

The a_1 parameter adjusts the shape of the function.

6.5.2.1 Example

AD_A = Relative product demand

AD_C = Current advertisement

AD_M = Maximum advertisement (predetermined)

Parameters of example

AD_C = 80000.-

AD_M = 100000.-

$a_1 = 4$ (constant)

$$AD_A = 1 - e^{-4(AD_C/AD_M)}$$

$AD_A = 1-e^{-4*0.8} = 1 - 0.04 = 0.96$

6.5.3 Sales Promotion

The shape of sales promotion (SP) function asymptotes to an upper bound, to $\overline{S}$, because the effect of sales promotion can not grow endlessly. This value is 1, because of the relative market share. The function is (Percze, 1991, p. 57)

$$S = \frac{\overline{S}}{1+e^{-(a_0+a_1 SP)}}$$

where

$a_0 < 0$, $a_1 > 0$

a_0, a_1 = parameters

SP = sales promotion

The a_0 and a_1 parameters adjust the shape of the function (see Figure 6-6).

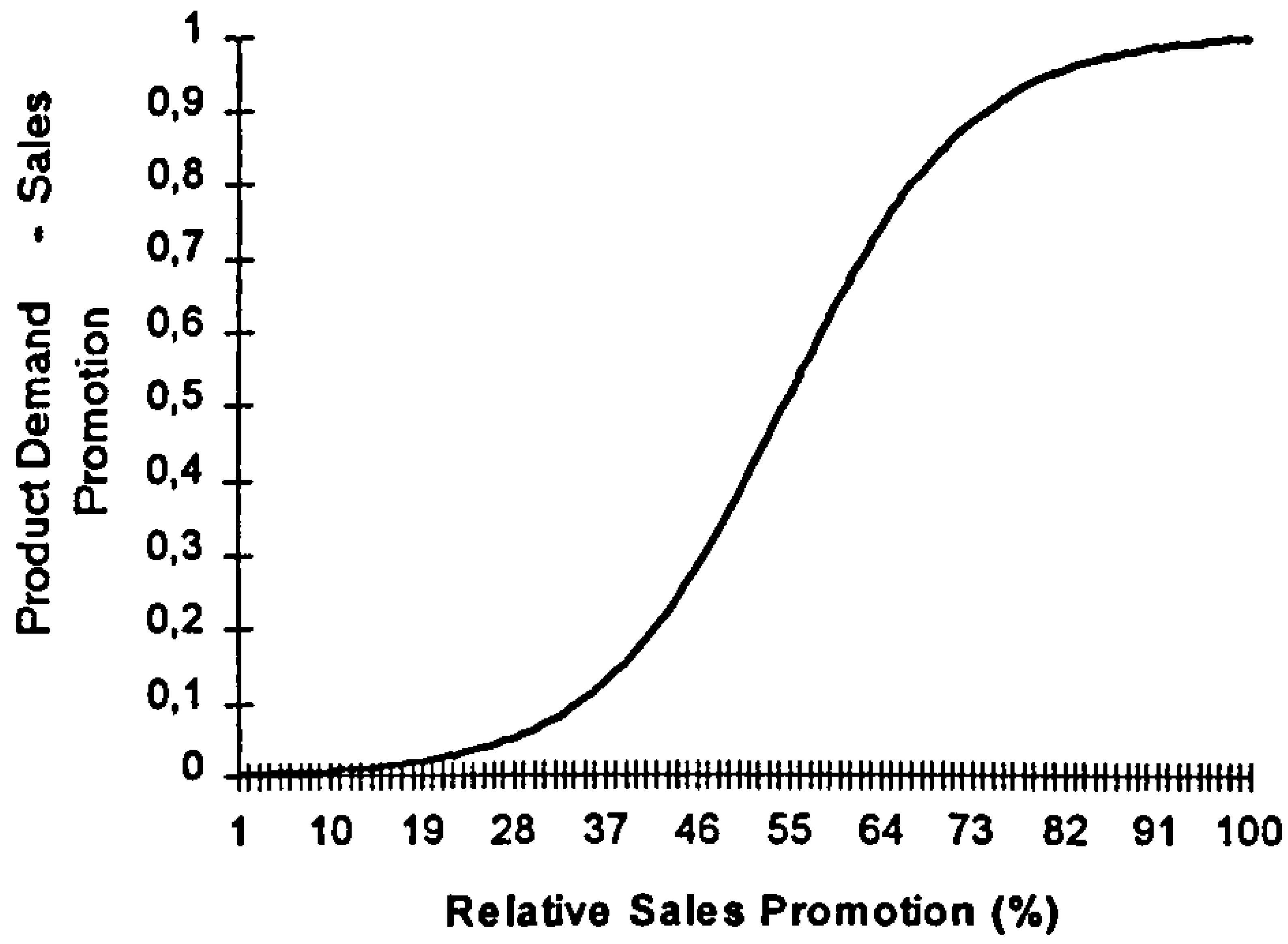

FIGURE 6-6 SALES PROMOTION EFFECT ON MARKET SHARE

6.5.3.1 Example

SP = Relative product demand for sales promotion

SP_C = Current SP price

SP_M = Maximum SP (predetermined)

Parameters of example

a0 = -6 (constant)

a1 = 11 (constant)

SP_C = 40000.-

SP_M = 80000.-

$$SP = \frac{1}{1+e^{-(-6+11(SP_C/SP_M))}} = \frac{1}{1+e^{-(-6+5.5)}} = \frac{1}{1+e^{0.5}} = 0.3775$$

6.5.4 Quality

The quality function has similar shape as sales promotion and advertisement. The higher the quality of the product, the higher the market share of the product. A GOMPERTZ type function can depict a proper shape for quality (Percze, 1991, p.55, Lilien, Kotler 1983, p. 78)

$$S = a_0 a_1^{a_2^{QU}}$$

where

$a_0 > 1$, $1 > a_1 > 0$, $a_2 < 1$

a_0, a_1, a_2 = parameters

QU = quality

The quality function asymptotes to a_0. The two other parameters (a_1 and a_2) influence the shape of the function (see Figure 6-7).

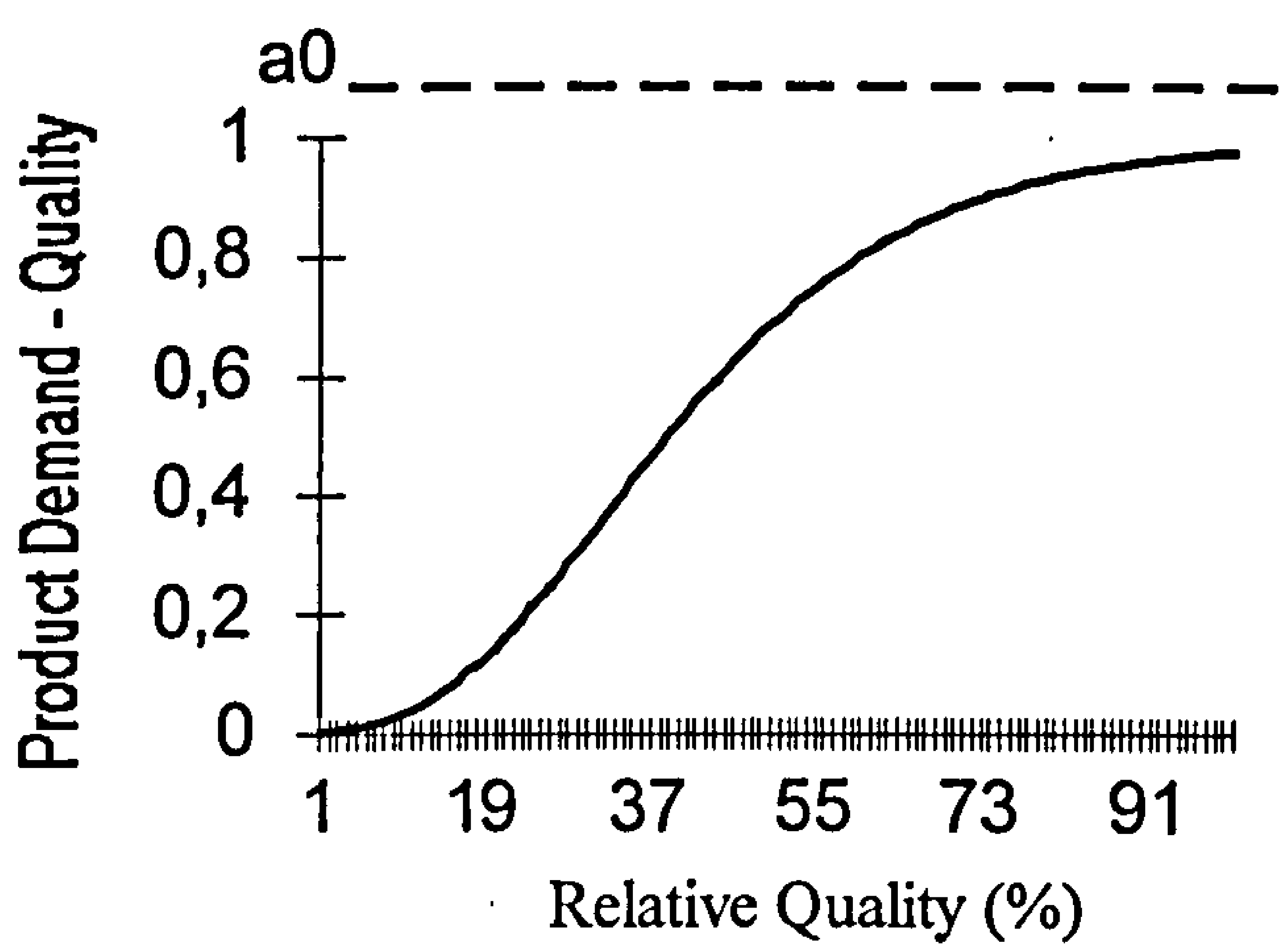

FIGURE 6-7 QUALITY EFFECT ON MARKET SHARE

6.5.4.1 Example

QU = Relative product demand for quality

QU_C = Current quality value

QU_M = Maximum quality value

Parameters of example

a_0 = 1

a_1 = 0.003 (constant)

a_2 = 0.0042 (constant)

QU_C = 20

QU_M = 40

$$QU = 1 * 0.003^{0.0042^{(QU_C/QU_M)}} = 0.003^{0.0042^{0.5}} = 0.003^{0.065} = 0.686$$

6.5.5 Previous Market Share

Previous market share can convey the "history" of the product. The BSG compares the market share of the product for a specific market to the maximum share of the given type of market. The maximum effect is 100%. The actual market shares are the results of a global market process, but they are constant for the firm's current decision process.

6.5.5.1 Example

S = Relative product demand for previous market share

S_C = Current market share of a product in a specific market

S_M = Maximum market share in a specific market

Parameters of example

S_C = 24 %

$S_M = 30\ \%$

$S = S_C / S_M$

$S = 24 / 30 = 0.8$

6.5.6 Compound Relative Market Share

In the equation of (6.14) the market model in relation to the individual firms was developed. This figure in generalised form:

$$S_{rit} = a_0(1-\lambda) + \lambda S_{it-1} + a_1 AD_{it} + b_1 SP_{it} + c_1 QU_{it} + d_1 P_{it}$$

where the new elements are

r = markets

I = firm

The estimation of coefficients of independent variables (λ, a_1, b_1, c_1, d_1) is based on PIMS data, as discussed in Section 6.4.4. These coefficients can also be set by the Umpire. In the example presented in Section 6.5.6.1 the coefficients are chosen to simplify computations.

6.5.6.1 Example

The parameters of (6.14) have the values of

$\lambda = 0.3$

$a_1 = 0.2$

$b_1 = 0.1$

$c_1 = 0.2$

$d_1 = 0.2$

Values for different variables are from the previous examples and are depicted in Table 6-3.

Variable	**Computed parameters**	**Pre-estimated weights**	**Sum**
S_{t-1}	0.8	0.3	0.24
AD	0.96	0.2	0.192
SP	0.378	0.1	0.0378
QU	0.686	0.2	0.13712
P	0.574	0.2	0.11418
Sum			0.728

TABLE 6-3 VALUES OF COMPOUND MARKET SHARE EXAMPLE

The final value (0.728, 72.8%) means that this firm lost 27% from its maximum potential market share.

6.5.7 Global Market Model

The global market model is uncertain from the firm's viewpoint. The industry demand will be equally distributed amongst firms, and later modified with the relative market shares of the firms.

$$Sa_i = ID/n + ((Sr_i/Sr_a)-1)*(ID/n) \qquad (6.17)$$

where

Sa_i = Absolute market share

ID = Industry demand

Sr_i = Relative market share of firms

Sr_a = Average relative market share

n = Number of firms

6.5.7.1 Example

$$Sr_a = \sum_{i=1}^{n} Sr_i/n$$

ID = 78939

$Sr_1 = 0.72$, $Sr_2 = 0.49$, $Sr_3 = 0.8$

n = 3

$Sr_a = (Sr_1+Sr_2+Sr_3)/3 = 0.67$

$Sr_1/Sr_a = 1.0746$

ID/n = 78939/3 = 26313

$Sa_1 = 26313 + (1.0746 - 1)*26313 = 28276$

The summary of the main features of the different games was shown in Table 3-2. This table is completed by the characteristics of the BSG, as it is shown in Table 6-4.

	Adver-tisement	**Other SP.**	**Quality**	**Various Markets**	**Automatic Forecast**
M500	Yes	No	No	Yes	No
MMG	Yes	Yes	Yes	Yes	No
Micro	Yes	Yes	Yes	Yes	Yes
Plan It	Yes	Yes	No	No	Yes
Wise	Yes	Yes	No	Yes	No
CTU	Yes	No	Yes	Yes	No
BSIM	Yes	Yes	Yes	Yes	No
BSG	Yes	Yes	Yes	Yes	No*

* Not automatic

TABLE 6-4 MARKETING VARIABLES IN DIFFERENT BUSINESS SIMULATIONS

Table 6-4 demonstrates that the traditional marketing tools are included into the BSG.

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PART II - A NEW BUSINESS SIMULATION MODEL

CHAPTER 7 - ACCOUNTING, FINANCE

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This chapter discusses the approach adapted in developing the accounting and the financial part of the BSG.

The accounting model consists of *three new concepts*. The *first* is *a process for harmonising of different countries' accounting systems*. The *second* element is *an activity run accounting system* on a *modifiable set of accounting items* which eliminates the necessity of recording the different accounting items and helps to identify different sets of accounting elements. The *third* concept promotes the active learning process by *allowing more immediate access to the accounting part of business processes.*

A brief summary of accounting theory is useful because it helps to demonstrate how the models were constructed. After a brief overview of accounting, different types of financial tables and ratios are discussed. Section 7.5 raises the problem of harmonisation of different accounting system, and Section 7.6 provides an appropriate software solution for the problem. Section 7.7 introduces the activity-run accounting system, and Section 7.8 describes the various ways the BSG supports active learning.

Following the discussion of the accounting part, the financial theory that underpins the practice will be discussed. This section includes shares, loans, dividends and the theoretical background.

The accounting and finance model also ask for input values and provide output tables, values.

There are not input variables in the accounting model. The outputs are:

- Balance sheet
- Profit and loss account;
- Cash flow statement;
- Financial ratios;
- Accounting records;
- Detailed analysis of the accounting process; and
- Detailed analysis of the table building process.

Input values in the financial model:

- Sum of short term loan;
- Sum of long term loan;
- Number of shares issued;
- Number of shares bought back; and
- Amount of dividends.

Outputs:

- Financial condition of the loans; and
- List of shares and loans.

7.1 Types of Businesses

Generally three types of business organisations can be differentiated (Clarke, 1993, p. 19): *Sole traders, Partnership and Limited Companies.* The third type was named "*corporation*" by Hermanson et al. (1987, p. 14). The first two types have one or more owners but they are different from a corporation. In corporations the owners *are stockholders or shareholders.* In this case the business processes are more complex and introduce a number of new elements, such as *stock, share, bonds.* Almost all large businesses are corporations, and many small businesses also are incorporated (Hermanson et al., 1987, p. 16). The BSG assumes that the companies in competition are corporations or limited companies. The assumption is essential because stock, share and bonds are important elements of business and their inclusion in the business simulation can enhance the knowledge and understanding of the participants in this area. This is more so in the Hungarian context because these concepts are fairly new. Section 7.9 comprises the details about the financial knowledge and discusses the usage and accessibility of tools applied in the BSG.

7.2 About Accounting

Accounting is an important process because it provides the information required for planning and control purposes. Furthermore, accounting information is used by external sources to judge the performance of the organisation. Hermanson et al. (1987, p. 10) defined accounting as:

> "The process of identifying, measuring, and communicating economic information to permit informed judgments and decisions by the users of the information."

External parties (stockholders, creditors) require information about the firm. These outside people are primarily interested in the *global* picture. The different *general-purpose financial statements* serve to satisfy this need. The Corporate Report in 1975 identified a range of users of accounting data and emphasised the importance of such data. Figure 7-1 depicts the main user groups involved with a commercial enterprise.

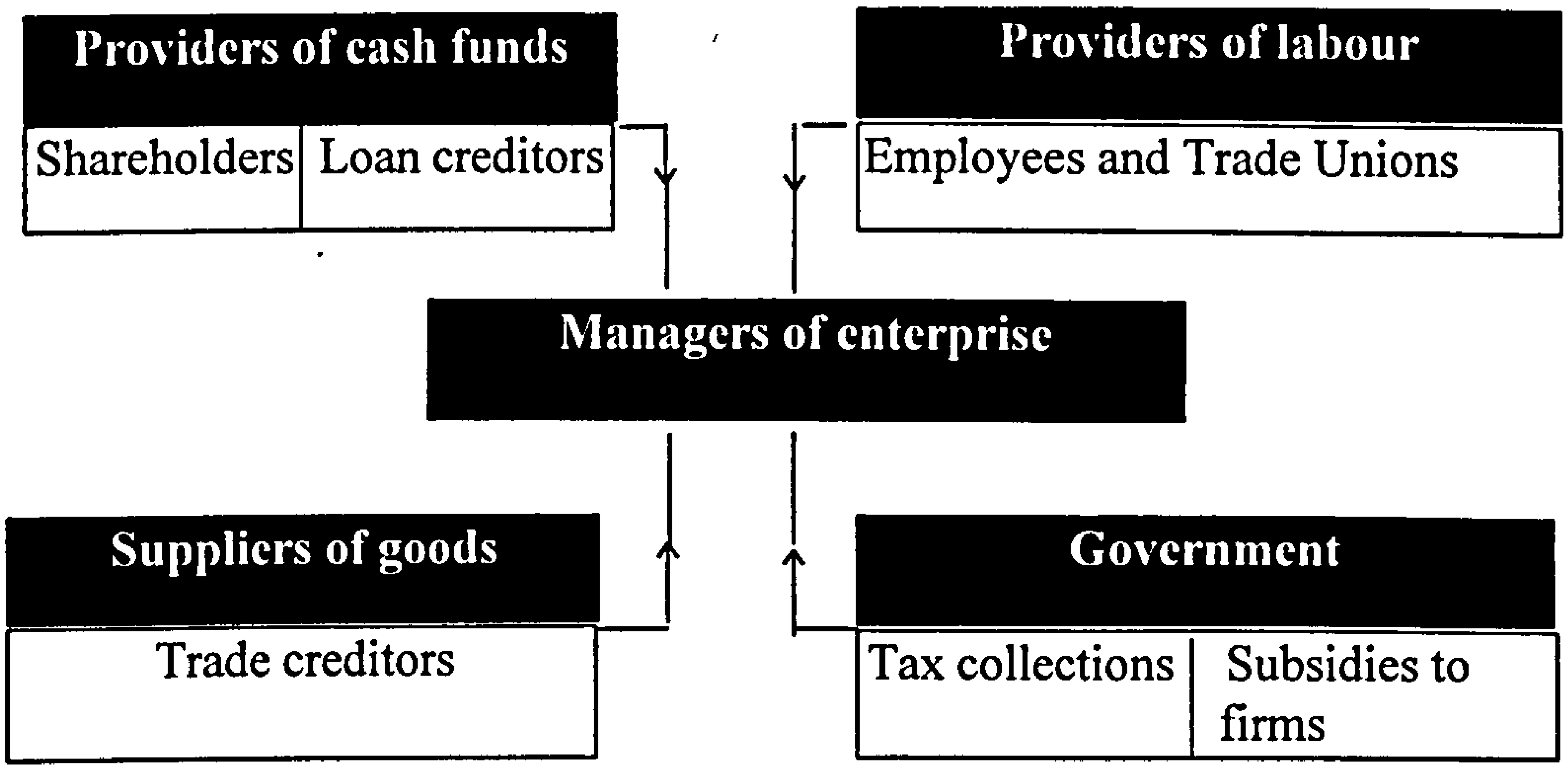

FIGURE 7-1 MAIN USER GROUPS OF ACCOUNTING INFORMATION
Source: Clarke, 1993, p. 5.

Managers within the company use accounting information for decision making purposes. Therefore, this type of accounting concentrates on the part of the company that the manager oversees. The purpose of this process may be financial decisions, resource allocation decisions, production decisions or marketing decisions (Hermanson et al., 1987, p. 8). This is usually seen as the role of *managerial accounting*. Further implications for the design of management accounting systems are given in Drury (1992, Chapter 21, Chapter 27).

Strategic Management Accounting (SMA) is the extension of managerial accounting. A definition of SMA is: "That body of Management Accounting concerned with the provision of strategically-orientated information for decision-making and control" (Guilding et al., 1995). Strategic management accounting has two objectives: integration of the cost of offering strategically excellent products into the firm's cost systems, and to ascertain the enterprise's cost positioning relative to its rivals (Bromwich, 1992). The BSG uses all the three types of accounting. Financial accounting, and the connected tables, constitute the basis for the managerial accounting where the participants are able to analyse the data from the business point of view. SMA is used when strategic decisions have to be made at the beginning of the simulation.

7.3 Financial Statements

The purpose of this section is to introduce the accounting notions and tables used by the participants during the simulation. Work sheets summarise the accounting data needed to prepare the financial statements. This section includes:

- Transactions;
- General ledger;
- Profit and loss account or income statement;
- Retained earnings statement;
- Balance sheet; and

• Cash flow statement.

The income statement is prepared first from the financial tables because net income is necessary to establish the retained earnings statement. A balance sheet can only be developed if the balance of retained earnings at the end of the accounting period is known.

7.3.1 Transactions

Transactions are exchanges of goods and services. "... each transaction affecting a business entity must be recorded in the accounting records ... " (Hermanson et al., 1987, p. 23). Most business transactions are repetitive in nature.

Assuming a *T-account* shape of an account, a *double-entry procedure* ensures that if there is an amount in a left hand side of an account (*debit*) then there has to be another account that will have the same amount in its right hand side, as *credit*. The connection can be described as:

Debits = Credits.

7.3.2 The Ledger

Systematic transactions are recorded on ledger accounts. The individual customers' account could be placed in separate ledgers (Warren and Fess 1988, p.

197). The accounts of separate ledgers are summarised in a principal, general ledger. The ledger accounts are the basis of financial statements.

> "A **ledger** (general ledger) is the complete collection of all the accounts of a company. Accounts are classified into two general groups: (1) **balance sheet accounts** (assets, liabilities, and stockholders' equity) and (2) **income statement accounts** (revenues and expenses)". (Hermanson et al., 1987, p.53)

Balance sheet accounts are called *real accounts,* while income statement accounts are *nominal accounts* because they are only sub-classifications of the stockholders' equity accounts (Hermanson et al.,

7.3.3 Income Statement

The excess of the revenue over the expense is called net income. This amount can not be calculated in connection with each transaction, consequently a stated period of time is applied (Warner and Fess 1988, p. 36).

> "The **income statement,** sometimes called an earnings statement, reports the profitability of a business organization for a **stated period of time.** In accounting, profitability is measured for a period of time, such as a month, or year, by comparing the revenues generated with

> the expenses incurred to produce these revenues." (Hermanson et al., 1987, p. 19)

The differences of *revenues* (inflows of assets) and *expenses* (costs to produce revenues) give the *net income.* Income statement reflects a *company's profitability.*

The net, after tax profit is not necessarily retained, because dividend can be paid from this profit and a part of the cash can be passed on to the stockholders. *Retained earnings statement* calculates the amount of the profit, retained by the company.

7.3.4 Balance Sheet

Balance sheet refers to a specific date and comprises the list of the assets, liabilities and owner's equity (Warren and Fess 1988, p. 36).

> "The balance sheet, sometimes called the statement of financial position, lists the company's assets, liabilities, and stockholders' equity (including dollar amounts) **as of a specific moment in time.** A balance sheet is like a still photograph; it captures the financial position of a company at a particular point in time." (Hermanson et al., 1987, p. 15-16)

The two sides of the balance sheet, the *assets* and the *liabilities* have to be balanced. Assets are resources; the things of value owned by the business. Liabilities are the business' debts that must be paid by certain dates. *Stockholder's equity* helps to balance the two sides. It comprises the shares of capital stock and retained earnings (Hermanson et al., 1987, p. 21).

Assets = Liabilities + Stockholders' Equity

7.3.5 Cash Flow Statement

The firm's major sources of cash receipts and major uses of cash payments are reported in *cash flow statement* (Warren and Fess 1988, p. 602). A company can be very profitable and extremely short of cash at the same time (Clarke 1993, p. 171). Cash flow statements identify the deficiencies and surpluses of funds. The surplus cash can be used elsewhere, while the deficiencies need additional financial resources.

> "A cash flow statement will show the funds generated (absorbed) from operation during the period, in addition to providing information about all the investing and financing activities of the company during the period. (Clarke 1993, p. 181)

Therefore, cash flow statement should assist creditors, shareholders and others. Further analysis of cash flow is provided in Lumby (1990, Chapter 6); Arnold and Hope (1990).

7.4 Financial Statement Analysis

The financial position of a firm is of interest to many groups. The financial statements present much of the information needed for various purposes but financial analysis can provide additional information that should be useful for making economic decisions (Warren and Fess 1988, p. 642).

> "Financial statement analysis consists of applying analytical tools and techniques to financial statements and other relevant data to obtain useful information. This information is shown as significant relationship between data and trends in those data assessing the company's **past performance** and **current financial position.**" (Hermanson et al., 1987, p. 653)

Investors wish to predict the company's dividends and changes in the market price of the company's common stock, and to understand the position of a company. Others may be interested in the solvency of the company. Short term solvency is affected by liquidity. "**Liquidity** is the state of possessing liquid assets, such as cash and other assets that will soon be converted into cash." (Hermanson et al., 1987, p. 653). Long term solvency is fulfilled when the company's assets exceed its liabilities (positive stockholder's equity).

Methods of financial statement analysis can be classified in various ways (Clarke 1993, p. 131, Warren and Fess 1988, Chapter 15, Brockington 1993, Chapter 17). The classification of Hermanson will be applied to underpin the financial analysis used in the BSG. Hermanson et al. (1987, p. 655) suggested that analysis of financial statements falls into four broad areas. These are:

- Comparative financial statements;
- Trend percentages;
- Vertical analysis; and
- Ratios

Comparative financial statements compare the statements for multiple years in absolute or percentage values. *Trend percentages* are applied if there is a base year and the other years are compared to this year. *Vertical analysis* is the study of a single financial statement, where the values are expressed as a percentage of a significant total. *Financial ratios* constitute the most significant group. They are therefore discussed more fully in the following section.

7.4.1 Financial Ratios.

Financial ratios express logical relationships between the values. External parties are especially interested in the areas of liquidity, solvency (short and long term) and profitability, as discussed at the start of Section 7.4. In this chapter the ratios are listed into four groups (Hermanson et al., 1987, p. 659) according to these requirements:

- liquidity ratios;
- equity or long-term solvency ratios;
- profitability tests; and
- market tests.

Financial ratios can be classified in various other ways; an example is the DuPont method (Kaplan and Atkinson, 1990, p. 660). Ratios are only an aid to analysis but not a substitution of sound thinking (Clarke 1993, p. 135). Financial ratios are described on the basis of Hermanson (1987, pp. 659-673) and are grouped in the following sections.

7.4.1.1 Liquidity Ratios

Liquidity indicates the extent to which current assets are available to meet the current liabilities (Clarke 1993, p. 136)

"Liquidity ratios are used to indicate a company's short-term debt-paying ability." (Hermanson et al., 1987, p.659)

The excess of current assets over current liabilities is *working capital*. The amount of the working capital does not provide an appropriate explanation, because of the lack of the possibility of comparison. Current ratio is a quotient and can be expressed in percentage. This provides the opportunity to compare it to other firm's similar ratio.

$$\text{R1.}\quad \text{Current Ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

Current assets comprise inventories and pre-paid expenses; therefore, they do not mean immediate access to cash. However, the acid test ratio includes only cash.

$$\text{R2.}\quad \text{Quick Ratio} = \frac{\text{Quick assets}}{\text{Current liabilities}}$$

Inventory turnover expresses the average inventory sold during a period. "The improvement in the turnover resulted from an increase in the cost of goods sold, combined with a decrease in average inventory" (Warren and Fess 1988, p. 655). The ratio of inventory turnover is given below:

$$\text{R3.}\quad \text{Inventory turnover} = \frac{\text{Cost of goods sold}}{\text{Average inventory}}$$

7.4.1.2 Equity, or Long-Term Solvency, Ratios

Equity ratio shows the proportion of stockholders' equity to total assets.

> "Equity, or Long-Term Solvency, ratios show the relationship of debt and equity financing in a company. (Hermanson et al., 1987, p. 684) .

A high value is desirable from a creditors' point of view, because it means a large protective buffer for creditors. Low value (too much debt) could be dangerous, because of the predictable lack of liquidity. Equity ratio is given below:

$$\text{R4. Equity ratio} = \frac{\text{Stockholders' equity}}{\text{Total assets (or total equities)}}$$

7.4.1.3 Profitability Tests

The overall profit performance in relation to the amount of resources available is perhaps the most important ratio of a company (Clarke 1993, p. 147). Return on investment (ROI) was developed by the DuPont Company (Kaplan and Atkinson, 1990, p. 660). Rate on return on operating assets and return on equity are two different ways of expressing the return on investment.

Rate of return on operating assets can be expressed as the product of *operating margin* and *turnover of operating assets*. Operating margin shows the proportion of net sale to net operating income. Turnover of operating assets shows the amount of sales in currencies generated for each unit of currency invested in operating assets.

R5. $\text{Rate of return on operating assets} = \frac{\text{Net operating income}}{\text{Net sales}} x \frac{\text{Net sales}}{\text{Operating assets}}$

Rate on equity (ROE) or rate on return on average stockholders' equity shows the income-producing ability of a company. It is a measurement of the efficient use of assets by management. The formula is given below:

R6. $\text{Return on equity} = \frac{\text{Net income}}{\text{Average stockholders' equity}}$

7.4.1.4 Market Tests

Certain ratios can provide information about the market price of the company's stock that help investors to assess the relative merit of the stock in the marketplace (Hermanson et al., 1987, p. 672). Probably the most widely used measure to appraise a company's operation is *earnings per share (EPS)* of common stock (Warren and Fess 1988, p. 660, Hermanson et al., 1987, p.669).

R7. $\text{EPS of common stock} = \frac{\text{Net income available to common stockholders}}{\text{Weighted - average number of common shares outstanding}}$

In the case of stock the denominator is the number of shares of stock outstanding because the weighted average is unnecessary (Warren and Fess 1988, p. 661). The BSG allows the user to build arbitrary ratios. This will be discussed in Section 7.6. Either the Umpire or the participants can insert additional ratios to ensure a bespoke system of ratios.

7.5 Standardisation and Harmonisation of Financial Statements

Because financial accounting is a means of communication from the company to the user, (for example stockholders) the financial accounting statements have to be uniformly explained and understood by the external users. Therefore, within a country these statements have to be *standardised*. Accounting is an important language of commerce as well and its effectiveness is aided by the precise definition of words and rules as to its structure (Thorell, Whittington 1994, p. 215). Because of national differences the standardisation is very difficult, but there is pressure to bring the accounting standards of different countries into closer harmony with one another (Thorell, Whittington 1994, p. 216).

"The particulars that companies published were plainly at variance, both qualitatively and quantitatively for one country to another. Annual accounts were not comparable with insufficient information (and non-comparable information) concerning assets, liabilities and overall performance." (Clarke 1993, p. 14)

International standardisation means that all countries share identical accounting standards, but even uniform methods will not necessarily lead to uniform results (Thorell, Whittington 1994, p. 216).

A common economy assumes a harmonised infrastructure, and financial accounting is a part of the infrastructure (Thorell, Whittington 1994, p. 216). The integration movement started in Rome, with the Treaty of Rome in 1957. This process does not refer only to Europe because several attempts have been made in other geographical areas (Garcia Diez, Mendivil, 1994). Since 1957 several efforts were made to harmonise the accounting regulations, conventions and standards in Europe. A number of changes in business processes followed the increased international business relationships (Dounban, Sowaidi, 1994). The International Accounting Standards Committee (IASC) has worked on international accounting harmonisation for two decades. There are 31 International Standards and

Conceptual Frameworks for financial accounting but "little progress has been made in achieving global uniformity in accounting" (Carlson, 1994). The Fourth Directive of the Council of Ministers within the EU deals with the accounts of single companies (Clarke 1993, p. 15). The main features of these requirements are: *format* rules, *disclosure* requirements, *valuation* rules and *true and fair view.* Two thorough surveys were conducted in 1991 and 1992. The results indicate that there is no accuracy in the statements. The reasons for discrepancies are the many detailed areas such as pension provisions and deferred taxation, and there are significant variations of practice (Thorell, Whittington 1994, p. 219). Hilda Theunisse conducted case studies on German, Belgian and French companies. All countries' annual accounts are legally based on the EC's Fourth Directive, but there were still difficulties and differences comparing the financial statements of companies, operating in different countries to each other (Theunisse, 1994).

7.6 An Appropriate Software Solution for Harmonisation

The BSG is a two country simulation, and the same problem arose during the design of the game. The unsolved harmonisation problems do not necessarily mean that without harmonisation it is not possible to achieve a level of understanding and communications between companies from different countries. A temporary new sub-goal is needed instead of harmonisation to bridge the gaps of understanding that currently exist between countries. The sub-goal has be *the understanding of each other's financial accounts in an internationally integrated environment* instead of the harmonisation of the different accounting systems. In this way the harmonisation is not necessary. Accounting statements used for financial reporting is made up of a series of rules. If a computer program is used to build up these rules from the original accounting rules, an arbitrary table can be built up with an appropriate country convention. However, in order to achieve this new sub-goal, an understanding of the culture of different countries may be required. The BSG builds up the rules from original ledger data. Arbitrary tables can be built with an appropriate country language (Kiss, 1994, 1; Kiss, 1994, 2; Ghobadian et al., 1995).

During the model building process, the program permits accountants from both countries to analyse and debate the rules before agreeing on the acceptable meaning of the rule. This will reveal differences and these differences can be assigned to tables as notices. This is demonstrated by Hilda Theunisse (1994) in her case studies. In the process of building the model, the differences between accounting country rules will be considered, explained and applied.

The accounting part of the BSG is able to build up the rules in a high level language. This set of rules is easily modifiable. The first step is to establish general summary categories, like "material" or "investment" from the general ledger data. All the relevant data have to be extracted from the general ledger. These summary categories serve as basic data for the financial tables and ratios. An arbitrary number of tables can be created, for example two balance sheets. The text and the content of the tables are also arbitrary. Consequently two balance sheets can be created with correct form and content on the basis of two countries' rules. Furthermore, during the model building process, the rules and the tables represent the systematic flow of the firm's data. The detailed description of the methodology is provided in Appendix VIII.

7.7 Activity-Run Accounting System

This section describes two new methods in the area of accounting. The first new element is *a modifiable set of accounting items* that provides the opportunity to change the accounting rules without changing the program. The second new element is the *activity-run accounting method* which can collect the set of accounting items into a well-defined group in relation with production or other types of activities and accomplishes the accounting process in one step for the group.

7.7.1 Modifiable Set of Accounting Items

In a normal accounting process a book-keeper has to record all items separately, and the accounting process will sort the items to the different accounts. The recording process is not suitable for business simulations because it would take a large proportion of the playing time and could distract the attention of participants from the general process - unless it is a specific functional game for accounting. That is the reason why an accounting system in a business simulation should be an *automatic process*. If the rules change, the program can not follow it because these rules were programmed into the model and fixed.

Table 7-1 and Table 7-2 illustrate the basic principle of the modifiable characteristic of accounting items. This example assumes a serial number for different elements of the accounting system, similar to those, applied in the harmonisation model.

```
{** 1. CLASS OF ACCOUNTS : INVESTED ASSETTS **}
{* 11 INTANGIBLE ASSETS *}
   1:  111      Rights as Possessions              +
   2:  112      Value of Firm                      +
   3:  113      Mental Products (Software)          +
   4:  1141     1.prod. Value of Developments      +
   5:  1142     2.prod. Value of Developments      +
   6:  1143     3.prod. Value of Developments      +
   7:  119      Intangible assets deprecations    +
{* 12 - 15 CURRENT ASSETTS *}
{ 12      PROPERTIES }
   8:  123      Properties, Plants                 +
   9:  129      Depreciation of Properties         +
...
{  18    GIVEN LOANS      }
{  19    LONG TERM BANK DEPOSIT }
{** 2. CLASS OF ASSETTS : STOCKS **}
{* 21 - 22     MATERIALS *}
  13:  211      "A" Material                       +
  14:  212      "B" Material                       +
  15:  213      "C" Material                       +
...
{* 97  REVENUE OF FINANCIAL OPERATIONS *}
 121:  96       Other Revenues                     +
 122:  977      Profit of Sale of Securities       +
```

TABLE 7-1 INITIAL SET OF ACCOUNTS

7.7.2 Activity-Run Accounting System

The main idea of the activity-run accounting system is for grouping the transactions that belong to a certain activity. Because of the closely related items, only one or a few parameters are adequate to operate the accounting items. This allows the flow of the items to be studied. In the following example the real value, the book value, and the VAT of the material are able to operate through three accounting items. Albeit this example contains separate accounting items with related values, it illustrates the related items and values. Table 7-2 comprises the group of items belonging to a well-defined *activity of a firm*. In this example the activity is purchasing material.

```
{ Purchasing Material}
=agva { Identifier }
{ Title Row          2         3         4         5 }
{1..................0.........0.........0.........0 }
=Accounting of ordering material
{ i = material,  quantity  * price      = valueTeny,  }
{                quantity  * book price = valuenyilv, }
{                valueteny  * VAT        = VAT     }
=3 { Number of Rows }
{ Debit      Credit    }
{1...5      1...5      }
=211        2291          { Purchasing materials  book price }
=2291       441           { Purchasing materials real price}
=466        441           { VAT }
{ Name of accounting2          3         4 }
{1..................0.........0.........0 }
=A material into price difference account
=A material into vendors
=VAT A. material
{ Values to rows : }
{ A = value, book price B = value, real price, C = VAT }
=A
=B
=C
*************************************************************
```

TABLE 7-2 ACTIVITY-BASED GROUP OF ACCOUNTING ITEMS

In this system there are six kinds of information. Every significant part begins with a "=" sign. The first is the identifier, that is a group of four letters: "agva". The four letter word identifies the appropriate accounting procedure that is built into the program. The second part is the name of the group of accounting items. This group includes three accounting records:

a./ purchasing material in predetermined price;

b./ purchasing material in real price; and

c./ VAT accounting.

The name of this group in the fifth row of Table 7-2 is "Accounting of purchasing material". The BSG uses this label in the accounting process. The third useful piece of information contains the number of accounting items. The example contains 3 accounting items. This means that the next three groups must have the same number of rows as well. The fourth contains the debit and credit serial number of accounts. The digits above (1...5) show the place of the first and the last position of possible digit of the serial number of accounts. Here these numbers are 211 and 2291, 2291 and 441, 466 and 441 for "Purchasing materials book price", "Purchasing materials real price" and "VAT" respectively. The fifth group contains the description of the accounting items that are used in the BSG as explanatory text. This contains the content of the accounting items, names. These texts will be seen within the BSG. In the sixth group there are the appropriate values of the rows. These values can be transferred to the program to the definite rows, with the values of (A, B). Obviously it is not possible to use other values and names, but fortunately it is not necessary. These changes can be made with the help of a simple word-processor by the Umpire, or anybody else who is expert in the accounting field. The modification of the file is only necessary if the accounting rules change. This is important, because general modification of the program is unnecessary. After the setting of the new values, the content has to be saved again into an ASCII file with the same name. If an error should occur, the earlier version can always help.

A programmed procedure accomplishes the accounting process on the basis of the information described above and illustrated in Table 7-3.

7.8 Promoting the Active Learning Process

In the case of automatic accounting, the process and the items are not visible to the participants. Only the end products, the financial tables are presented. The accounting theory, applied in the models can not be followed, and it is impossible to track the items and to study them from one step to another step.

The BSG provides means for allowing the opportunity to follow the accounting process step by step. This active learning process allows the participants

- to make detailed accounting inquires;
- to check the operation of accounting items; and
- to follow the build up process.

The *detailed accounting inquires* allows the participants to follow the records of transactions. Firstly, the full accounting procedure of the previous period can be seen. Secondly, the accounting records of the last transactions can be listed. These possibilities were discussed in Section 4.2.3.

The *second means* is the philosophy, partly discussed in Section 7.7, in the "activity-run accounting system". Checking the operation of accounting items means that the participants can change the operation of the program in the "accounting method change" menu-part, as discussed in Section 4.1.4.3. In that case the participants can see the accounting procedure when the transaction actually occurs. Participants can follow the accounting process with real numbers. Table 7-3 illustrates this part of BSG.

Paying Dividends *1* Debit : 474 Dividend Credit : 384 Bank Account	 Paying Dividends 1000000

TABLE 7-3 COMPLETED ACCOUNTING RECORDS

The third means is the possibility of following the process of building up the financial tables and ratios. Section 7.6 and 7.7 described the software solution for harmonisation where the methodology was discussed. The tables and processes can be tracked by the users including all computational details, as it is shown in Table 7-4.

{A - Basic data }	
1. Revenue	
911*.E Domestic market revenue	6744696
931*.E P.Soc. market. revenue	0
932*.E Developing market revenue	0
933*.E Competitive market revenue	0
467.E- VAT	1085595
2. Other revenue	
96.E Other revenue	1359
3. Cost of Sales	
...	
38*.F Cash and Bank accounts	34770
12. Creditors	
44*.E Creditors	

TABLE 7-4 PART OF THE DETAILED COMPUTATIONS

The accounting part of this chapter applied new theories and means in the area of accounting. Until the real harmonisation of different accounting systems, a software solution provides the best opportunity for understanding the content of each other's accounting systems. The activity run accounting system collected the accounting items according to certain activities and the accounting processes were accomplished on the basis of modifiable set of accounting items. Immediate access to the elements of accounting processes ensures active learning by the participants.

7.9 Financial Part

The main purpose of this part is to describe the financial model of the BSG. As shown in Section 3.4, nearly all of the games provide the opportunity to raise short and/or long term loans, issue shares and pay dividends. The BSG allows the participants to use the same means for extending the financial resources of the firm. Figure 7-2 depicts the BSG's financial screen.

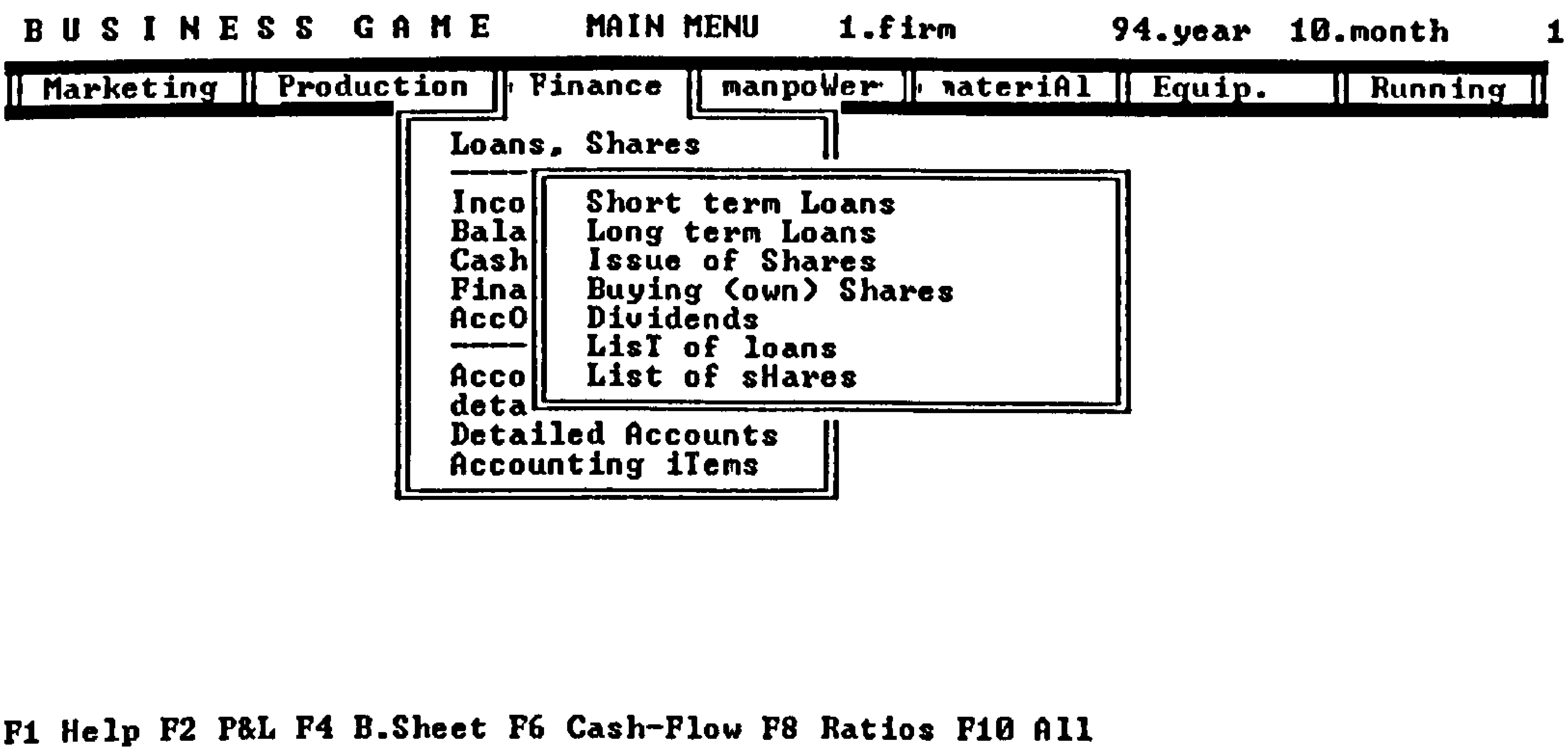

FIGURE 7-2 FINANCIAL MENU COMMANDS

7.9.1 Parameter File, Initial Decisions

The outer parameter file allows the Umpire to set initial parameters according to the objective of the Umpire, as discussed in Section 4.2.1. The initial decision of the Umpire is to set the estimated value of the firm, and consequently the amount of cash the company can use. Table 7-5 presents a part of the outer parameter-file where the Umpire can insert the appropriate value for different parameters. These parameters will be loaded at every decision, and they can be changed continuously between the periods. The number of shares and the estimated value of the firm effect the game only at the start, as these values are used in the initialisation process of the BSG.

An upper limit of loss and loans ensures reasonable simulation of the environment. The permitted loss of the firm can be 20% of the estimated value of the firm, and the amount of loan allowed for by the firm cannot exceed the amount of estimated value, as shown in Table 7-5.

1000	{ Number of Shares }
500000000	{ Estimated value of the firm }
6	{ %, Long term Loan Interest, year }
36	{ %, Long term Loan expire, month }
9	{ %, Short term Loan Interest, year }
10	{ %, Short term Loan expire, month }
20	{ %, Immediate Loan Interest, year }
2	{ %, Immediate Loan expire, month }
100	{ %, Measure of the maximal sum of loans as a % of estimated value of firm }
20	{ %, Measure of maximal loss as a % of estimated value of a firm }

TABLE 7-5 PART OF THE PARAMETER-FILE

Both the maximum sum of loans and loss can be predetermined by the values in Table 7-5.

If the firm's deficit can not be covered by loans, then the firm will become bankrupt and has to re-start the game. Some simulations compel the firm to give up the game if there is no more cash available. There is no penalty for bankruptcy, because the initialisation procedure re-starts the game from the original situation.

7.9.2 Short, Long-Term and Immediate Loans

Short and long term loans can be used for long term investments (equipment) and overcome any *anticipated* financial difficulties. Short term difficulties can occur for example, when the company needs cash to finance the build-up of seasonal inventories (Hermanson et al., 1987, p. 392)

Immediate loan facility is provided without a request of the participants if there is no cash on the bank account. This is an automatic feature of the BSG. The upper limit for this type of loan is the same as that shown in Table 7-5. The duration and the interest rate are also pre-determined. Obviously this kind of loan attracts higher interest rates. Figure 7-3 depicts the screen for a short term loan. The short and long term screen only differs at the parameters, predetermined in the parameter-file.

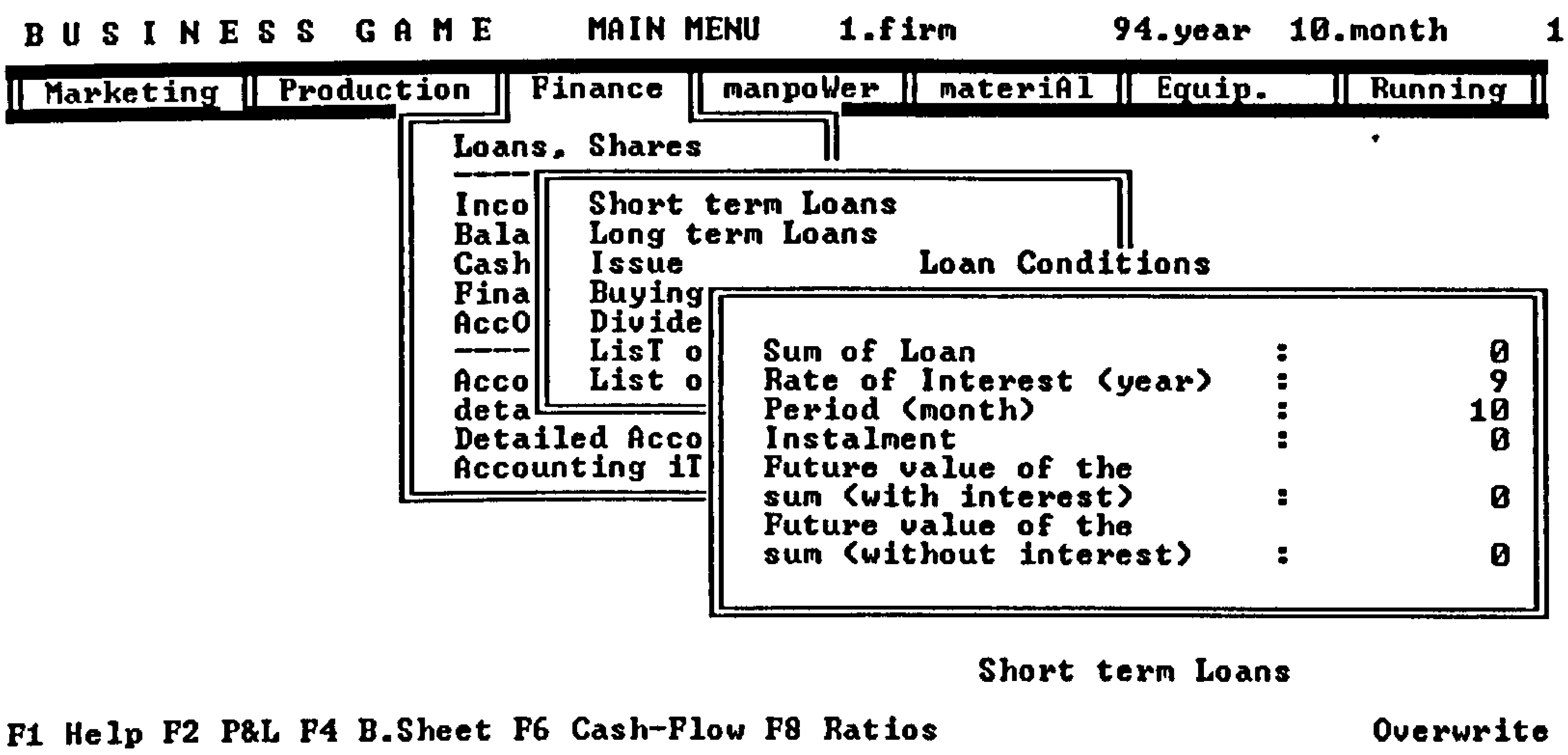

FIGURE 7-3 SHORT TERM LOANS

The participants can only input the first value in Figure 7-3, the sum of the loan. The other values are calculated by the program. The interest rate and the period (in month) are known, as shown in Table 7-5. The monthly instalment and the future value can be computed from these two values (Sipos, 1995). The first future value in Figure 7-3 calculates the value of the current loan considering the length of period and the interest rate. This meaning of future value is accepted (Warren and Fess 1988, p. 518). The second future value assumes a zero interest rate. If the company does not invest that amount of money, then the future value of this current sum will be the amount, presented in the lowest figure of the screen in Figure 7-3.

7.9.3 Dividends

Dividend is a distribution of income to owners (Hermanson et al., 1987, p. 32) and it can only be paid if the firm has cash available or access to cash resources (see Figure 7-4). The amount of dividend influences the goodwill that affects the value of share, as shown in Section 7.9.4.

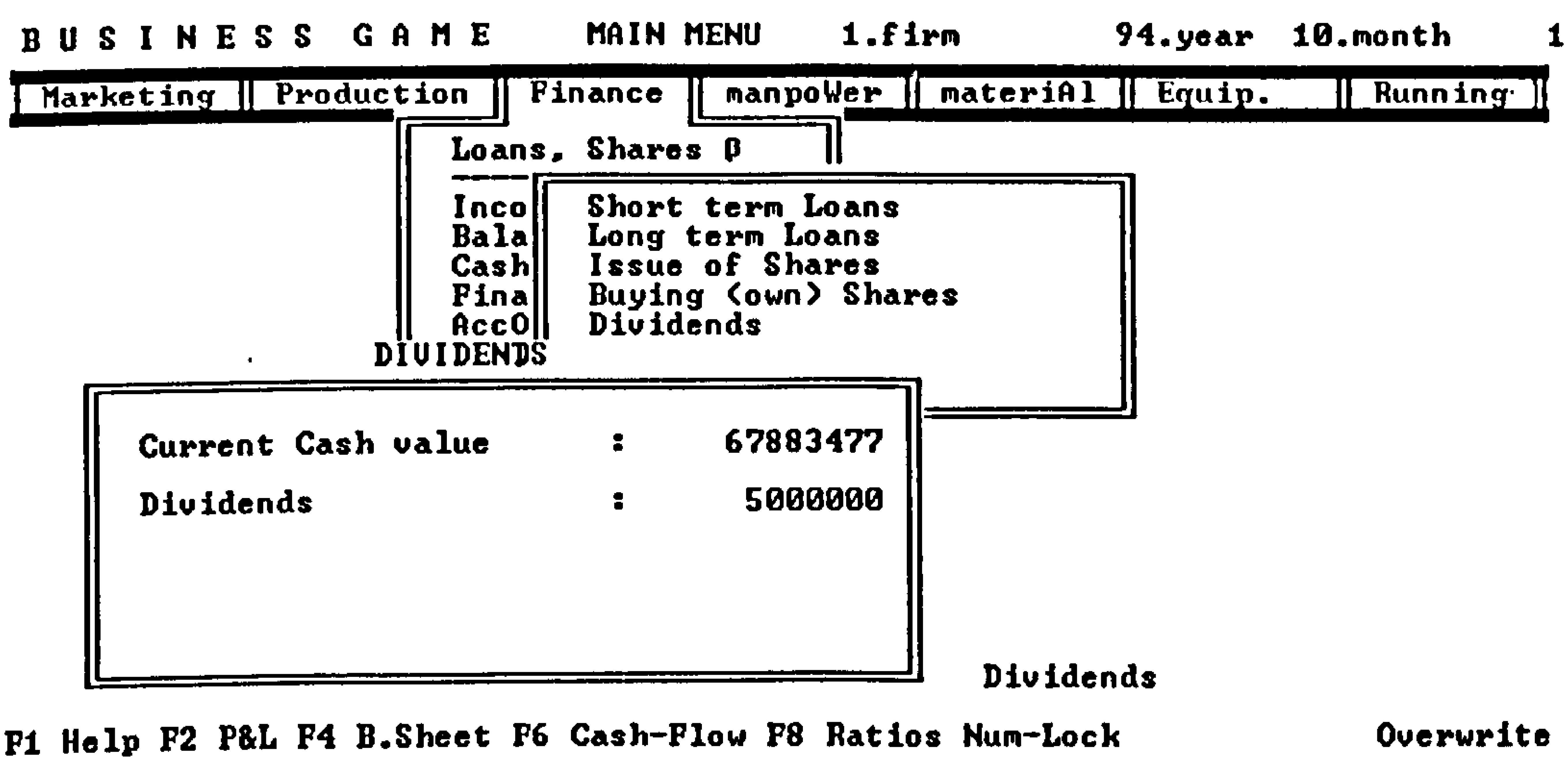

FIGURE 7-4 DIVIDENDS

7.9.4 Shares

Stockholders, or shareholders - the owner of the firm - buy shares of stock, which are units of ownership (Hermanson et al., 1987, p. 33). At the beginning of the game there is a predetermined sum of shares and value of the firm (see Table 7-5) by which the initial value of share is determined. The BSG allows the firm to issue additional shares. Upper and lower limits of the number of shares possessed by the firm are set in the BSG to ensure similarity to the real life environment. The maximum number of shares is double of the original number and the minimum is a quarter of the original number of shares. Figure 7-5 depicts a share issue of 200 new shares.

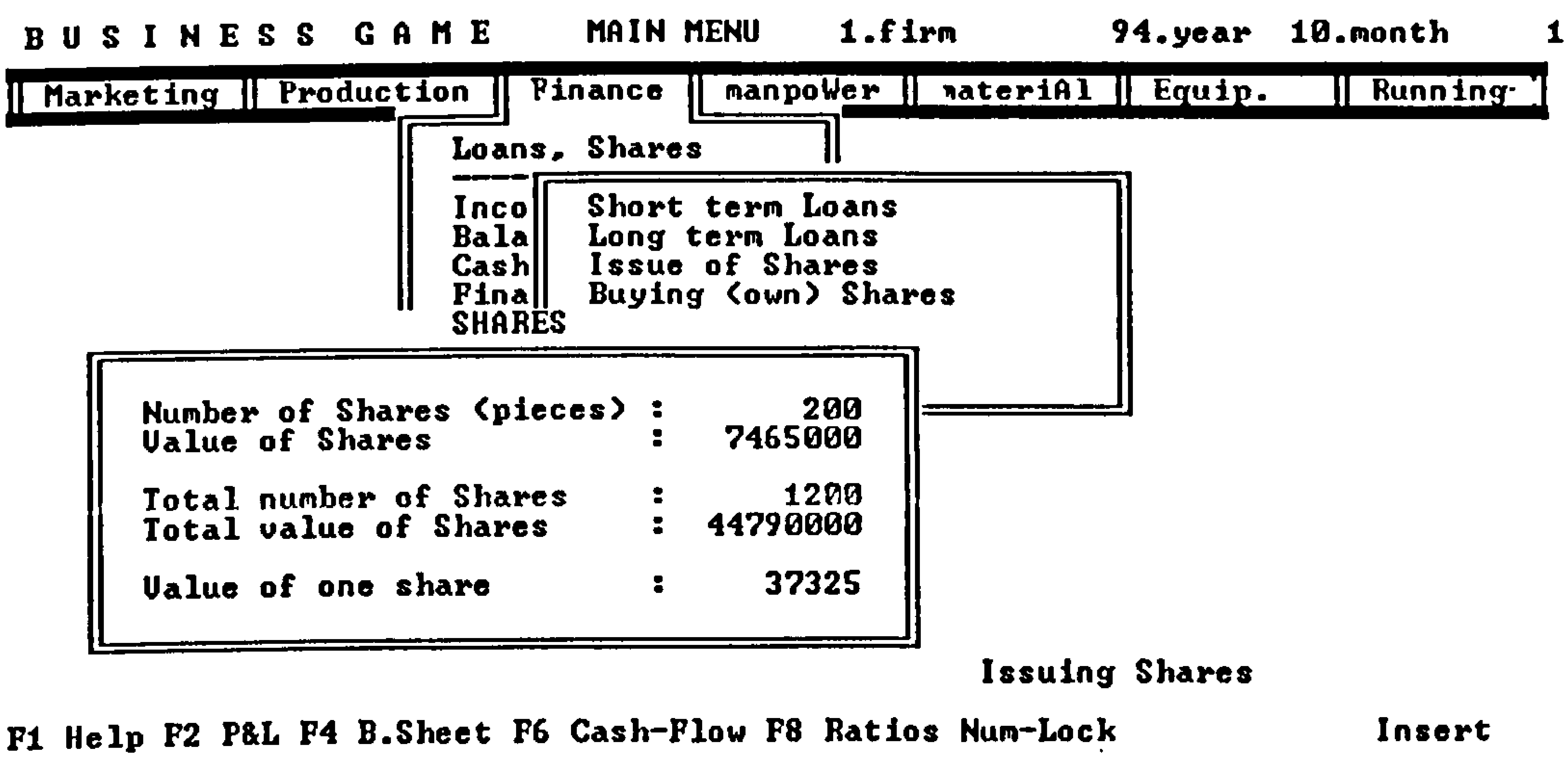

FIGURE 7-5 ISSUE OF SHARES

Four examples about share transactions can be found in Appendix IX.

The main features of the accounting and financial parts of the different games were depicted in Tables 3-7 and 3-8. These tables are completed by the characteristics of the BSG as shown in Tables 7-6, and 7-7.

	Short term loan	**Long term loan (bonds)**	**Issuing shares**	**Paying Dividends**
M500	No	No*	No	No
MMG	Yes	Yes	Yes	Yes
Micro	Yes	Yes	Yes	Yes
Plan It	Yes	Yes	Yes	Yes
Wise	Yes	Yes	Yes**	Yes
CTU	Yes	Yes	No	No
BSIM	Yes	Yes	Yes	Yes
BSG	Yes	Yes	Yes	Yes

* It ensures a building lease.
** Can not be repurchased

TABLE 7-6 FINANCIAL POSSIBILITIES

	Balance Sheet	**Profit & Loss Account**	**Cash Flow Statement**	**Financial Ratios**
M500	Yes	Yes	Yes	No
MMG	Yes	Yes	No	Yes
Micro	Yes	Yes	Yes	No
Plan It	Yes	Yes	No*	No
Wise	Yes	Yes	Yes	Yes**
CTU	Yes	Yes	No	No
BSIM	Yes	Yes	No	Yes***
BSG	Yes	Yes	Yes	Yes

* Detailed data about cash movements
** Return on Equity
*** Earnings per Share

TABLE 7-7 FINANCIAL TABLES AND RATIOS

Tables 7-6 and 7-7 prove, that apart from the new developments, the regular managerial tools are also included into the BSG.

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PART III - VALIDATION

CHAPTER 8 - VALIDATION OF THE BUSINESS SIMULATION GAME

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The primary aim of this chapter is to validate the BSG through the application of a validation methodology. The notion of "validity" can be applied to different types of procedures, methodologies.

> "Stanislaw ... noted a loose usage of the word validity as applied to simulators and proposed a very powerful definition: "the degree of homomorphism between one system and a second system that it purportedly represents"." (Carvalho, 1991, p. 329).

A validated business simulation has a number of advantages compared to simulation games that have not been validated. A business simulations' ability to behave in a realistic manner will enhance learning and keep participants' enthusiasm. A validated business simulation is able to create a better understanding of the interrelationship between functions. A valid simulation game provides a powerful interactive learning medium for the participants. A number of researchers have emphasised the significance of validation. Amongst them are Carvalho(1991), Machuca (1992), Perry and Euler (1988).

The validation procedure, applied in this chapter, is based on the work of Carvalho (1991). Carvalho argues that despite the widespread application of computerised business simulations there are no generally accepted validation theory and methodology (Carvalho, 1991). Face validity of the business simulation describes how the simulation mimics the behaviour of a real enterprise. The proposed procedure is based on premise that the validity consists of the following five parts (Carvalho, 1991, p. 331-333):

1) Face validation of the business simulator;
2) Validation from the perspective of the student;
3) Sensitivity validation;
4) Validation for the existence of dominant factors; and
5) Sufficiently stable decision variable-performance criterion relationships.

The methodology part comprises the methods, that were used in the five premises listed above to prove the validity of the BSG. The following sections of this chapter provide arguments that the BSG can be considered as a valid business simulation according to the premises listed above.

8.1 Methodology

The following procedures and statistical methods are applied in the validation of the BSG:

- Response surface methodology;
- Experiential design;
- Regression analysis; and
- F- and t-statistics.

A number of papers investigate the validation of business simulations (Perry and Euler, 1988; Anderson and Lawton, 1991; Machuca 1992). The quantitative methods, suggested by Carvalho (1991) are acceptable for validation and provide objective measurement tools. *Response Surface Methodology* (RSM) is ideal for evaluating such complex systems as computerised business simulations. RSM comprises three phases (Carvalho, 1991, p. 334):

Phase 1 - data collection using experimental design;

Phase 2 - calculation of regression equation to model the simulator's response surface; and

Phase 3 - canonical analysis of the response surface to analyse the simulator's behaviour in the case of more complex systems.

Phase 1 emphasises using experimental design in data collection. Experimental design ensures orthogonal variables, eliminating the collinearity problem amongst the variables. Furthermore, the regression parameters will all be mutually independent and each effect, such as the first and second order effects will be additive for easy interpretation. (Carvalho, 1991, p. 335).

Two experimental design matrices are necessary for the decision variables (independent variables). One is at the beginning of the simulation and one at a later stage. The second point should be sufficiently far in time from the first point, to avoid overlapping of regions.

Phase 2 needs mathematical methods for objective validation. Premise 1, 4 and 5 of the five premises listed above require regression analysis. F- and t-statistics were used for testing the hypothesis of equality of the response surfaces, the effect of decision variables and the sensitivity and stability of the parameters of decision variables.

Phase 2 also needs mathematical statistical software to support the computations. REGAL, Expert System for Multivariate Regression Analysis (Kiss, 1991) was used for data processing. PIMS database is analysed using the statistical package of the PIMS Institute. The software of Continuous Probability Distribution Functions (Hajdu and Kiss, 1992) is used for determining the exact probability values for F- and t-statistics and the exact value for different confidence intervals.

Premise 1 (face validity) also requires an adequate data base. The Profit Impact on Marketing Strategy (PIMS, Buzzel and Gale, 1987) database contains data in connection with the marketing strategy of strategic business units. PIMS data provide relevant information about the different marketing factors. The real life business data can provide adequate validation means.

Phase 3 comprises the possibility of the usage of canonical analysis. This research conducts an experiment with a single performance criterion. The experiment will be preceded with one performance criterion variable. Using one criterion as dependent variable does not indicate an especially complex system and for this reason canonical analysis will not be provided.

The significance level of the statistical procedures (1 or 5%) follows that generally accepted in the referenced literature.

8.2 Face Validity

This section is intended to show that the BSG has face validity. Computerised business simulators must have *face validity*. Face validity is concerned with how closely a business simulator mimics the behaviour of a real life enterprise. Face validity of a business simulation is an important factor of internal validity. All the data input have to have verisimilitude.

> „For computerised business simulators to be effective for the development of objectively measurable managerial competencies, the appearance of the simulator to the students is vital. It must have face validity to be motivational (Dittrich, 1977)" (Carvalho 1991 p. 331).

A simulated environment can never be the same as the real environment. Whether the simulation is quite close to the real situation or not, is largely perceptional. One way to overcome this is Keys' suggestion (Keys, 1987) that the business simulation has to fulfil the learning objectives. Keys applies Piaget's definition about learning (in Keys, 1987) that learning is "that ability of the students to organise reality". Keys elaborated a learning model (Keys, 1987) that consists of three phases:

> "(1) Experience: This phase of learning is provided by game play, decision inputs, and team interaction.
>
> (2) Content: This phase includes dissemination of ideas, principles, or concepts regarding business practices and principle.
>
> (3) Feedback: This phase includes feedback in the form of financial statement, comparative team standings, and

participant and team critiques by the professor or game administrator." Keys, 1987, p.236.

Keys suggested evaluation on the basis of these three phases. Are they "properly balanced" or not, that is also the question of a subjective decision. The BSG comprises the elements of all the three phases, and the ratio of them can be considered as balanced. In Chapter 9 the participants' opinion will be discussed.

The BSG uses an additional tool to create a face valid simulation. Data, collected by the PIMS Institute with reference to specific industries can provide data that can establish a simulated environment close to a real life situation. The significant parameters of an industry can be applied to the starting parameter set of the BSG. Multivariate regression analysis is used to determine the parameters relating to important decision factors. Equation (8.1) depicts the new market model for individual firms, developed for the BSG in Chapter 6:

$$S_t = a_0(1-\lambda) + \lambda S_{t-1} + a_1 AD_t + b_1 SP_t + c_1 QU_t + d_1 P_t \qquad 8.1$$

where
t = time
S = market share
AD = Advertisement
SP = Sales Promotion
QU = Product quality
P = Price

PIMS database comprises data relating to the variables in (8.1) (PIMS, 1988). The values of the variables chosen from the PIMS database are "End" data, the average value of the last half of the time span. Previous market share, in time (t-1), contains the average value of the first half of the time span. The variables in the PIMS database that are equivalent to (8.1) are listed below.

1. Sales force expenses/Revenues

   Content: Sales force expenses/ (Net sales + lease revenues)

2. Advertising and promotion expenses/ revenue

   Content: (Media advertising expenses + Sales promotion expenses) / (Net sales + lease revenues)

3. Media advertising expenses / revenue

   Content: Media advertising expenses / (Net sales + lease revenues)

4. Market share

   Content: Market share of the SBU in percentage

5. Relative product quality

   Content: superior product quality in %

6. Relative price

   Content: 10000.0 / relative price of competitors in percentage

Other sales promotion variables are derived in the following way: (2-3)+1, where the numbers are the serial numbers of the variables above. This sales promotion variable contains additionally the sales promotion and the sale forces' expenses.

Regression models use decision variables of the marketing model as independent variables and market share as dependent variable. Independent variables attempt to explain the variation of the dependent variable. Regression coefficients are the parameters that can best fit the regression line with independent variables. The coefficients explain the change in dependent variable in absolute value. Standardised, relative regression coefficients are used because of the correct ratio of the decision variables. Table 8-1 depicts the standardised regression coefficients of different industries. The names of industries are not shown because PIMS database can not be published in public without the special permission of the PIMS institute (The PIMS Program, 1981). Seven other industries' data are shown in Appendix III where the effect of independent variables is significant to the dependent variable.

Independent variables - Industry 1	Regr. Coeffi-cients	Stan-dard error	Proba-bility value
Constant	0.000	0.035	
Previous Market Share	0.965	0.035	0.000
Other Sales Promotion	0.058	0.035	0.055
Advertising	-0.048	0.035	0.091
Relative Product Quality	0.022	0.035	0.267
Relative Price	0.023	0.035	0.257

R SQUARE: 0.9640, **F** = 155 (5,29 DF): **P** = 0.000

TABLE 8-1 REGRESSION STATISTICS - INDUSTRY 1.

Regression coefficients show the strength of the effect of the different decision variables and the probability values test the strength of the variables. If the probability values are below 0.05 then the effect of the variable is significant at 0.05 level.

Regression coefficients shown in Table 8-1 are not in harmony with the accepted and taught theory. This specific industry has a negative advertisement effect, similarly to industry 4 in Appendix III. Apart from industry 1 and 4, every other industry has positive effect of advertisement. Other types of sales promotion, including sales force expenses, have a negative effect in all the industries examined, with the exception of Industry 1. As a consequence of the decision variables in Table 8-2, the values in column "Var.1." (Variation 1) can be "face valid" percentages. However, teaching a negative effect of advertisement does not serve basic marketing knowledge, and it is in sharp contradiction of the general accepted theory. Variation 2 in Table 2 avoids this problem, but this solution is still not satisfactory. The outstanding value of previous market share refers to a stable market without new participants. Competition amongst new firms can be significantly confined by such a high previous market share-effect. Column "Var.3." in Table 8-2 attempts to find a group of percentages that still keeps the main features of the specific industry and is not in contradiction with theory.

Independent variables - Industry 1	**Percentage of effects Var. 1.**	**Percentage of effects Var. 2.**	**Percentage of effects Var. 3.**
Previous Market Share	90	87	40
Other Sales Promotion	10	7	30
Advertising	-8	0	10
Relative Product Quality	4	3	20
Relative Price	4	3	20

TABLE 8-2 POSSIBLE WEIGHTS FOR THE EFFECT OF DECISION VARIABLES

The parameter file allows the Umpire to set arbitrary parameters at the beginning of the game, but the pre-set parameters can also be used, as discussed in Section 4.1.1.3. Other researches can provide similarly acceptable group of parameters and face validity still can be maintained. Table 8-3 depicts the part of the parameter file of the BSG. The first column shows the relative percentages of the effect of the decision variables.

40	{ %, Previous market share determining market shares }
20	{ %, Quality determining market share }
20	{ %, Price determining market share }
10	{ %, Advertisement determining market shares }
30	{ %, Other Sales Promotion determining market shares }

TABLE 8-3 PART OF THE PARAMETER TABLE OF THE BUSINESS GAME

Face validation of market decision variables is supported by PIMS data. Furthermore, the flexibility of the program facilitates to use results of other relevant research. However, all other important parameters can be set by the Umpire. Appendix IV depicts the whole parameter file.

8.3 Validation from the Perspective of the Student

Computerised business simulators are systems that must be validated from the perspective of the students (premise 2). Students should be able to estimate an economic relationship, like the price-demand relationship. However, unexplainable differences between economic theories should not be revealed (Carvalho, 1991).

The economic theories used in the development of the functional aspects of the BSG; production, finance, and marketing were discussed in the previous chapters. Production chapter demonstrated the meaning and usage of such theoretical notions as marginal and average production and cost functions. (Sections 5.3.5 and 5.3.6). The marketing chapter applied individual models for price, sales promotion, advertisement and quality. Behaviours of these individual models are based on economic theories (Section 6.5).

The trial part of the marketing chapter allows the student to experience the behaviour of different marketing decision variables (Section 4.1.2.5). The accounting and finance chapter describe the effect of buying and issuing shares (Section 7.9.4). Other important business decision subjects are used in the BSG, such as loans, and leverage. Sound theories with appropriate programming work assure detection of fundamental economic relationships.

Apart from the objective theoretical knowledge the subjective feeling of participants can be as important as the objective knowledge. Chapter 9 is devoted to ascertaining the impact of the BSG in the classroom situation.

8.4 Sufficient Sensitivity

The change in performance criterion should be sufficiently detectable if decision variables change. The effect of any random error function built into the simulator should not be stronger than the effect of the decision variables (Carvalho, 1991 p.331). The possible market share is used as the performance criterion, while decision variables are the marketing tools, that is to say, price, advertisement, sales promotion, and quality. The purpose of this section is to show that the performance criterion changes significantly if the decision variables change. The first part of this section uses regression analysis to test the sensitivity of the decision variables.

In the practice mode of the BSG two artificial competitors are generated to study a competitive environment. Artificial competitors can be very competitive, and their reactions to the firm's decisions can be too "smart" and probably beat the participant's. This situation could cause insufficient learning effect. The reason for insufficiency is that participants apply acquired methods (price reduction, growth in advertising, sales promotion) and apparently the market share and the profit decrease and they lose. Consequently, in order to ensure adequate learning experiences, the competitors are made weaker to allow the participants to win. In competition mode the competition can not be regulated. As a consequence, the focus of this experiment is the automatic mode where the competitors are generated by the system.

Three different sets of reasonable decision variables are shown in Table 8-4. Previous market share is shown in percentage, while the value of the possible market share (performance criterion) is the number of products which can be sold.

Values serial number	**Price**	**Advertisement**	**Sales Promotion**	**Quality**	**Previous Market Share**
1	162	2000	32000	11	20
2	198	17000	40000	14	33
3	234	90000	46400	32	46

TABLE 8-4 THE THREE DIFFERENT VALUES OF DECISION VARIABLES

Sensitivity analysis requires two separate blocks of data in order to compare the effects of decision variables. The decision matrices are of orthogonal design. There are six variables with three possible values. The total number of ways that the values can be arranged is therefore, $3^5=243$. One block has been generated at period 3 in the case of one product when the competitors just entered into the simulators. The second block is created at period 7, in the second half of the simulation. The second block has two instances; one is in the case of one product while the second is in the case of the maximum of three products. It is reasonable to assume that for period 7 three products will be developed. Examination of this case is important, because the three products developed ensure a more difficult context in the BSG than it was in Period 3. Regression analysis was used to analyse the effect of the decision variables as independent variables. The results are presented in Table 8-5, 8-6 and 8-7. Parameter values (the regression coefficients) and probability levels are shown in italic. This method is not really applicable for measuring the elasticity amongst the decision variables, because the three values chosen can be different, and it can result in different ratios. However, the application of the same database indicates the changes correctly and shows the effect of the decision variables.

Variab-les	Conf.Int. 95% Low	Parameter value	Conf.Int. 95% Upper	Standard error	t-stat. Value	Proba-bility	Elasti-city
Const	-22844	*-16721*	-10597	3105.4	-5.38	*8.6206E-08*	-16721
Price	-47.878	*-27.645*	-7.4108	10.261	-2.69	*0.00378*	-0.57659
Advert	0.06297	*0.07845*	0.09392	0.00785	9.997	*0.0000*	0.30024
SP	0.53671	*0.63768*	0.73864	0.05120	12.45	*0.0000*	2.6511
Qual	14.217	*78.351*	142.48	32.522	2.409	*0.00837*	0.15682
P.M.S	10.075	*66.107*	122.14	28.414	2.326	*0.01041*	0.22980

TABLE 8-5 STATISTICS OF REGRESSION MODEL IN PERIOD 3 (ONE PRODUCT)

Variab-les	Conf.Int. 95% Low	Parameter value	Conf.Int. 95% Upper	Standard error	t-stat. Value	Proba-bility	Elasti-city
Const	-22727	*-16637*	-10546	3088.6	-5.38	*8.5345E-08*	-16637
Price	-47.613	*-27.489*	-7.3642	10.205	-2.69	*0.00378*	-0.57730
Advert	0.06247	*0.07786*	0.09325	0.00780	9.977	*0.0000*	0.30007
SP	0.53402	*0.63443*	0.73485	0.05092	12.45	*0.0000*	2.6558
Qual	15.727	*79.514*	143.30	32.346	2.458	*0.00733*	0.16024
P.M.S	0.08770	*0.64500*	1.2023	0.28260	2.282	*0.01167*	0.22576

TABLE 8-6 STATISTICS OF REGRESSION MODEL IN PERIOD 7 (ONE PRODUCT)

Variab-les	Conf.Int. 95% Low	Parameter value	Conf.Int. 95% Upper	Standard error	t-stat. Value	Proba-bility	Elasti-city
Const	-16369	*-12551*	-8732.6	1936.1	-6.48	*0.0000*	-12551
Price	-18.646	*-6.0307*	6.5846	6.3972	-0.94	*0.17339*	-0.20558
Advert	0.03999	*0.04963*	0.05928	0.00489	10.14	*0.0000*	0.31047
SP	0.34060	*0.40354*	0.46649	0.03192	12.64	*0.0000*	2.7420
Qual	12.267	*52.253*	92.239	20.277	2.577	*0.00528*	0.17093
P.M.S	-9.7699	*25.165*	60.099	17.715	1.420	*0.07838*	0.14297

TABLE 8-7 STATISTICS OF REGRESSION MODEL IN PERIOD 7 (THREE PRODUCTS)

Parameter values of Tables 8-5, 8-6 and 8-7 prove that all decision variables are moving in the expected direction because the parameter values of the decision variables (third column) are positive, with the exception of the price variable. The parameter value of price variable proves that price has a negative effect while the others have positive effects. Decision variables have a significant effect in 5 percent in the case of one product (Table 8-5 and 8-6), because the values in the "probability" column are less then 0.05. The effect of variables is stable if there is one product. However, a three product situation changes the ratios amongst decision variables. The probability value in the row of previous market share (0.07838) is higher than 0.05 but lower then 0.1. This probability value means that previous market share is only significant in 10 % in the case of three developed products, but it is not significant in the generally used 5%. The effect of price can not be accepted as significant, because the probability value of 0.17339 can be the result of a random effect. The probability column has zeros in the case of the other decision variables. Consequently, advertisement, sales promotion and quality, as in Period 3, have a significant influence on market share. The results of the sensitivity analysis indicate that the effect of advertisement, sales promotion, and quality is stable in both cases.

That is, in the case of 1 and 3 products. The previous market share has a weaker effect in the case of 3 products, while the price variable does not significantly affect the performance criterion, that is, the possible market share. However, the decision variables always influenced the performance criterion positively, or negatively in the case of the price variable.

8.5 Existence of Dominant Factors

A dominant factor exists when one decision variable, usually the price, is of prominent importance. It is important to remember that business simulation is a competitive game, and participants will try to "win" independent of the original purpose of the simulation. Participants may recognise the importance of the dominant variable. When discovered, the dominant factor is likely to be used as a means to beat the game (Carvalho, 1991, p. 332). Such a behaviour can disrupt the learning process. There is no method that prevents participants from trying to beat the game. The design of a simulation attempts to ensure a real life environment where the trials of beating the game coincide with the original purpose of a business simulation. That is to say, to acquire business experiences, competencies, and a better understanding of concepts. Participants may discover one possible set of parameters to beat the game. However, the parameter set can be changed, and the weighting system prevents an automatic winning strategy. Changes in parameters (Section 8.2) provide a means of changing the effects of decision variables to ensure more equally applicable ways of developing successful management strategies, and tactics.

8.6 Stable Decision Variable-Performance Criterion Relationships

The relationship between the decision variables and performance criterion (premise 5) are always a central theme in a business simulation. Repeated analysis should ensure that the effect of decision variables on performance criterion permanently exists. The relationship between decision variables and performance criterion should be reasonably stable throughout the simulation (Carvalho, 1991, p. 333). Stability is a multi-dimensional issue. In Section 8.6.1 the global stability is discussed with the help of Period 3 and 7 of the BSG. Global stability cannot be proven in the BSG statistically. Separate examination of the decision variables, presented in Section 8.6.2 and 8.6.3 is necessary to detect the effect of the variables. These examinations can reveal the variables that cause instability. The dependent variable is always the possible market share in the case of market 1 and with product 1. This means, that one segment of the whole market is analysed: the first market from the possible four markets; and the first product out of the three possible products. There are always four markets, but the number of products can vary from 1 to 3. In the case of more products the possible market share for product 1 is obviously reduced. This will be discussed later.

8.6.1 Global Stability

Table 8-5 and 8-6 depicted the regression surface of Period 3 and Period 7 in the case of the one product introduced in Section 8.4. Regression analysis provides a method to discover similarity or difference between two regression surfaces (Neter et al., 1990, p. 360). Introduction of a new variable can serve as an indicator variable. This new variable has a value of 1 in period 3, and a value of 0 in period 7. This "yes or no" position indicator variable provides a means of showing the difference between the two periods. A significant effect of this variable on the dependent variable causes a difference between the two regression surfaces. The name of the variable is "ZeroOne". Table 8-8 depicts the result of the new analysis with the number of cases of 486. This number (486) is the sum of the cases of the two different periods, that is 243 separately. The dependent variable - as in the case of Table 8-5 and 8-6 - is the possible market share of products in market 1.

Variab-les	Conf.Int. 95% Low	Parameter value	Conf.Int. 95% Upper	Standard error	t-stat. Value	Proba-bility	Elasti-city
Const	-21012	*-16711*	-12410	2188.7	-7.63	*0.0000*	-16711
Price	-41.711	*-27.567*	-13.423	7.1979	-3.82	*7.2553E-05*	-0.57694
Advert	0.06734	*0.07815*	0.08897	0.00550	14.19	*0.0000*	0.30015
SP	0.56548	*0.63605*	0.70663	0.03592	17.71	*0.0000*	2.6534
Qual	34.102	*78.932*	123.76	22.815	3.459	*0.00029*	0.15852
P.M.S	26.136	*65.303*	104.47	19.933	3.276	*0.00056*	0.22779
ZeroOne	-766.36	*65.132*	896.62	423.15	0.153	*0.43887*	0.00344

TABLE 8-8 STATISTICS OF COMMON REGRESSION MODEL IN PERIOD 3 AND 7 (ONE PRODUCT)

The effect of the "ZeroOne" variable (last row) is not significant. The t-value (in the sixth column) is very small, and the probability level (next column) proves that the effect of the difference variable is not significant, because the value is much higher than 0.05.

The furthest situation in the BSG from the initial one product competition (in Period 3) is when the firm and its competitors have the maximum of three products, as discussed in Section 4.1.1.2. With three products and four markets, there are twelve possible market segments to compete in. The existing capacity is spread between the three products. Because of this fact the constant term would be expected to be smaller, but the behaviour of the slopes and the stability of the parameter is unknown. Comparison of the two regression surfaces (Table 8-5 and 8-7) can give different results. Table 8-9 depicts the results of the comparison of the two most extreme situations.

Variab-les	Conf.Int. 95% Low	Parameter value	Conf.Int. 95% Upper	Standard error	t-stat. Value	Proba-bility	Elasti-city
Const	-20183	*-16478*	-12773	1885.6	-8.73	*0.0000*	-16478
Price	-29.023	*-16.838*	-4.6526	6.2010	-2.71	*0.00343*	-0.43576
Advert	0.05472	*0.06404*	0.07336	0.00474	13.50	*0.0000*	0.30412
SP	0.45981	*0.52061*	0.58141	0.03094	16.82	*0.0000*	2.6856
Qual	26.680	*65.302*	103.92	19.655	3.322	*0.00048*	0.16217
P.M.S	11.893	*45.636*	79.379	17.172	2.657	*0.00407*	0.19684
ZeroOne	2968.4	*3684.7*	4401.0	364.54	10.10	*0.0000*	0.24081

TABLE 8-9 STATISTICS OF COMMON REGRESSION MODEL IN PERIOD 3 AND 7 (THREE PRODUCTS)

The difference variable ("ZeroOne") has a significant effect that shows significant difference between the two periods. The last row of Table 8-9 shows that the high t-statistic value (10.10, in the sixth column) resulted in very low probability value (0.000, in the seventh column). This significant difference demands a further examination in order to reveal the stability and/or instability of the parameters of the decision variables. The results of these further investigations are presented below.

Analysis of the combined group of the cases in two periods provides the means for comparing the behaviour of one decision variable in two periods. Examination of the possible market share variable, as dependent variable, with the decision variables individually, as independent variable, can prove the stability of parameters. The regression model applied in the experiment is the following (Neter et al., 1990, p. 365)

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i1} X_{i2} + \varepsilon_i \qquad 8.2$$

where

Y = Market share

X_{i1} = One decision variable

X_{i2} = 1 in the case of period 3

0 in the case of period 7

i = cases

The second and third variable in (8.2) indicate the differences between the two periods. The last factor is a common error term that raises the question of the equality of the error terms in both periods. The model represented by equation (8.2) assumes that the variance of the error term in both periods is the same. The relationship between the variables is additive, as discussed in Section 6.4.2. Consequently, the connection between market share, and the decision variable is linear.

The structure of the database used here is the same as that used in Section 8.4. The price is replaced by a random variable in Table 8-10, and the other decision variables are set to constant in the BSG.

	Price	Advertisement	Sales Promotion	Quality	Previous Market Share
1	120	50000	40000	20	50
2	217	50000	40000	20	50
3	125	50000	40000	20	50

TABLE 8-10 RANDOM TEST VARIABLE WITH CONSTANT OTHER DECISION VARIABLES

This method ensures the detection of the effect of the test variable on the market share variable. The results provide the dependent variable (Y) and the X_1 variable for equation (8.2).

Detailed analysis of the effect of the price variable is given in Section 8.6.2, while the analysis of the other variables proceeds together on the basis of the price analysis.

8.6.2 Price

Detailed analysis of the stability of the price variable will be discussed in this section. An examination of the combined data set (period 3 and 7) provides the means to establish the stability of the price decision variable. Difference in the regression lines can be caused by the slopes and the constant term. These are explained more fully in Sections 8.6.2.2 and 8.6.2.3 respectively. Equal error terms are necessary for these statistical procedures. This examination is conducted in Section 8.6.2.4. Table 8-11 depicts the statistics of the regression model in the equation (8.2) for the price variable. β_0 parameter is the constant term. β_1 regression coefficient refers to the price, while β_2 and β_3 are the parameters of difference variables.

Coef.	Parameter	Std.dev	t-stat
β_0	17743.7	228.3	77.7
β_1	-32.12	0.9939	-32.3
β_2	16727.7	322.47	51.9
β_3	-45.2	1.3982	-32.2

TABLE 8-11 STATISTICS OF PRICE VARIABLE

The possible market share is affected by all of the independent variables to different extents. The bigger the effect of the price variable (β_1), and the smaller the influence of the difference variables (β_2

and β_3), the bigger the probability of a stable decision variable, because the difference between the two periods is small.

The division of the sum of square of the regression model is shown in Table 8-12. This table depicts the effect of the separate variables.

	Sum of Square
Regression	1.127E10
X_1 (price)	4970200000
$X_2 \mid X_1$	5440800000
$X_1X_2 \mid X_1,X_2$	859000000
Error	401565752
Total	1.1672E10

TABLE 8-12 DIVISION OF SUM OF SQUARE

The total value (1.1672E10) is explained by the regression line with an amount of 1.127E10. The sum, explained by the regression model can be divided into three parts, for the three independent variables. The Price variable explained the sum of 4.97E9, the difference variable the sum of 5.44E9 and the product variable (also difference variable) the sum of 8.59E8. The unexplained sum (error term) is 4.016E8. The effect of the price variable is smaller than the difference variable, because the t-values in the last column in Table 8-11 are bigger for the difference variables. An analysis in the next section determines the level of stability of the price variable.

8.6.2.1 Difference in Regression Lines

The statistics of the regression models in Table 8-11 and 8-12 provide the data to examine the differences between the data of period 3 and period 7. The H_o hypothesis states that the difference variables have no effect at all. The effect of these variables can not be bigger than that of the error term.

H_o: $\beta_2 = \beta_3 = 0$

H_a: not both β_2 and $\beta_3 = 0$

The total of explained sum of squares by the difference variables can be compared to the error term by means of F-statistic (Neter et al. 1990, p. 368):

$$F = \frac{5440800000 + 859000000}{2} / \frac{401565752}{482} = 3780$$

The F-statistic at level 0.01 is

$F(.99;2;482) = 4.65 < 3780$

H_a hypothesis is accepted, indicating that the two regression functions are not identical. The different situation results in different regression surfaces. Stability test requires the examination of the slopes and the constant terms. This is presented in the following sections.

8.6.2.2 Examination of Slopes

The slope of the two regression lines can be compared to each other to decide whether they are identical or not. H_0 hypothesis states that the regression lines are identical, so the effect of the third, product variable is zero.

$$H_0 : \beta_3 = 0$$

$$H_a : \beta_3 \neq 0$$

Using the regression results in Table 8-12 and the partial F-statistic:

$$F = \frac{859000000}{1} / \frac{401565752}{482} = 511.25$$

At a significance level of 0.01 $F(.99;1;482) = 6.69 < 511.25$

The slopes of the two regression functions are not identical.

8.6.2.3 Difference in Constant Terms

The constant difference between the two regression surfaces can be determined as well by means of t-statistic. The confidence interval of the difference variable (β_2) determines the difference with the values in Table 8-11 (Neter et al. 1990, p. 369).

At 95 percent confidence interval

$$t(.975;482) = 1.965$$

$$16727.7 \pm 1.965(322.47)$$

Hence, the confidence interval for β_2 is:

$$16094 \leq \beta_2 \leq 17361$$

With 95 percent confidence the mean amount of the regression surface of period 3 exceeds that of the regression surface of period 7 by somewhere between 16094 and 17361.

8.6.2.4 Equality of the Error Terms

The equality of the error terms for the two periods has to be tested as a theoretical condition for the above statistical procedures (Neter et al. 1990). Two separate regression lines have to fit. The results are shown in Table 8-13. Comparison of the two error terms provides the data for the F-statistic (Neter et al. 1990, p. 368).

Period	Regression line	MSE	df
3	$34471-77.15X_1$	767253	241
7	$17734-32.12X_1$	899013	241

TABLE 8-13 REGRESSION LINES OF THE TWO PRICE FUNCTIONS

Specifying the level of significance at 0.05, the two F-table values are needed: F(0.025;241;241) = 0.7764 and F(0.975;241;241) = 1.288. If the F-value falls between the two limits then the two error terms have equal variances.

$$F = \frac{767235}{899013} = 0.85$$

$$0.7764 \leq 0.85 \leq 1.288$$

The F-value falls between the two limits, so the two regression lines have equal variances. The exact probability value for F = 0.85 is 0.8904. Consequently, the theoretical condition is fulfilled.

8.6.2.5 Evaluation

The two regression surfaces are different from the viewpoint of price (see Section 8.6.2.1). This difference can be argued with the bigger number of products, but it needs further examination. An examination of the two different regression equations is the first step in the process.

Section 8.6.2.2 proved that the slopes are different. Table 8-13 provided information about the two coefficients, where the slope is steeper in Period 3 than in Period 7.

This divergence indicates that the price does not disperse the possible market share to the same extent in period 7 than in period 3. The price parameter is definitely not stable as far as the quantity is concerned, because either the slope, or the constant term is different. However, the quality, the direction of the effect is stable; it is always negative.

The two regression lines in Table 8-13 prove that the constant term is much bigger in period three. The change in constant term is expected because of the reduction in the amount of the product 1 in market 1. The results can be considered theoretically stable because the error terms of the two regression models are not different, as Section 8.6.2.4 demonstrated.

8.6.3 Other Decision Variables

The other decision variables - advertisement, sales promotion, quality and previous market share - are analysed together on the basis of Section 8.6.2.

8.6.3.1 Difference in Regression Lines

The statistics of the regression models are shown in Table 8-14.

	Parameter	Std.dev	t-stat
Advertisement			
β_o	9815.3	296.2	33.1
β_1	0.0492	0.0087	5.678
β_2	6718.55	413.09	16.3
β_3	0.0423	0.0121	3.483
Sales Promotion			
β_o	-216.6	315	-0.68
β_1	0.2278	0.0096	23.8
β_2	833.51	471.16	1.769
β_3	0.1415	0.0134	10.6
Quality			
β_o	8402.2	341.4	24.6
β_1	135.87	13.64	9.959
β_2	6423.92	482.75	13.3
β_3	71.63	19.3	3.712
Previous Sarket Share			
β_o	7669.2	40	185.9
β_1	124.37	1.7725	68
β_2	6568.92	56.55	105.8
β_3	31.89	2.5067	12.21

TABLE 8-14 STATISTICS OF OTHER DECISION VARIABLES

The distribution of the independent variables for the sum of square of the regression model is shown in Table 8-15. This table depicts the effect of the separate variables.

Sum of Square				
	Advertisement	**Sales Promotion**	**Quality**	**Previous Market Share**
Regression	8,42E09	2,02E10	9,5E09	7,51E09
X1	6,95E08	1,63E10	1,55E09	1,21E09
X2|X1	7,66E09	3,03E09	7,91E09	6,29E09
X1X2|X1,X2	70000000	9,01E08	37500000	15600000
Error	2,78E09	3,9E09	2,36E09	46383534
Total	1,12E10	2,41E10	1,19E10	7,55E09

TABLE 8-15 DIVISION OF SUM OF SQUARE OF OTHER DECISION VARIABLES

The differences between the data of period 3 and period 7 will be examined with the H_o and the H_a hypothesis:

H_o: $\beta_2 = \beta_3 = 0$

H_a: not both β_2 and $\beta_3 = 0$

Table 8-16 depict the F-statistics for the different decision variables. "F-Num-val" is the sum of differences explained by the decision variables. This is the numerator in the F-statistic equation. The "F-Num-df" represents the degree of freedom of the numerator. "F-Dnum-val" is the error term, the denumerator in the t-statistic equation, and the "F-Fnum-df" is the degree of freedom.

	Advertisement	Sales Promotion	Quality	Previous Market Share
F-Num-val	7729255834	3929000000	7948500000	6302000000
F-Num-df	2	2	2	2
F-Dnum-val	2779000000	3899700000	2360600000	46383534
F-Dnum-df	482	482	482	482
F-value	670.295306	242.810729	811.483733	32743.9906
F(.99; 2; 482)	4.65	4.65	4.65	4.65

TABLE 8-16 TESTING THE DIFFERENCES BETWEEN THE REGRESSION SURFACES

All decision variables are significantly different at 0.01 significance level, because the F-value with the two degrees of freedom, and regression surfaces of 482, is bigger than 4.65. (F-statistic has two degrees of freedom; one for the numerator and one for the denominator.) In the next section the examination of slopes and constant term will be discussed to reveal the reason for the differences.

8.6.3.2 Examination of Slopes

The slopes of regression equations have been tested in Table 8-17. H_o hypothesis is the same as that in Section 8.6.2.2: the two slopes are identical, so the effect of the product variable is zero.

$$H_o : \beta_3 = 0$$

$$H_a : \beta_3 \neq 0$$

	Advertisement	Sales Promotion	Quality	Previous Market Share
F-Num-val	70000000	901000000	37500000	15600000
F-Num-df	1	1	1	1
F-Dnum-val	2779000000	3899700000	2360600000	46383534
F-Dnum-df	482	482	482	482
F-value	12.12	11.36	7.65	162.1
F(.99; 1; 482)	6,69	6,69	6,69	6,69
Evaluation	different	different	different	different
Exact probab.	0.0005	0	0.0059	0

TABLE 8-17 TESTING THE SLOPES OF THE REGRESSION SURFACES

H_a hypothesis is accepted in the case of all other decision variables, because all F-values are bigger than F(.99;2;482) = 6.69, as shown in the fifth row of Table 8-17. Consequently, the two slopes of the regression functions of all the other decision variables are not identical. In the case of quality the exact probability value is just below the 0.01 significance level.

8.6.3.3 Difference in Constant Terms

The constant difference between the two regression surfaces of decision variables is also computed. The 95 percent confidence interval of the difference variable (β_2) determines the upper and lower value of the amount of differences. Table 8-18 depicts the results.

	Lower value	Differences	Upper value
Advertisement	5906.8	6718.5	7530.3
Sales Promotion	-92.3	833.5	1759.3
Quality	5475.3	6423.9	7372.5
Previous Market Share	6457.8	6568.9	6680.0

TABLE 8-18 DIFFERENCES WITH LOWER AND UPPER VALUES

The market share in period 3 always exceeds that for period 7. Advertisement, quality and previous market share changed equally about 6500-7000 pieces in constant term, while sales promotion has smaller change, about 1000 pieces. The differences are shown in the "difference" column of Table 8-18.

8.6.3.4 Equality of the Error Terms

Equality of the error terms for the two periods can be tested for all variables. The results of the two regression lines are shown in Table 8-19.

Period	Regression line	MSE	df
Advertisement			
3	$15583.2+0.0915X_1$	767253	241
7	$9815.3+0.0492X_1$	899013	241
Sales Promotion			
3	$619.9+0.3693X_1$	11905055	241
7	$-216.6+0.2278X_1$	4276246	241
Quality			
3	$14826+207.51X_1$	7360647	241
7	$8402+135.87X_1$	2434341	241
Previous Market Share			
3	$14238.1+156.26X_1$	9774.2	241
7	$7669.2+124.37X_1$	182689	241

TABLE 8-19 REGRESSION LINES OF THE TWO FUNCTIONS OF ALL VARIABLES

Table 8-19 provides all the information necessary for the comparison of error terms using F-statistic. The results of F-statistic analysis are shown in Table 8-20.

	Numerator	Denumerator	F-value
Advertisement	8855603	2675612	3.309749
Sales Promotion	11905055	4276246	2.783997
Quality	7360647	2434341	3.023671
Previous Market Share	9774.2	182689	0.053502

TABLE 8-20 RESULTS OF THE F-STATISTICS

The two F-table values required for the determination of the values for 5 and 95% confidence interval are: F(0.025;241;241) = 0.7764 and F(0.975;241;241) = 1.288. F-statistic values for advertisement, sales promotion and quality are above 1.288, while previous market share's value is below 0.744. Because the model, represented by equation (8.2) assumes that the variance of error terms are the same in both periods, the equality of the variances had to be proved. The two regression lines do not have equal variances; consequently, the results of comparison of two regression surfaces have to be handled with care.

8.6.3.5 Evaluation

The results of the other decision variables are in harmony with the result of price analysis. Table 8-19 proves that the slope of the regression line in period 7 is not so steep as in period 3. Section 8.6.3.3 supports the fact that the possible market share decreases if additional products are developed.

The validation procedure proved that the BSG is a powerful business simulation that has objective learning validity. The effectiveness of the BSG is supported by five premises suggested by Carvalho (1991). The BSG, as a computerised business simulator has face validity. Students can acquire relevant theoretical knowledge, hence the simulation is validated from the perspective of the student in Section 8.3. All the decision variables in the simulation have significant effect on the possible market share (performance criterion), consequently, the BSG has sufficient sensitivity. A dominant factor can be created by the weights of the decision variables and other parameters. The decision variable-performance criterion relationship can be considered as a stable relationship. However, the strength of the effect of decision variables on performance criterion is decreasing throughout the game as more products are developed.

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PART III - VALIDATION

CHAPTER 9 - VERIFICATION IN CLASSROOM SITUATION

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The primary aim of this chapter is to ascertain the effectiveness of the new BSG model in classroom situation. Teach and Govahi (1993) conducted an experiment into the role of classroom techniques (including business simulations) in teaching management skills, as discussed in Section 2.1. They developed a set of desirable skills using the results of Mintzberg, Livingstone and Waters' research (Teach and Govahi, 1993, p. 431). To test the BSG's effectiveness the author adapted and used questionnaires based on a set of managerial competencies developed by Teach and Govahi. The questionnaires were distributed among the in JPU's undergraduate and postgraduate students who had used the BSG as a part of their curriculum of studies. Copies of the questionnaires are presented in Appendix I and II. The results of the survey conducted by the author and comparison of these findings with that of Teach and Govahi provide an opportunity to ascertain the effectiveness of the BSG in the classroom situation. The ascertainment of the effectiveness is possible, because the overwhelming majority of respondents in the Hungarian sample used only the BSG, as business simulation.

Other types of investigation are also conducted to reveal other characteristics of the BSG, such as differences caused by the year of study or educational forms. These are presented in Section 9.4.4. Additionally, structured observations were carried out, to identify the active learning characteristics of the BSG. The result of this activity is presented in Section 9.5. This chapter furthermore investigates the following original objectives:

- The usefulness of the white box theory; and
- Understanding the interrelationship between functional areas.

This investigation is accomplished in Section 9.6 entitled the "Report of the participants".

9.1 The Sample and the Questionnaire

The American sample was collected by Teach and Govahi from different parts of USA. There is an over-representation of several schools due to a better response rate from some programs. The sample collected contained graduate students with 3 to 5 year working experience who had experienced in different business simulation games. The results of these surveys enabled the researchers to draw conclusions that are generally applicable to the subject of teaching using business simulations (Teach and Govahi, 1993. p. 433).

The participants of the Hungarian fieldwork were undergraduate and postgraduate students who used the BSG as a part of their curriculum of studies in the 94-95 and 95-96 academic years at the Faculty of Economics and Business at JPU. Twenty-four questionnaires (from 1994-1995 sample), and eighteen questionnaires (from 1995-1996 sample) were completed by the undergraduate students. Fifteen questionnaires were completed by postgraduate students. Thus, the total sample consisted of 57 students.

Two questionnaires were used in this study. The first questionnaire examined the importance of managerial skills from the viewpoint of the respondents. The original instructions for the first questionnaire were:

> "Following is a list of 41 attributes that have proven to be critical in effective management. First, read the entire list. Second, select about 8 attributes which you consider to be the most important in your current position and circle the "1" beside each. Next select about 8 more attributes which you consider to be slightly less important and circle "2". Continue selecting sets of about 8 attributes in descending order of importance

until you have exhausted the list (the last set will have a rating of 5). If you have some sets with 9 and a few with 7, that is OK, but be sure to use all 5 scale values." (Teach, Govahi 1993, p. 431)

The second questionnaire comprised the same skills as the first questionnaire, but the task was different. Participants had to rate these skills from the viewpoint of teaching methods, such as lectures, experiential exercises, case studies and business simulations. The original instructions provided for the second questionnaire were:

> "Below is the same set of attributes once again. This time we would like you to consider the different teaching techniques that you have experienced in learning these sets of skills. These teaching techniques include: Lectures, Case Study, Experiental Learning Exercises (Role Playing, etc.), and Business Simulations (Business Games). For each attribute, please rate each teaching technique on its importance in your learning the skill. ... If you have not experienced one of these methods, please insert an "N" in the appropriate column(s). (Teach and Govahi, 1993, p. 432)

In the Hungarian study experiential exercise was replaced by the traditional seminar. Seminar is one of the usual teaching methods used in the Hungarian higher education. However, in the recent years a degree of experiential learning was introduced into one seminar. In discussions it becomes clear that a small number of respondents had experienced a degree of experiential learning. Therefore, sometimes respondents were indicating their experience with not a traditional seminar but with experiential learning. However, the overwhelming majority of the students have not experienced the experiential exercise at the faculty, and the results mainly refer to the seminars.

9.2 Methodology

Univariate statistics evaluate variables separately. The results of the American study did not include the variance of the variables, therefore, it was not possible to compare the results of the two studies using independent samples t-test. However, the three Hungarian samples provided the opportunity of cross comparisons. The results of the comparisons shed light on the differences between the groups. The comparison furthermore allowed the three sub-groups to be handled as one common group that properly characterises the Hungarian experiences.

Discriminant analysis was performed in the American experiment. This analysis was repeated in the Hungarian study. The comparison between the results of the studies, using the appropriate statistics, potentially can result in a deeper understanding.

Application of two other multivariate statistical methods, factor analysis and cross tabulation, provided additional valuable information regarding the Hungarian experiments. These methods were not used to analyse the survey data collected in the USA. Other statistical methods, such as hierarchical, vertical and K-means cluster analysis were also considered, but they proved to be inappropriate in this case.

The statistical package used for data processing is SPSS (SPSS, 1993). In addition, three output processing programs (Kiss and Jones, 1994; Kiss, 1994, 1; and Kiss, 1994, 2) that were written for processing SPSS outputs were used to facilitate the presentation of the data. SPSS outputs contain most of the necessary information, *in detail*, but the results are neither summarised nor focused on the needs of the user. The output processing programs address these deficiencies.

9.3 Comparison of the Samples

Three samples were collected from those who played the BSG as the part of the normal curriculum. The first sample comprised 24 undergraduate students from the academic year of 1994/1995. The name of this sample is referred to as UNDGR_1 hereon. The second sample consisted of 18 undergraduate students from the academic year of 1995/1996. The name of this sample is referred to as UNDGR_2 hereon. This group formed 6 teams to compete. Both groups are from the last two years (the 4th and 5th year). The third sample comprised 15 postgraduate students from an MBA course. The name of this sample is referred to as POSTGR hereon. They formed 5 groups to compete. The participants of the first two samples attended the courses for two semesters. In the first semester they played in practice mode, and in the second semester in competitive mode. The postgraduate students played the game for two and a half days (in 8-8-4 hours). In the first day they played in practice mode, and in the remaining one and a half day in competitive mode.

Comparison of the samples reveals the differences between the samples. The means of comparison is the SPSS's t-test for independent samples, and the t-test for the independent samples' output processing program developed by Kiss (1994, 2). The database is the participants' responses for qualifying the four educational types from the viewpoint of the 41 managerial skills (second questionnaire).

The comparison of the two first samples proved that there is no difference between the two samples at 5% significance level. It means that the opinion of the two undergraduate students' samples in connection with the managerial skills does not differ significantly. This result is due to the broadly same conditions: the Umpire; the methodology; and the duration of the game were the same in the case of the two samples.

However, comparison of the two first samples (UNDGR_1 and UNDGR_2) with the third sample (POSTGR) resulted in significant differences in some cases. Table 9-1 depicts the result of the comparison of the variable "Set objectives" in UNDGR_1 and UNDGR_3.

t-tests for independent samples

Variable	Number of Cases	Mean	SD	SE of Mean
SET OBJECTIVES				
UNDGR_1 .	88	2.8864	1.236	.132
POSTGR .	60	3.6333	.956	.123

Mean Difference = -.7470
Levene's Test for Equality of Variances: F= 6.416 P= .012

t-test for Equality of Means

Variances	t-value	df	2-Tail Sig	SE of Diff	95% CI for Diff
Equal	-3.94	146	.000	.189	(-1.121; -.373)
Unequal	-4.14	143.60	.000	.181	(-1.104; -.390)

TABLE 9-1 T-TEST FOR INDEPENDENT SAMPLES - SET OBJECTIVES

Analysis of the more important values of the table indicates, that the participants in UNDGR_1 evaluated the skills more rigorously then those in POSTGR. The mean in UNDGR_1 is 2.8864, while in POSTGR is 3.6333 and the "Mean difference" is -0.747. (Note: the higher is the value, the better can the educational type convey the managerial skill.) If variances are equal (row "Equal") then the t-test is calculated in a different way than in the case when variances are not equal (last row, "Unequal"). The Levene's Test for Equality of Variances provides the statistics to evaluate the equality of variances. The F-statistic value (6.416) has a probability value of 0.012. The H_0 hypothesis is the equality of variances, that there is no difference between the variances. If the H_0 hypothesis is entirely true and the variances are exactly equal, then the probability value is 1.0. Consequently, in this case the variances are unequal, because the p-value is below 0.05 (0.012) that means significant differences between the variances at 5% significance level. The "Unequal" row has to be considered for the correct evaluation. The column of "2-Tail Sig" (that contains the two-tail significance value) comprises a value of 0.000 that means also significant difference between the means of the samples. The H_0 hypothesis is the same as it was previously: zero difference between the means. The p=0.000 value proves that the difference between the two samples is very strong. Table 9-2 depicts all the managerial skills were there are significant differences between the means of the samples. This table is the output of the T-test for Independent Samples Output Processing Program.

Skill	Group_1	Group_2	F-Val	P-Val	Eval.	T-Test	P-Val	Final E.
PRI_TASK	UNDGR_1	POSTGR	2.154	0.144	EQUAL	-2.410	0.017	DIFF
MAN_TIME	UNDGR_1	POSTGR	6.833	0.010	UNEQU	-2.300	0.023	DIFF
WRIT_EFF	UNDGR_1	POSTGR	0.641	0.425	EQUAL	-2.600	0.010	DIFF
PLANNING	UNDGR_1	POSTGR	6.642	0.011	UNEQU	-2.540	0.012	DIFF
MOTIVOTH	UNDGR_1	POSTGR	0.580	0.448	EQUAL	-2.380	0.018	DIFF
SET_OBJ	UNDGR_1	POSTGR	6.416	0.012	UNEQU	-4.140	0.000	DIFF**
LEAD	UNDGR_1	POSTGR	3.478	0.064	EQUAL	-2.490	0.014	DIFF
CONCEPT	UNDGR_1	POSTGR	2.418	0.122	EQUAL	-3.290	0.001	DIFF*
SLV_PR_S	UNDGR_1	POSTGR	8.849	0.003	UNEQU	-2.030	0.044	DIFF
EXC_INFL	UNDGR_1	POSTGR	7.263	0.008	UNEQU	-4.120	0.000	DIFF**
ENFRCRUL	UNDGR_1	POSTGR	0.374	0.542	EQUAL	-2.450	0.016	DIFF

TABLE 9-2 THE RESULTS OF COMPARISON OF UNDGR_1 AND POSTGR

This output provides the essential information from Table 9-1. The output allows for the user to see the relevant statistics in one row. On the basis of the F-statistics the program chooses the appropriate t-test, according to the equal or unequal variances. The final evaluation column (last column in the table) evaluates the two samples from the viewpoint of differences. In this table only those skills are enumerated where there is significant difference between the two samples. If the p-value is between 0.05 and 0.01 then the significance level is 5 % and the "Final E" column will show "Diff" that means differences between the two sample means. If this value is between 0.01 and 0.001 then the "Final E" column comprises "Diff*". In case of lower p-value the evaluation is "Diff**".

Between UNDGR_1 and POSTGR there were three variables where the differences were found to be very significant (0.1% significance level): "Set objectives"; "Conceptualise"; and "Exert Influence". The minus sign before the t-statistic values (column 7) indicates that the opinion of the postgraduate students was always more favourable from the viewpoint of conveying managerial skills. The minus sign is the result of the deduction of the mean of POSTGR from UNDGR_1. Consequently the means in POSTGR are always bigger than those in UNDGR_1.

Table 9-3 shows the result of the comparison of UNDGR_2 and POSTGR.

Skill	Group_1	Group_2	F-Val	P-Val	Eval.	T-Test	P-Val	FinålE.
ORGANISE	UNDGR_2	POSTGR	19.206	0.000	UNEQU	-2.150	0.034	DIFF
SEE_BIGP	UNDGR_2	POSTGR	4.583	0.034	UNEQU	-2.050	0.043	DIFF
ANAL_PRB	UNDGR_2	POSTGR	4.639	0.033	UNEQU	-2.690	0.008	DIFF*
PRI_TASK	UNDGR_2	POSTGR	0.581	0.447	EQUAL	-2.850	0.005	DIFF*
ANAL_DAT	UNDGR_2	POSTGR	3.296	0.072	EQUAL	-3.050	0.003	DIFF*
MAN_TIME	UNDGR_2	POSTGR	2.219	0.139	EQUAL	-3.950	0.000	DIFF**
WRIT_EFF	UNDGR_2	POSTGR	3.741	0.055	EQUAL	-2.250	0.026	DIFF
CREA_THK	UNDGR_2	POSTGR	7.914	0.006	UNEQU	-2.170	0.031	DIFF
PLANNING	UNDGR_2	POSTGR	9.667	0.002	UNEQU	-3.060	0.003	DIFF*
MOTIVOTH	UNDGR_2	POSTGR	1.439	0.233	EQUAL	-3.430	0.001	DIFF*
SCH_COOR	UNDGR_2	POSTGR	0.845	0.360	EQUAL	-2.910	0.004	DIFF*
SET_OBJ	UNDGR_2	POSTGR	1.597	0.209	EQUAL	-2.900	0.004	DIFF*
CONCEPT	UNDGR_2	POSTGR	9.998	0.002	UNEQU	-2.970	0.004	DIFF*
SLV_PR_S	UNDGR_2	POSTGR	9.807	0.002	UNEQU	-2.200	0.030	DIFF
EXC_INFL	UNDGR_2	POSTGR	12.016	0.001	UNEQU	-2.830	0.005	DIFF*
MAN_STRS	UNDGR_2	POSTGR	0.260	0.611	EQUAL	-2.680	0.008	DIFF*
FORECAST	UNDGR_2	POSTGR	1.679	0.197	EQUAL	-2.360	0.020	DIFF
SUPERVIS	UNDGR_2	POSTGR	0.036	0.851	EQUAL	-2.110	0.037	DIFF
ENF_RUL	UNDGR_2	POSTGR	0.058	0.811	EQUAL	-4.130	0.000	DIFF**

TABLE 9-3 THE RESULTS OF COMPARISON OF UNDGR_2 AND POSTGR

Between UNDGR_2 and POSTGR there were more variables where the differences were found to be very significant (0.1% significance level). These are:

"Analyzing problems", "Analyzing data"; "Prioritise tasks"; "Managing Time"; "Planning"; "Motivate others"; "Schedule and co-ordinate"; "Set Objectives"; "Conceptualise"; "Exert influence"; "Managing stress"; and "Exert Influence". The t-statistic values also indicate that means in POSTGR are always bigger than those in UNDGR_2. However, the number of variables where the differences are very significant between UNDGR_2 and POSTGR (12) exceeds the number of variables in the previous comparison (3). These variables indicate the areas where the participants in practice (postgraduate students) emphasised the importance of the managerial skills. The postgraduate students can learn more from the subjects, taught at the University that conveyed these skills. The reason for this may be that they better understand the business environment and can relate the knowledge to their actual situation.

The results of the t-test for independent samples indicate, that the three samples can be used together to evaluate the BSG. There is no difference between the two samples of undergraduate students. The differences between the undergraduate and postgraduate students show constant positive divergence in the favour of the postgraduate students. Consequently, the three sub-groups can be used together as a combined group, because the responses are broadly in consonance with each other. Deeper analysis was needed for exploring further reasons for the differences between the postgraduate and undergraduate groups.

9.4 Results and Comparisons

This section will compare the results of Teach and Govahi's study with the results of the study conducted at JPU. Univariate statistics, discriminant analysis, factor analysis and cross tabulation will be used for better understanding of the main features of the samples.

9.4.1 Univariate Statistics

This section discusses the results of the univariate statistics of the two samples. It comprises the comparison of the two samples (Section 9.4.1.1); the distribution of the Hungarian sample (Section 9.4.1.2); and the relationship between the managerial skills and educational forms in the two samples (Section 9.4.1.3).

9.4.1.1 Comparison of the Evaluation of the Managerial Skills

The first questionnaire requires the respondents to rate the 41 managerial skills from important skills (rating of 1) to unimportant (rating of 5) in clusters of eight skills for each rating category. The first four groups contain eight skills and the last group comprises nine skills. Comparison of the results of the American and Hungarian experiment shows the different evaluation of the skills of the respondents in the two countries.

Table 9-4 depicts the results and comparison of the two samples. The "new BSG" column contains the average values for the BSG; "T&G" refers to the Teach and Govahi experiment. The lower the value in these two columns, the more important is the skill itself. "Difference column" shows the difference between the two columns. The rows in italic fonts show that the skill is more important for the Hungarian respondents, because the difference of the first two columns in Table 9-4 are negative. The "Grade" column comprises evaluation of the "Difference" column.

	Skills	New BSG	T&G	Difference	Grade
1	Adapt to new tasks	2.052	1.95	0.102	
2	*Make decisions*	*1.621*	*1.97*	*-0.349*	
3	Organise	2.034	1.97	0.064	
4	*Assess a situation quickly*	*1.724*	*2.17*	*-0.446*	
5	*Gather pertinent information*	*2.017*	*2.21*	*-0.193*	
6	See the "big picture"	2.345	2.32	0.025	
7	*Analyse problems*	*2.175*	*2.35*	*-0.175*	
8	*Prioritise tasks*	*2.172*	*2.38*	*-0.208*	
9	Analyse data	3.379	2.47	0.909	*
10	*Manage time*	*2.103*	*2.53*	*-0.427*	
11	Write effectively	4.41	2.56	1.85	***
12	*Think creatively*	*2*	*2.57*	*-0.57*	*
13	Reflective listening	4.31	2.61	1.7	***
14	*Plan*	*2.362*	*2.68*	*-0.318*	
15	*Set objectives*	*2.12*	*2.73*	*-0.61*	*
16	*Motivate others*	*2.603*	*2.74*	*-0.137*	
17	*Solve problems creatively*	*2.103*	*2.77*	*-0.667*	*
18	Schedule and co-ordinate	2.931	2.77	0.161	
19	*Set goals*	*1.793*	*2.79*	*-0.997*	*
20	*Lead*	*2.328*	*2.8*	*-0.472*	
21	Conceptualise	3.158	2.99	0.168	
22	Solve problems systematically	3.105	3.03	0.075	
23	Exert influence	4.328	3.06	1.268	**
24	Make presentation	4.845	3.07	1.775	***
25	Persuade	3.309	3.12	0.189	
26	*Manage people*	*2.397*	*3.17*	*-0.773*	*
27	Manage stress	3.328	3.21	0.118	
28	Delegate responsibility	3.482	3.24	0.242	
29	*Appraise performance*	*3.1*	*3.27*	*-0.17*	
30	*Resolve conflict*	*2.879*	*3.29*	*-0.411*	
31	Put structure to unstructured problem	3.483	3.29	0.193	
32	Develop people/teams	3.724	3.31	0.414	
33	Forecast	3.567	3.32	0.247	
34	*Direct the work of others*	*3.175*	*3.45*	*-0.275*	
35	*Measure objectives*	*3.362*	*3.55*	*-0.188*	
36	Speak in public	3.862	3.72	0.142	
37	Supervise	4.421	3.87	0.551	*
38	Enforce rules	4.1579	3.92	0.2379	
39	*Develop consensus*	*3.586*	*3.96*	*-0.374*	
40	Conduct interviews	4.776	4.23	0.546	*
41	*Form coalitions*	*4.448*	*4.49*	*-0.042*	
	Mean of group means	**3.0507**	**2.9732**	**0.0775**	

TABLE 9-4 MANAGERIAL SKILLS RANKED BY THEIR MEAN IMPORTANCE

Table 9-5 contains the meaning of the asterisks and the boundaries for grading the differences.

Absolute Value of Differences	**Number of Asterisks**
0.00 - 0.50	0
0.51 - 1.00	1
1.01 - 1.50	2
1.51 - 4.00	3

TABLE 9-5 GRADING DIFFERENCES

The 41 skills were split into five groups. Four of these groups contained 8 skills, while one group contained 9 skills. The first four groups were rated from 1 to 4, while the last group containing 9 skills was rated as five. Therefore, the expected average value was above 3. This grand mean proves, that the respondents understood the task well, and completed the questionnaires correctly.

Lower values (more important skills) are usually at the top of Table 9-4 in both experiments. Consequently both countries' respondents broadly evaluated the same skills as important skills. The skills are ordered by the American experiment.

9.4.1.1.1 Negative Differences

Negative differences that are bigger than 0.5 are found in five cases. All these skills have one asterisk, as shown in Table 9-4, which does not mean very strong differences. Negative value means that the Hungarian students evaluate the skill as more important compared to their American counterparts. These skills are: "Solve problems creatively"; "Manage people"; "Set goals"; "Set objectives"; and "Think creatively".

9.4.1.1.2 Positive Differences

Strong positive differences were found in seven cases. Positive value means that the American respondents evaluate a skill as more important in management education. These were:

"Conduct interviews"; "Supervise"; and "Analyse data" each with one asterisk. "Exert influence" with two asterisks (**), and "Write effectively" (1.85); "Reflective listening" (1.7); and "Make presentation" (1.775) each with three asterisks that indicates very strong differences. These outstanding skills have proved much more important amongst American respondent than amongst Hungarian respondents. It is beyond the scope of this dissertation to discover the reasons for the differences, but these skills can be emphasised later in the Hungarian management education.

The comparison of the two samples proved that mainly the same skills were considered as important and unimportant. There were a number of exceptions. These were discussed separately in Sections 9.4.1.1.1 and 9.4.1.1.2.

Table 9-6 provides an additional means to reveal the differences in the two samples from the Hungarian point of view. The first column's serial number can be compared to the second column that shows the original order of the American experiment, shown in Table 8.1.

This section revealed the differences and the similarities between the Hungarian and American experiments from the viewpoint of the first questionnaire. The aim of this questionnaire was to ascertain the importance of different managerial skills from students point of view. In the main the American and Hungarian respondents evaluated the skills in the same way. However, there were differences also, and these are partially caused by cultural differences. An investigation of precise reasons for these observed differences lies outside the scope of this research.

Serial number (Rank)	American importance number	Name of Managerial Skills	Mean of ratings
1	2	Make decisions	1.6666
2	4	Assess a situation quickly	1.667
3	10	Manage time	1.83
4	7	Analyse problems	1.958
5	12	Think creatively	2
6	16	Motivate others	2
7	19	Set goals	2.083
8	26	Manage people	2.083
9	6	See the "big picture"	2.125
10	3	Organise	2.167
11	8	Prioritise tasks	2.29
12	17	Solve problems creatively	2.29
13	1	Adapt to new tasks	2.2916
14	5	Gather pertinent information	2.33
15	14	Plan	2.375
16	20	Lead	2.4167
17	30	Resolve conflict	2.5
18	15	Set objectives	2.583
19	18	Schedule and co-ordinate	3
20	27	Manage stress	3
21	22	Solve problems systematically	3.083
22	29	Appraise performance	3.125
23	21	Conceptualise	3.167
24	25	Persuade	3.217
25	39	Develop consensus	3.25
26	34	Direct the work of others	3.29
27	28	Delegate responsibility	3.39
28	9	Analyse data	3.5
29	32	Develop people/teams	3.541
30	33	Forecast	3.583
31	35	Measure objectives	3.625
32	31	Put structure to unstructured problem	3.83
33	36	Speak in public	3.875
34	38	Enforce rules	4.13
35	13	Reflective listening	4.29
36	23	Exert influence	4.375
37	37	Supervise	4.375
38	11	Write effectively	4.5
39	41	Form coalitions	4.5
40	40	Conduct interviews	4.67
41	24	Make presentation	4.9583

TABLE 9-6 MANAGEMENT SKILLS ORDERED BY THE RATINGS OF HUNGARIAN RESPONDENTS

9.4.1.2 Distribution of the Evaluation in the Hungarian Sample.

The values of distribution of the individual rating scores that are presented in the last column of Table 9-6 depict the distribution of managerial skills from the Hungarian point of view in Figure 9-1. The height of the columns represents the means of the responses. Figure 9-1 shows that how many skills (means of the skills) are found in the intervals of 1.52..2.02, 2.02..2.42, ..., 4.42..5.00.

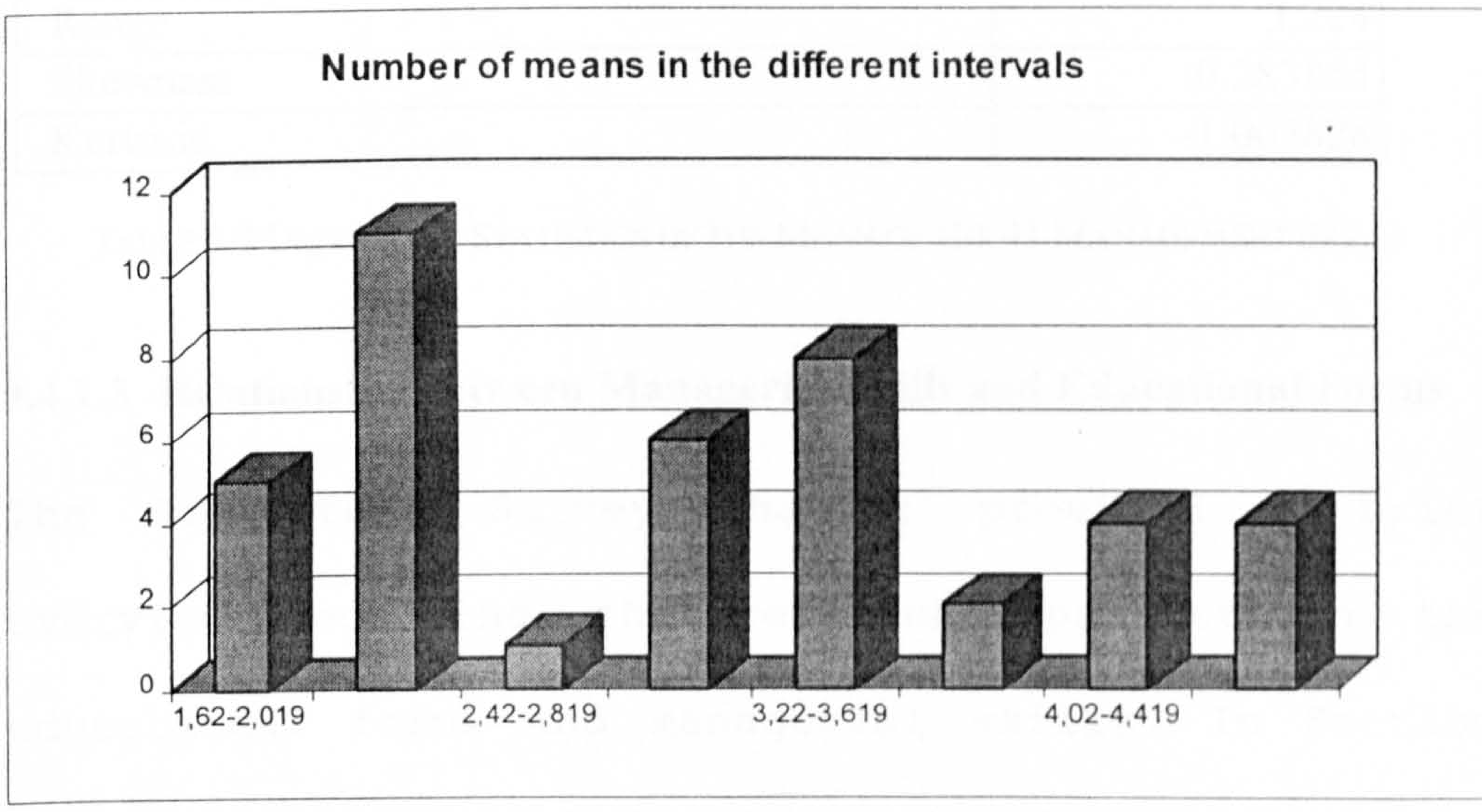

FIGURE 9-1 DISTRIBUTION OF INDIVIDUAL SKILLS

Kurtosis and Skewness (see Table 9-7) provide further information about the distribution of the sample. This distribution can be described as a single-peaked, positively skewed distribution, but it can be considered as a normal distribution, because the value of Kurtosis and Skewness are low (Canavos, 1984, p.66-67). The distribution of the importance of the managerial skills revealed, that sixteen skills (serial numbers of 1 to 16 in Table 9-6) were considered as very important, as it can be seen in the first two columns in Figure 9-1. Univariate statistics of all skills of the Hungarian sample are shown in Table 9-7.

Name of Statistics	Statistics
Mean of group means	3.050619
Std Deviation	0.931312
Maximum	4.845
Minimum	1.621
Range	3.224
Skewness	0.283854
Kurtosis	-1.065828

TABLE 9-7 UNIVARIATE STATISTICS OF THE MEAN OF THE 41 MANAGEMENT SKILLS

9.4.1.3 Relationship between Managerial Skills and Educational Forms

The Literature Survey Chapter provided a brief overview regarding the relationships between the educational forms and managerial skills. In Section 2.1 findings of that American experiment, where the respondents were asked to rate the ability of the four educational types in conveying the 41 managerial skills, were briefly presented. In this case the higher values mean better ability. Tables 9-8, 9-9 and 9-10 depict the comparison of the Hungarian and

American experiments in the case of business simulation, case studies and seminars.

BSG	Hungarian	American
Common Skills	(18) Make decisions; Forecast; Assess a situation quickly; Adapt to new tasks; Organise; Plan; Measure objectives; Set goals; Develop consensus; Set objectives; Delegate responsibility; Manage time; Solve problems systematically; Develop people/teams; Schedule and coordinate; Prioritise tasks; Appraise performance; Enforce rules of policies;	
Specific Skills	(8) Gather pertinent information; See the big picture; Analyse data; Conceptualise; Lead; Supervise; Think creatively; Solve problems creatively;	(2) Make presentations; Form Coalitions.

TABLE 9-8 SPECIFIC AND COMMON SKILLS IN BUSINESS SIMULATION

Lectures received the highest average value in "Reflective listening" in the American experiment, while "Effective writing" received the highest average value in the Hungarian experiment. The upper, common part comprises the skills that have got equally the highest average values in both experiments (common skills). The order of the skills does not convey any significance. In these tables specific skills were presented below the horizontal line. Specific skill refers to the fact that the skill has the highest average value in only one experiment, either in the Hungarian, or in the American experiment. The number of skills is written in brackets with bold font on the top of the skills in the tables. The most notable table from the viewpoint of the business game is Table 9-8. The summary table of the BSG shows that there are skills that are evenly conveyed best by the business simulations in both the Hungarian and American respondents' opinion. The common, evenly conveyed skills can be seen in Table 9-8, as "common skills".

Case Studies	Hungarian experiment	American experiment
Common Skills	(2) Analyse problems; Put structure to unstructured problems;	
Specific Skills	(0)	(6) Analyse data; Gather pertinent information; Conceptualise; Think creatively; See the "big picture"; Write effectively;

TABLE 9-9 SPECIFIC AND COMMON SKILLS IN CASE STUDIES

The comparison of the results of the American and Hungarian fieldwork showed that the American and Hungarian respondents identified 18 common skills that were conveyed more effectively by business simulation. However, case studies (in Table 9-9) show notable differences, because the number of specific skills in the case of the American experiment is high (6) compared to the common skills (2). Differences in curriculum and methodology equally can result in the differences in Table 9-9. Seminars in Table 9-10 show different skills. The differences may be due to the content of the subject, as discussed at the beginning of this chapter. However, the number of common skills

(9) is also higher than the number of specific skills (3,3). Another conclusion is, that six skills from the case studies in the American sample were grouped into the BSG in the Hungarian sample. This fact can be seen from the number of skills in case studies and business simulation in the case of the Hungarian and American sample.

Seminars	Hungarian	American
Common Skills	(9) Motivate others; Exert influence; Persuade; Manage people; Manage stress; Resolve conflict; Direct the work of others; Speak in public; Conduct interviews;	
Specific Skills	(3) Reflective listening; Make presentation; Form coalition	(3) Solve problems creatively; Lead; Supervise;

TABLE 9-10 SPECIFIC AND COMMON SKILLS IN SEMINARS

An analysis of Table 9-8; 9-9; and 9-10 reveals, that the lectures have only 1 skill in both experiments, and case studies in the Hungarian sample have a very weak evaluation with the two skills. However, these two skills are common with the

American sample. The importance of the skills in case studies is smaller than of those in business simulations. Seminars have 12 skills, that are more important than those in the BSG, as it can be revealed from the third column of the Table 9-11. (Note: Lower values mean more important skills). The BSG conveys the necessary skills best in 26 skills out of 41, as discussed in this section. Because of the great number of conveyed skills, the average importance of the skills is not too big.

Educational Form	**Number of Skills**	**Mean**
Business Simulation	26	3.73
Case Studies	2	3.86
Seminars	12	3.24
Lectures	1	3.02
Grand Mean	41	3.05

TABLE 9-11 NUMBER AND MEAN OF SKILLS

Analysis of univariate statistics in this section resulted in valuable information about the role of different educational forms. From the Hungarian participants point of view, the BSG provides a useful vehicle for learning important managerial skills.

9.4.2 Discriminant Analysis

The four educational forms convey the managerial skills to a different extent. Discriminant analysis determines those managerial skills where these differences are most distinctive. Discriminant functions are a kind of composition of these skills.

The first part of this section comprises this analysis. The managerial skills participate in the discriminant functions. Consequently, the managerial skills with their average values, are able to determine the different educational forms. However, the values in the cases (in the questionnaires) can differ from the average values. If the number of cases where the values are strongly different from the average is high, than few cases can estimate the educational forms from the values of managerial skills. If the majority of the values are around the average values, then the grouping ability of the values is good.

The second part of this section analyses this ability in the case of the Hungarian sample, and compares the results of the analysis to the results of the American investigation. Discriminant analysis is a multivariate analysis, similar to regression analysis. In the case of discriminant analysis the dependent variable is not continuous, but discrete. The purpose of this section is to investigate the differences between educational forms. (Note: the educational forms got the values of 1,2,3 and 4 for the lectures, seminars, case studies and business games, as shown in the first and second column of Table 9-14. The scores of importance were given from 1 to 5, from the less important to the more important skills. Consequently, the educational forms, as dependent variable can be studied by discriminant analysis. Discriminant analysis will distinguish the different teaching methods on the basis of the ratings of each method (Teach and Govahi, 1993, p. 439). The linear combination of independent variables maximises the probability of correct classification of observations. Discriminant analysis provides one, two or more artificial functions, similar to factor analysis. These factors categorise (estimate) the dependent variable.

The number of valid questionnaires was 56; two from the original 58 were invalid because of misinterpreted questions. Every respondent had to evaluate the 41 skills from the viewpoint of the four teaching methods. The number of cases is 41*56=224, but some of them are invalid because of at least one missing discriminant variable.

Discriminant analysis was run by a stepwise method. Stepwise method allows variables to be entered step by step, if the effect of the variable is strong enough. An F-statistic tests the effect of the variable. If the F value is sufficiently high (higher than the threshold of the F-to Enter level) then the variable enters as independent variable into the model. The F-statistic is computed for the variables within the model as well, and if the value of F-statistic is not high enough (lower than the threshold of the F-to Remove level) then this variable will be removed from the model. The higher the F-to Enter and F-to Remove variable, the fewer variables can enter into the model. The F-to Enter level was set to 3.84 and the F-to Remove level was set to 2.71. These two values are default in the SPSS. The contribution of canonical discriminant functions to the variation of dependent variable is shown in Table 9-12.

Function	Eigen-value	Pct of Var.	Cum. Pct	Canonical Corr	After Func.	Wilks' Lambda	Chi-Square	df	Sig
					0	0.113	430.85	27	0.000
1	3.307	77.92	77.9	0.876	1	0.486	142.46	16	0.000
2	0.873	20.41	97.7	0.683	2	0.91	18.482	7	0.01
3	0.099	2.29	100	0.299					

TABLE 9-12 CONTRIBUTION OF DISCRIMINANT FUNCTIONS TO THE VARIATION OF DEPENDENT VARIABLE

The first two functions are of most importance, with high eigenvalues and great influences. This is shown in the last column, where the significance level is much below 0.05 that means very strong effect. The American experiment also resulted in three functions. The explained percentages in the American investigation are 51.6, 35.8 and 12.8 respectively, while the Hungarian experiment contains 77.92%, 20.41% and 2.29% in grouping the educational form as dependent variable, as can be seen from Table 9-12.

Pooled within-groups correlation between the discriminating variables is shown in Table 9-13. This correlation shows the relationship between the variables and discriminant functions. The values in the table are from -1 to +1, where the 1 means that the function contains the whole effect of the variable.

Variable	Function 1	Function 2	Function 3
Make decisions	0.78771*	-0.08584	0.18894
Adapt to new task	0.63266*	0.26133	-0.09326
Assess a situation quick	0.57130*	0.00970	0.30735
Analyse problems	0.44252*	0.16479	-0.21336
Conceptualise	0.37426*	-0.02595	0.08671
Analyse data	0.36543*	-0.05128	0.18101
Manage time	0.34508*	0.05407	0.14696
Solve problems systemat.	0.29766*	0.01490	0.15456
Organise	0.28763*	0.19920	0.16968
Prioritise task	0.28753*	0.10709	0.24794
Set goals	0.28514*	0.02197	0.16406
Think creatively	0.27487*	0.13028	0.00943
Plan	0.26015*	0.02388	0.17961
Set Objectives	0.24208*	-0.06288	0.15665
Solve problems creat.	0.23641*	0.18807	0.13529
Put structure to uns.pr.	0.20670*	0.02716	0.16910
Gathering pertinent info.	0.20384*	-0.00217	0.08675
Speak in Public	0.10321	0.69787*	0.44184
Form Coalition	0.18360	0.26590*	0.24679
See the "big picture"	0.03136	-0.13915*	-0.01499
Write effectively	-0.00017	0.12562*	0.06997
Measure objectives	0.17791	-0.15726	0.66701*
Make presentation	-0.05491	0.47219	0.48387*
Direct work of others	0.14134	0.20451	0.45940*
Resolve conflict	0.12418	0.11651	0.42545*
Motivate others	0.11151	0.09559	0.41321*
Conduct Interviews	0.05873	0.27712	0.40973*
Delegate responsibility	0.26431	-0.05567	0.38739*
Enforce rules or policies	0.01246	0.01278	0.36237*
Develop consensus	0.17967	0.18509	0.35319*
Schedule and co-ordinate	0.19505	-0.00225	0.35055*
Manage people	0.05419	0.19805	0.34940*
Exert influence	0.20039	0.16320	0.34581*
Develop teams	0.27275	0.14021	0.33640*
Manage stress	0.15121	0.11572	0.33041*
Appraise performance	0.29985	-0.04017	0.31859*
Lead	0.20270	0.00496	0.31805*
Supervise	0.10245	0.05230	0.31046*
Forecast	0.28619	-0.09911	0.30311*
Persuade	0.14193	0.24048	0.28149*

TABLE 9-13 POOLED WITHIN-GROUPS CORRELATION BETWEEN DISCRIMINATING VARIABLES

* denotes largest absolute correlation between each variable and any discriminant function.

The variable participation in the functions characterises the function itself. In this example the effect of Function 1 is strong; the participation of "Make decision" variable is also strong in Function 1. Consequently, variable "Make decision" with other variables denoted by "*" are also important factor of grouping the educational forms. "Make decisions" is an outstanding variable in the first function with a value of 0.788, while "Adapt to new tasks" is also important with a value of 0.6327, and assists to distinguish the different educational types. "Asses a situation quickly" and "Analyse problems" have values of 0.5713 and 0.4425 respectively. The American experimentation has also four important variables: "Adapt to new tasks"; "Analyse problems"; and "Assess a situation quickly" are also found in the Hungarian experiment. "Reflective listening" is the fourth variable, and it has a negative effect. The negative effect means, that the bigger is the value of the dependent variable (educational form) the smaller is the value of the variable. The first educational types (lectures, seminars) got bigger scores in the case of "Reflective listening". The two other types, case studies and business game got smaller scores on the importance in conveying the skill of "Reflective listening".

In the second discriminant function the "Speak in public" variable has an outstanding participation, with double the weight of any others (0.6978). The other variables are all below 0.3. The American investigation does not have as high participation value as the "Speak in public" variable in the Hungarian experiment. Weaker connections, but above 0.3, are "Adapt to new tasks", "Speak in public", "Conduct interviews" with negative effect, and "Write effectively" with the highest value of 0.419. The third discriminant function has also significant effect, as it can be seen from the last element of the last column of Table 9-12. The value of 0.01 means 1% level of significance. The "Measure objectives" is the outstanding variable with the third discriminant function. The main variables in the discriminant functions are the variables that characterise well the differences between the educational forms.

In the second part of this section the grouping ability of the discriminant functions will be examined. Table 9-14 illustrates, how successfully the discriminant functions can estimate the different educational types, on the basis of the independent variables. The numbers below the "Predicted group membership" in Table 9-14 also signify the educational forms. The percentage of correctly classified types are 80.56%.

Actual Group	No. of Cases	Predicted Group Membership 1	2	3	4
Group 1 Lectures	55	50 90.9%	4 7.3%	1 1.8%	0 .0%
Group 2 Seminars	54	4 7.4%	39 72.2%	11 20.4%	0 .0%
Group 3 Case Studies	54	0 .0%	8 14.8%	41 75.9%	5 9.3%
Group 4 Business Game	53	2 3.8%	0 .0%	7 13.2%	44 83.0%

Percent of "grouped" cases correctly classified: 80.56

TABLE 9-14 CLASSIFICATION TABLE- IN THE CASE OF F-VALUES OF 3.84 AND 2.71

Table 9-14 shows that lectures can be classified best. Business game has a high percentage as well, but seminars and case studies can be mixed with each other more easily, because about one fifth of the cases was misgrouped as case study instead of seminar, and seminar instead of case study.

The American experiment used the value of 1 as F-to Enter and F-To Remove level. These two values determine the level of significant effect of the entered variables. Consequently, the American experiment had much more variables - 17. Percent of "grouped" cases correctly classified was: 72.62%. In similar conditions, the Hungarian experiment had much higher percentages (86.38), as depicted in Table 9-15.

Actual Group	No. of Cases	Predicted Group Membership 1	2	3	4
Group 1 Lectures	55	50 90.9%	4 7.3%	1 1.8%	0 .0%
Group 2 Seminars	53	4 7.5%	44 83.0%	5 9.4%	0 .0%
Group 3 Case Studies	53	0 .0%	6 11.3%	42 79.2%	5 9.4%
Group 4 Business Game	52	2 3.8%	0 .0%	2 3.8%	48 92.3%
Percent of "grouped" cases correctly classified: 86.38%					

TABLE 9-15 CLASSIFICATION TABLE- IN THE CASE OF F-VALUES OF 1

The way to allow to enter every variable into the equations is to reduce the two F-values to the minimum. The correctly specified cases are 88.8 % in case of every variable (F-to Enter level is 0.01; F-to Remove level is 0.00), see Table 9-16.

Actual Group	No. of Cases	Predicted Group Membership 1	2	3	4
Group 1 Lectures	53	50 94.3%	3 5.7%	0 .0%	0 .0%
Group 2 Seminars	51	4 7.8%	41 80.4%	6 11.8%	0 .0%
Group 3 Case Studies	51	0 .0%	3 5.9%	44 86.3%	4 7.8%
Group 4 Business Game	50	1 2.0%	0 .0%	2 4.0%	47 94.0%
Percent of "grouped" cases correctly classified: 88.78%					

TABLE 9-16 CLASSIFICATION TABLE- IN THE CASE OF 41 ENTERED VARIABLE

The American experiment's classification table is shown in Table 9-17 (Teach and Govahi, 1993, p. 442). The sample size was bigger than the experiment conducted in Hungary. Lectures could be classified best, but the other three educational types had more failed cases. For example, in the case of simulations 25 cases of 71 were misgrouped, and only 46 cases were correctly specified that means 64.8%.

Actual Group	No. of Cases	Predicted Group Membership 1	2	3	4
Lecture	88	75	8	2	3
Case	87	4	62	5	16
Experiential Exercises	79	2	10	53	14
Simulations	71	3	9	13	46
Percent of "grouped" cases correctly classified: 72.62%					

TABLE 9-17 CLASSIFICATION TABLE OF THE AMERICAN EXPERIMENT

Discriminant analysis supplied better results in the case of the Hungarian investigation as far as the correctly "grouped" cases are concerned. It means, that the respondents' evaluation regarding the conveying ability of educational forms is more homogenous in the Hungarian sample. Furthermore, the percentages of correctly grouped educational forms indicate, that business simulation (that is the BSG) can be classified best. Consequently, the BSG has the more specific nature in conveying the different managerial skills.

9.4.3 Factor Analysis

Factor analysis is the traditional means for grouping variables that have similar effects, into some artificial factors that can reduce the number of variables. Factor analysis creates artificial factors on the basis of the important effect of the variables. These effects are summarised by the factors. The statistical procedure was applied to the same data set as in the case of discriminant analysis in Section 9.4.2, but the "teaching methods" variable was excluded here, because it is not a managerial skill. Figure 9-2 depicts the main characteristics of the first two factors with the help of a Factor Analysis Output Processing Program (Kiss and Jones, 1994). The statistics of the efficient factors will be described in written form. Efficient factor means, that the eigenvalue of the factor is higher than 1, that is the factor can explain more than a single variable.

```
Factor Analyzer :  fakt.lst
 ROUND :   1    Rotated : TRUE

     FACTOR :    1    Loadings             FACTOR    2      Loadings
+--------------------------------*****************************---+
¦ ****    2 DEC_MAKE  0.80247 \\ ¦  ****  36 SPEAPUBL  0.77165 \\ ¦ ¦
¦ ****    4 ASS_SITU  0.79243 \\ ¦  ****  40 INTERVIW  0.75664 \\ ¦ ¦
¦ ****    1 NEW_TASK  0.78290 \\ ¦  ****  41 COALITIO  0.63136 \\ ¦ ¦
¦ ****    7 AN_PROBL  0.72408 \\ ¦  ****  34 DIR_OTHR  0.59509 \\ ¦ ¦
¦ ****   12 CREAT_TH  0.70357 \\ ¦  ****  24 PRESENTA  0.58441 \\ ¦ ¦
¦ ****   17 CREAT_PR  0.64291 \\ ¦  ****  26 MAN_PEAP  0.54874 \\ ¦ ¦
¦ ****    9 AN_DATA   0.62859 \\ ¦  ****  30 CONFL.    0.52729 \\ ¦ ¦
¦ ****   10 MAN_TIME  0.60418 \\ ¦  ****  25 PERSUAS   0.52174 \\ ¦ ¦
¦ ****    8 PRI_TASK  0.58269 \\ ¦        32 DEV_PEOP  0.47193 \\ ¦ ¦
¦ ****   29 EVA_PERF  0.54781 \\ ¦        39 CONSENS   0.46669 \\ ¦ ¦
¦         5 COLL_INF  0.49517 \\ ¦        23 EXC_INFL  0.39457 \\ ¦ ¦
¦        21 CONCEPT   0.47238 \\ ¦         3 ORGANISE  0.38079 \\ ¦ ¦
¦        39 CONSENS   0.45552 \\ ¦        17 CREAT_PR  0.37980 \\ ¦ ¦
¦        14 PLANNING  0.44939 \\ ¦        16 MOTIVATE  0.33639 \\ ¦ ¦
¦        15 SET GOAL  0.42202 \\ ¦        12 CREAT_TH  0.30903 \\ ¦ ¦
¦        32 DEV_PEOP  0.37077 \\ ¦        27 MAN_STRS  0.29557 \\ ¦ ¦
+---------- E.v. :  14.92509--------------- E.v. :    3.75724------+
```

FIGURE 9-2 THE FIRST TWO FACTORS

The higher the eigenvalue of a factor, the more important is the factor. The factors can be labelled by the variables that participated in the factor, similar to discriminant analysis in Section 9.4.2. On the basis of the participated variables the labels of the more important factors, above the eigenvalue of 1.5, are:

- Decision making (Factor 1);
- Human factor (Factor 2);
- Planning (Factor 3); and
- Control (Factor 4).

Table 9-18 depicts the factors and their eigenvalues in the Hungarian experiment.

Factors	Eigenvalues
Decision Making	14.925
Human Factor	3.757
Plan	2.042
Control	1.66

TABLE 9-18 FACTORS WITH THEIR EIGENVALUES

The first factor, *Decision Making,* has an eigenvalue of 14.92. Some important variables in the factor are: "Make decision", "Assess a situation quickly", "Adopt to new tasks", "Analyse problems", "Think Creatively".

The second factor is the *Human factor* with variables of "Speak in public", "Conduct interview", "Form coalition", "Direct the works of others", "Make presentation".

Planning is the third factor (eigenvalue is 2.04). This contains the following variables: "Set goals", "Set objectives", "Planning".

The fourth factor (eigenvalue is 1.66) is the *Control* factor, and the three most important variables are: "Supervise", "Enforce rules" and "Managing stress".

The result of factor analysis indicates that the selection of the forty-one management skills can be grouped into broader types of management abilities, such as decision making, control, planning that includes some better defined specific skills. The most important factor in this analysis is the decision making factor that indicates the importance of the decision making characteristic of the 41 managerial skills. The three most important variables in the *Decision Making* factor, and three other variables of this factor are amongst the variables that were conveyed best by both the American and Hungarian respondents' opinion, as was shown in Table 9-8 amongst the common skills. The results indicate that the BSG is among the most important subject in the curriculum of business education.

9.4.4 Cross Tabulation - The Year of Study, Educational Form

Hungarian students were asked personal questions, such as gender, the year of study and level of education. The relationships between the 41 managerial skills and these variables were analysed by cross tabulation. The output of cross tabulation was further processed by the cross tabulation output processing program (Kiss, 1994, 1).

Connections were not found between the managerial skills and the gender; and between the skills and level of education (undergraduate, postgraduate). However, the year of study and the educational type variables indicate connections with some of the managerial skills. Examination of the effect of the educational forms (lecture, seminar, case studies and business simulation) on the managerial skills is accomplished in Section 9.4.4.1. On the basis of the evidence in the previous sections, (Sections 9.4.2 and 9.4.3) significant difference should be found between the educational forms in conveying the managerial skills. The examination of the year of study variable (fourth and fifth year) in Section 9.4.4.2 reveals the differences between the students of these two years. The subject of the investigation in the next section is the variable of educational forms.

9.4.4.1 Educational Forms

Discriminant and factor analysis provided an overall picture about the managerial skills. Comparing the skills directly to educational types provides additional information regarding the relationship between the educational types and the managerial skills. The output table of the cross tabulation between "Make decision" and "Educational forms" is shown in Table 9-19.

MAKEDEC Make Decision by FORM Educational Form

Page 1 of 1

MAKEDEC	Count / Exp Val	FORM Lecture 1	Seminar 2	Case Studies 3	Business Game 4	Row Total
Not at all	1	23 6.0	1 6.0	 6.0	 6.0	24 10.9
Not	2	24 11.5	15 11.5	6 11.5	1 11.5	46 20.9
Neutral	3	5 10.0	24 10.0	9 10.0	2 10.0	40 18.2
Well	4	3 12.8	15 12.8	26 12.8	7 12.8	51 23.2
Very well	5	 14.8	 14.8	14 14.8	45 14.8	59 26.8
	Column Total	55 25.0	55 25.0	55 25.0	55 25.0	220 100.0

Chi-Square	Value	DF	Significance
Pearson	235.59486	12	.00000
Likelihood Ratio	239.35764	12	.00000
Mantel-Haenszel test for linear association	143.37017	1	.00000

Minimum Expected Frequency - 6.000

Number of Missing Observations: 0

TABLE 9-19 CROSS TABULATION OF "MAKE DECISION" AND "EDUCATIONAL FORMS"

Table 9-19 indicates that lectures are not good in conveying decision making abilities, because the expected value in the cell of "not at all" is 6.0, while the actual number is 23. Consequently, many more students consider the lectures ineffective in this area. Business simulation's expected value in the "very well" cell is 14.8, but the number of actual cases is 45. This is much bigger than it was expected. Seminars have a neutral role, while case studies are also acceptable in this connection.

The difference between the educational forms is significant at 0.0001 level, because the probability value of Pearson's chi-square (235.6) is 0.00000. The explanation of these values is similar as in the case of t-test for independent samples in Section 9.3. The minimum expected frequency, shown at the bottom of the table (current value is 6), has to be higher than 1, if the results are to be theoretically perfect (SPSS, 1993). This is the first theoretical assumption of a correct table. The evaluation of the number of cells below the minimum expected frequency is the second theoretical assumption. Less than 20 % of the cells must contain a smaller expected frequency than 5, to obtain a sound result (SPSS, 1993). This value does not appear in Table 9-19, because the expected frequencies are bigger than 5 in each cell.

Table 9-20 and Table 9-21 depict parts of the outputs from the output processing program. This output shows the p-values, together with the probability level and the required theoretical assumptions. Table 9-20 contains the skills where there is a significant relationship between the managerial skills and the educational forms (20 skills). Table 9-21 comprises the 6 skills where no relationship between the managerial skills and the educational form exists, that is, when the p-value is above 0.05. The remaining of the 41 skills indicates significant relationship with educational forms, but the theoretical assumptions are not fulfilled and therefore they are not shown.

Var-1	Var-2	P-Value	Ev.	Min.E.F.	Ev.	CellsEF<5	Ev.	FinalE.
MAKE DECISION	FORM	0.0000	OK**	6.000	OK	0.00%	OK	OK**
ASSES SITUATION	FORM	0.0000	OK**	8.500	OK	0.00%	OK	OK**
PRIORITAZE TASKS	FORM	0.0000	OK**	5.750	OK	0.00%	OK	OK**
MANAGING TIME	FORM	0.0000	OK**	7.500	OK	0.00%	OK	OK**
EFFECTIVE WRITING	FORM	0.0010	OK**	7.750	OK	0.00%	OK	OK**
REFLECTIVE LISTEN	FORM	0.0000	OK**	6.968	OK	0.00%	OK	OK**
SET OBJECIVE	FORM	0.0000	OK**	4.954	OK	10.00%	OK	OK**
CREATIVE PR. SOLV	FORM	0.0000	OK**	4.932	OK	5.00%	OK	OK**
SET GOALS	FORM	0.0000	OK**	5.972	OK	0.00%	OK	OK**
SOLV PROBLEMS SYS	FORM	0.0000	OK**	5.475	OK	0.00%	OK	OK**
MAKE PRESENTATION	FORM	0.0000	OK**	5.450	OK	0.00%	OK	OK**
PERSUADE	FORM	0.0010	OK*	6.719	OK	0.00%	OK	OK*
MANAGING PEOPLE	FORM	0.0060	OK*	4.977	OK	15.00%	OK	OK*
APPRAISE PERFORM	FORM	0.0000	OK**	6.439	OK	0.00%	OK	OK**
DEVELOP PEOPLE	FORM	0.0000	OK**	8.384	OK	0.00%	OK	OK**
FORECAST	FORM	0.0220	OK	5.226	OK	0.00%	OK	OK
MEASURE OBJECTIVE	FORM	0.0001	OK**	6.470	OK	0.00%	OK	OK**
SPEAK IN PUBLIC	FORM	0.0000	OK**	7.927	OK	0.00%	OK	OK**
CONSENSUS	FORM	0.0000	OK**	7.217	OK	0.00%	OK	OK**
FORM COALITION	FORM	0.0000	OK**	4.977	OK	15.00%	OK	OK**

TABLE 9-20 THEORETICALLY CORRECT TABLES - EDUCATIONAL FORMS

Var-1	Var-2	P-Value	Ev.	Min.E.F.	Ev.	CellsEF<5	Ev.	FinalE.
SEE BIG PICTURE	FORM	0.2328	BAD	4.932	OK	5.00%	OK	BAD
LEAD	FORM	0.0764	BAD	4.728	OK	20.00%	BAD	BAD
MANAGING STRESS	FORM	0.5725	BAD	1.991	OK	20.00%	BAD	BAD
PUT STRUCTURE	FORM	0.0715	BAD	4.728	OK	20.00%	BAD	BAD
SUPERVISE	FORM	0.4023	BAD	0.995	BAD	20.00%	BAD	BAD
ENFORCE RULES	FORM	0.9600	BAD	0.995	BAD	20.00%	BAD	BAD

TABLE 9-21 CROSS TABLES WITHOUT CONNECTIONS - EDUCATIONAL FORMS

Low p-value (probability value) means that the difference between the educational forms and other variables are not incidental, but a significant relationship exists between them. If the p-value (third column) is between 0.05 and 0.01 then the significance level is 5 % and the "EV" column after the p-value will show "OK". The reason for this "OK" is that researchers normally look for differences in the investigations. If this value is between 0.01 and 0.001 then the "EV" column comprises "OK*". In case of lower p-value the evaluation is "OK**". The advantage of this solution is that the more stars there are, the stronger is the relationship between the two variables that are visible immediately.

The minimum expected frequency is shown in column 5. The evaluation of the minimum expected frequency is given in the next column. The percentage of the number of cells with smaller expected frequency than 5, and it's evaluation, can be found in the next two columns. Final evaluation is also available, in the last column. In the case of three "OK" evaluations (in columns 4, 6, and 8) the final evaluation is "OK" as well. Table 9-21 contains only these cases. This evaluation can also contain asterisks, depending on the p-value. If the p-value is higher than 0.05 then the final evaluation is "BAD", as in the case of Table 9-21. If the p-value evaluation is "OK", but the other two factors are "BAD" then the final evaluation is "?", indicating that the result is not accurate theoretically.

Table 9-20 and 9-21 prove that there are significant relationships between the educational forms and the ability of conveying the managerial skills in the case of most variables. The analysis of the 20 tables, like Table 9-19 is beyond the scope of this dissertation. However, Appendix XI contains all the tables where there are significant relationships between the managerial skills and the educational forms. Tables in Appendix XI allow the reader to gain a deeper insight to this area.

9.4.4.2 The Year of Study

The managerial skills are examined in connection with 4th and 5th year undergraduate students. The forty-one managerial skills were analysed with the year of study variable to test whether they view the managerial skills differently. The evaluation of managerial skills was accomplished using two values: Value 1 means bad or neutral, while value 2 means good ability to convey the managerial skills in Table

9-23. Table 9-22 depicts a summary of the tables, showing the significant probability level.

Var-1	P-Value	Ev.	Min.E.F.	Ev.	CellsEF<5	Ev.	FinalE.
Set objectives	0.0228	OK	2.526	OK	50.00%	BAD	?
Motivate others	0.0131	OK	3.789	OK	25.00%	BAD	?
Manage stress	0.0111	OK	7.158	OK	0.00%	OK	OK
Forecast	0.0244	OK	7.579	OK	0.00%	OK	OK
Measure objectives	0.0052	OK*	5.895	OK	0.00%	OK	OK*
Develop consensus	0.0129	OK	6.737	OK	0.00%	OK	OK

TABLE 9-22 SUMMARY TABLE OF CROSS TABULATION - COURSE IV AND V

"Measure objectives" in the sixth row of Table 9-22 has highly significant p-value, with good minimum expected frequency. Table 9-23 depicts the cross table of this skill with the year of study variable. "Manage stress", "Develop consensus" and "Forecast" are the variables where theoretically correct tables indicate differences between the two years.

EVALUATION Page 1

COURSE	Count / Exp Val	1,00	2,00	Row Total
Graduate IV	4	10 5,9	6 10,1	16 42,1%
Graduate V	5	4 8,1	18 13,9	22 57,9%
	Column Total	14 36,8%	24 63,2%	38 100,0%

Chi-Square	Value	DF	Significance
Pearson	7,81899	1	,00517
Continuity Correction	6,03035	1	,01406
Likelihood Ratio	7,98421	1	,00472

Minimum Expected Frequency - 5,895

Number of Missing Observations: 0

TABLE 9-23 CROSS TABLE BETWEEN "MEASURE OBJECTIVES" AND YEAR VARIABLE

Table 9-23 indicates the differences between the two years. The fifth year students were better able to appreciate the "measure objectives" ability of the business game, due to their greater experience. The expected value of a good evaluation in Year V is 13.9, but the real number is 18. This is in contrast to Year IV, where the bad evaluation (10) is more than expected (5.9). "Forecast" is in the same situation as "Measuring objectives". However, "Manage stress" and "Develop consensus" got better evaluations from the forth year students than from the fifth year students.

9.5 Structured Observations about Team Work

During BSG sessions structured observations were made regarding the team work. Among the functions observed were seating position; use of [illegible] only the computer) such as papers, calculators; and appearance of chair person.

Structured observations were made four times in the case of the undergraduate students at the end of the academic year of 96/97, and nine times in the case of the postgraduate students. The elements of teamwork are scored from 1 to 5. In the case of seating position score of 5 means that all of the participants behaved as team members, and concentrated on the BSG. Value 1 means that the participant apparently did not participate in business game related activities. Additional tools were the paper and pen, or calculator. Further factors were the number of persons using these tools. If some of the participants used additional tools, then score of 5 was given. In the case of the existence of an obvious chair person score of 5 was given, while entirely equal work meant score of 1. The results of the observations are discussed below. Table 9-24 depicts the results of the undergraduate students, and Table 9-25 the results of the postgraduate students.

	Seating position						Usage of additional tools						Appearance of chair person					
Firms	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
Obs. 1	5	5	5	5	5	5	1	3	4	3	5	3	4	3	1	3	1	4
Obs. 2	5	5	5	5	5	5	1	1	4	4	5	2	5	4	3	3	2	4
Obs. 3	5	5	5	5	5	5	1	3	4	3	5	3	4	3	1	3	1	4
Obs. 4	5	5	5	5	5	5	1	1	4	4	5	2	5	4	3	3	2	4
Mean	**5**	**5**	**5**	**5**	**5**	**5**	**1**	**2**	**4**	**3.5**	**5**	**2.5**	**4.5**	**3.5**	**2**	**3**	**1.5**	**4**

TABLE 9-24 STRUCTURED OBSERVATION OF UNDERGRADUATE STUDENTS

	Seating position					Usage of additional tools					Appearance of chair person				
Firms	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Obs. 1	5	5	5	5	5	5	4	5	4	4	1	1	1	1	1
Obs. 2	5	5	5	5	5	4	4	4	5	4	1	1	1	1	1
Obs. 3	5	5	5	5	5	5	4	5	4	5	1	1	1	1	1
Obs. 4	5	5	5	5	5	4	5	4	4	5	1	1	1	1	1
Obs. 5	5	4	5	5	5	5	5	5	5	5	1	1	1	1	1
Obs. 6	5	5	5	5	5	5	5	5	4	4	1	1	1	1	3
Obs. 7	5	5	5	5	5	5	5	5	5	4	1	1	1	1	1
Obs. 8	5	5	4	5	5	4	4	3	4	5	1	1	1	1	2
Obs. 9	5	5	5	5	5	3	5	3	4	5	1	1	1	1	2
Mean	5	4.9	4.9	5	5	4.4	4.6	4.3	4.3	4.6	1	1	1	1	1.

TABLE 9-25 STRUCTURED OBSERVATION OF POSTGRADUATE STUDENTS

Analysis of the tables indicates that the interest of the students is well maintained by the BSG. The seating position of the students was always half-round shape, and practically everybody looked at the screen.

Additional tools were used more extensively in the postgraduate group, but two groups from undergraduate students also constantly used such tools. However, the observations were taken at later stages in the undergraduate group that could influence the results. That means that the participants in the undergraduate group already knew the game, while the postgraduate group could not acquire the rules of the game to the same extent.

Chair persons frequently exist in the case of undergraduate student, but not at all in the case of postgraduate students.

9.6 Report of the Participants

At the conclusion of BSG a detailed report regarding the firm's activity was prepared by the participant teams. Participants were asked to address the following three areas in their report:

- the way they used the elements of white box theory;
- the way, BSG helped them to understand the interrelationship between the functional parts; and
- the skills best conveyed by the BSG.

As with the previous activity, only the latter two groups participated in this investigation. Data from the three areas were collected in the following ways:

- in team reports (group responses); and
- in questionnaires (individual responses).

Participants of the BSG answered questions about these elements individually at the end of the second questionnaire. The compound analysis of the two sets of responses provides objective data, enabling the author to ascertain the extent by which the BSG fulfils the original objectives of this research.

9.6.1 Usage the Elements of White Box Theory

Team evaluation by the *postgraduate* students evenly indicates that the white box theory promoted their activities. Every team addressed this issue in its report, and all of them positively evaluated the effect of the white box theory. Additionally, they reported further benefits for the white box theory in the following areas:

- Planning;
- Quick price and cost analysis;
- Risk reduction;
- Price analysis;
- Competitor's evaluation;
- Determination of the own market position;
- Understanding the market processes; and
- Market analysis.

Undergraduate students have not evaluated the white box theory in the same way. Two of the six teams forgot to address this area. One team indicated that the white box theory was not of benefit to them, they did not provide reasons for this observation. The remaining three teams suggested that they could not properly utilise this aspect of the game.

Among the possible reasons for the observed differences between the perception of the two groups are the time; and the effort that the Umpire put into explaining the use of white box theory in the case of the two samples.

Individual responses allowed for a deeper insight into the area of the usage of white box theory. Statistical analysis can reveal further aspects of the usefulness of the white box theory. In the questionnaire the team members had to evaluate the usefulness of the white box theory from 1 (not at all) to 5 (very well) where the 5 signifies the most useful case. The construct was: "How did the white box theory promote the better understanding of business processes?" The frequencies provide a broad picture about the individual opinions in the two samples in Table 9-26. For the purposes of the statistical analysis the two groups were combined, therefore, the total number of cases was 33 people.

WHITE White box theory						
Value Label		Value	Frequency	Percent	Valid Percent	Cum Percent
not		2	2	6,1	6,1	6,1
neutral		3	6	18,2	18,2	24,2
well		4	14	42,4	42,4	66,7
very well		5	11	33,3	33,3	100,0
		Total	33	100,0	100,0	
Mean	4,030	Std dev	,883	Variance		,780
Minimum	2,000	Maximum	5,000			
Valid cases	33	Missing cases	0			

TABLE 9-26 FREQUENCIES OF THE EVALUATION OF WHITE BOX THEORY

The data presented in Table 9-26 show that overall the participants found the white box theory useful, because the mean of the combined sample is above 4 ("Mean 4.03"). This means that the white box theory promotes a better understanding of business processes. This overall evaluation, however, does not explain the differences between the two teams' evaluations. Application of t-test for independent samples on the other hand helps to reveal the differences. Table 9-27 allows for a deeper analysis.

Variable	Number of Cases	Mean	SD	SE of Mean
WHITE White box theory				
UNDGR_2.	18	3.8333	.786	.185
POSTGR .	15	4.2667	.961	.248

Mean Difference = -.4333

Levene's Test for Equality of Variances: F= 1.320 P= .259

t-test for Equality of Means

Variances	t-value	df	2-Tail Sig	SE of Diff	95% CI for Diff
Equal	-1.43	31	.164	.304	(-1.053; .187)
Unequal	-1.40	27.03	.173	.310	(-1.069; .202)

TABLE 9-27 T-TEST FOR INDEPENDENT SAMPLES BETWEEN UNDGR_2 AND POSTGR - WHITE BOX THEORY

The comparison of the two samples shows that the postgraduate participants found the white box theory useful, because the mean in this group is 4.27 that is larger than the mean in the undergraduate group (3.83). The difference between variances is not significant, because the significance of the Leven's test for equality of variances is 0.259. The "Equal" row at the bottom of the table indicates that the difference is not significant, because the p value (2-Tail Sig) is 0.164, that is above 0.05. Consequently, the perception of the participants regarding the benefit of the white box theory does not differ significantly. Additionally, the mean in the case of the undergraduate group was 3.83. This suggests, that undergraduates also found the white box theory useful.

9.6.2 Understanding the Interrelationship Between Functional Parts

Analysis of understanding the interrelationship between functional parts was also based on two different evaluations; (a) the team evaluation; and (b) the individual evaluation. The postgraduate teams' evaluation shows that they found BSG a useful tool in this area. The only exception is one team that did not mention this feature of the game. Similarly, the undergraduate teams' responses clearly indicate that use of BSG helped them to form a better and clearer understanding of the interrelationship between the functional areas. The analysis of team responses was followed by the analysis of individual responses to the questionnaire's construct. The frequencies of the individual evaluations are depicted in Table 9-28.

FUNCTION Understanding relationship

Value Label		Value	Frequency	Percent	Valid Percent	Cum Percent
not at all		1	1	3.0	3.0	3.0
not		2	1	3.0	3.0	6.1
neutral		3	1	3.0	3.0	9.1
well		4	15	45.5	45.5	54.5
very well		5	15	45.5	45.5	100.0
		Total	33	100.0	100.0	
Mean	4.273	Std dev	.911	Variance		.830
Minimum	1.000	Maximum	5.000			
Valid cases	33	Missing cases	0			

TABLE 9-28 FREQUENCIES OF THE EVALUATION OF UNDERSTANDING RELATIONSHIPS

Apart from the three first responses (Values of 1, 2, and 3 in Table 9-28) every other participant indicated that BSG promotes a better understanding of the interrelationship between functional areas. The mean of responses (4.273) is larger than the mean in the case of white box theory. The difference between the evaluation of undergraduate and postgraduate students is analysed in Table 9-29.

Variable	Number of Cases	Mean	SD	SE of Mean
FUNCTION Understanding relationship				
UNDGR_2.	18	4.5000	.618	.146
POSTGR .	15	4.0000	1.134	.293

Mean Difference = .5000

Levene's Test for Equality of Variances: F= .255 P= .617

t-test for Equality of Means

Variances	t-value	df	2-Tail Sig	SE of Diff	95% CI for Diff
Equal	1.61	31	.118	.311	(-.134; 1.134)
Unequal	1.53	20.75	.141	.327	(-.180; 1.180)

TABLE 9-29 T-TEST FOR INDEPENDENT SAMPLES BETWEEN UNDGR_2 AND POSTGR - UNDERSTANDING FUNCTIONAL RELATIONSHIPS

The results in Table 9-29 indicate that undergraduate students evaluated this feature of the BSG higher with a mean of 4.5, than the postgraduate students with the mean of only 4.0. However, this difference between the two samples is not significant, as it can be seen in the row of "Equal" in Table 9-29, where the significance value is 0.11.

9.6.3 Skills Best Conveyed by the BSG

The construct of "What managerial skills are best conveyed by the BSG" was responded to by writing the name of the managerial skills. Consequently, statistical analysis cannot be performed. However, a thorough analysis of the table in this section allows for building a broad picture regarding the managerial skills experienced by the BSG. The differences and similarities between the graduate and postgraduate students are also considered. Table 9-30 depicts the result of the opinion of the postgraduate group.

Team	Skill 1	Skill 2	Skill 3
1	Understanding relationships	--	--
2	Make decisions	Time management	Analyze problems
3	Analyze problems	Planning	Make decisions
4	Make decisions	Assess a situation quickly	Planning
5	Assess a situation quickly	Analyze data	Make decisions

TABLE 9-30 SKILLS, BEST CONVEYED BY THE BSG - POSTGRADUATE TEAMS (GROUP RESPONSES)

"Make decisions" and "Assess a situation quickly" are the most important skills, because they are most mentioned as important skills by the participants. Two other important variables are the "Analyze problems" and "Planning". The participants individual responses reflect the team opinion, as shown in Table 9-31, where these skills are mentioned frequently.

Case	Skill 1	Skill 2	Skill 3
1	Make decisions	Analyze problems	Time management
2	Adapt to new tasks	Assess a situation quickly	Make decisions
3	Make decisions	Conceptualize	Assess a situation quickly
4	Set goals	Planning Decision	Arguing
5	Analyze data	Planning	Make decisions
6	Make decisions	Analyze problems	Gather pertinent information
7	Assess a situation quickly	Analyze problems	Make decisions
8	Adapt to new tasks	Assess a situation quickly	Analyze data
9	Make decisions	Assess a situation quickly	Planning
10	Assess a situation quickly	Analyze data	Solve problems creatively
11	Creative Decision	Analyze data	Planning
12	Solve problems creatively	Assess a situation quickly	Make decisions
13	Analyze data	Analyze problems	Time management
14	Make decisions	Planning	Assess a situation quickly
15	Develop people/teams	Develop consensus	Motivate others

TABLE 9-31 SKILLS, BEST CONVEYED BY THE BSG - POSTGRADUATE PARTICIPANTS (INDIVIDUAL RESPONSES)

In Table 9-31 "Make decisions" and "Assess a situation quickly" are enumerated 9 or 8 times. The two other variables, "Analyze problems" and "Planning" are chosen 4 times. "Analyze data" has an outstanding position with its 5 occurrences. Table 9-32 depicts the result of the opinion of the undergraduate group.

Team	Skill 1	Skill 2	Skill 3
1	Develop consensus	--	Analyze data
2	Solve problems creatively	Analyze data	Develop people/teams
3	Strategic thinking	Make decisions	Understanding relationships
4	Make decisions	See the "big picture"	Lead
5	Recognise problems	Make decisions	Understanding relationships
6	Resolve conflict	Adapt to new tasks	Assess a situation quickly

TABLE 9-32 SKILLS, BEST CONVEYED BY THE BSG - UNDERGRADUATE TEAMS (GROUP RESPONSES)

Analysis of data in Table 9-32 point to the differences between the two groups. Albeit "Make decisions" is also the most important skill, but "Assess a situation quickly" is not too important. "Analyze data" and "Understanding relationships" are with 2-2 occurrences. The detailed table is depicted below.

Case	Skill 1	Skill 2	Skill 3
1	Understanding relationships	Adapt to new tasks	Assess a situation quickly
2	Form coalitions	Make decisions	Analyze problems
3	Adapt to new tasks	Make decisions	Analyze problems
4	Analyze problems	Crisis management	Arguing
5	Develop consensus	Analyze problems	Make decisions
6	Analyze problems	See the "big picture"	Crisis management
7	Develop people/teams	See the "big picture"	Resolve conflict
8	See the "big picture"	Stockpiling	Strategic thinking
9	Understanding relationships	Make decisions	Gather pertinent information
10	Gather pertinent information	Arguing	Lead
11	Analyze problems	Assess a situation quickly	Set goals
12	Make decisions	Gather pertinent information	See the "big picture"
13	Make decisions	Solve problems creatively	Develop people/teams
14	Analyze problems	Develop people/teams	Assess a situation quickly
15	Make decisions	Analyze problems	Think creatively
16	Make decisions	Set goals	Planning
17	Make Strategy	Understanding relationships	Make decisions
18	Planning	Analyze data	Form coalitions

TABLE 9-33 SKILLS, BEST CONVEYED BY THE BSG - UNDERGRADUATE PARTICIPANTS (INDIVIDUAL RESPONSES)

In Table 9-33 "Make decisions" also appears 9 times, but "Assess a situation quickly" are enumerated only 3 times. In this investigation the other strong skill is "Analyze problems" with 8 occurrences. "See the big picture" is enlisted 4 times. More skills are mentioned by undergraduate students than by postgraduate students. Another interesting feature of this examination is the relatively strong existence of the strategic skills in this functional game.

On the basis of the above three investigations it can be concluded that the BSG does convey the necessary managerial skills. The white box theory is used by the participants and it contributes to the better understanding of the business activities. The main objective, that is understanding the interrelationships between the functional areas, is well accomplished by the BSG.

9.7 Reinforcement the Results of the Examinations

The question that arose during the analysis was whether the observed results were directly attributable to BSG or they represented the effect of using other simulation games by the participants. In the first sample there was only one student who had experienced a simulation game before the BSG. However, this issue was not collected systematically and the information was received by accident. In the case of the other samples, respondents were required to answer the question: "Have you ever played a simulation game before?". Table 9-34 depicts the cross tabulation of respondents' answers.

PARTICIP participated ever in simulation game by SAMPLES

PARTICIP	Count	SAMPLES 2	3	Row Total
no	0	16	8	24 77,4
yes	1	2	5	7 22,6
	Column Total	18 58,1	13 41,9	31 100,0

Chi-Square	Value	DF	Significance
Pearson	3,22996	1	,07230

Minimum Expected Frequency - 2,935
Cells with Expected Frequency < 5 - 2 OF 4 (50,0%)

TABLE 9-34 CROSS TABULATION OF PARTICIPATION IN PREVIOUS SIMULATION

Two postgraduate students did not answer this question. Seven people previously had come across a simulation game, while 24 respondents had no previous experience with simulation games. The majority of postgraduate participants who responded positively had used a computer package as an aid to learning accounting. Therefore, some respondent classified the Computer Aided Learning package (CAL) as a simulation game, but others did not. To take these responses as a whole, 8 of 58 students answered that they have come across some kind of simulation as a learning package. On the other hand, for 50 of the respondents the BSG was the first simulation game that they had experienced. Consequently, it is safe to conclude that the observed responses are the direct result of using the BSG.

The quantitative data presented in this chapter indicate that simulation technique has a significant role to play in the further development of management education. This is in agreement with the findings of the American study quoted previously. Furthermore, BSG facilitates the development of management skills as depicted in Table 9-8. Responses of the students (presented in Section 9.6.1), proved that the white box theory is useful from the viewpoint of understanding business processes. The BSG also fulfilled the objective of enabling the students to understand the relationships between the functional areas. This was discussed in Section 9.6.2. Structured observations (presented in section 9.6.3) showed the strong active learning feature of the BSG. Further discussion of the analysis of the quantitative data is presented in the Conclusion chapter.

9.8 References

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CHAPTER 10 - CONCLUSION

TABLE OF CONTENTS

The objective of this chapter is to summarise the arguments, data and analysis presented in parts 1, 2 and 3 of this thesis. Furthermore, the contribution of this work to the existing knowledge and areas for the future research is highlighted. The sections are divided into the following parts:

- background;
- aims and objectives;
- basic principles;
- methodology
- realisation of the aims and objectives;
- relationship of the research to previous work in the field;
- implications of findings;
- deficiencies of the BSG; and
- future developments.

10.1. Background

In general, a business simulation is an effective tool for acquiring abilities and skills that are not sufficiently conveyed by traditional business education methods, as discussed in Chapter 2. In classroom situations, involving three different cohorts of students with different educational attainment and work experience, an experiment was conducted. In this experiment the BSG, developed and demonstrated in this work, proved to be an effective tool for conveying managerial skills, promoting greater understanding of functional interrelationships, and encouraging team work. The analysis of the quantitative data was presented in Chapter 9.

Prior to the introduction of market economy most post socialist enterprises were primarily concerned with meeting the production targets determined centrally. Therefore, the functional divisions prevalent in organisations operating in market economies were not as well developed in the these organisations. The move towards of a market economy has radically changed this situation. The new generation of managers needs to understand the functional interrelationships and the behaviour of an enterprise in a competitive environment, as well as the functional parts in themselves.

In the traditional education system, students may learn about different subsystems, such as marketing and production, but not about the interrelationships between the subsystems as a whole system. However, the whole system has its own characteristics, as discussed in Chapter 1. BSG allowed the participants to study and gain a better understanding of the interrelationships between the subsystems. This was discussed in Chapter 9.

Business simulations provide the participants with the opportunity to act, to test, and to experience the result of their own actions (Elgood 1988, p.17). In Chapter 2, with the help of published research, it was argued that business simulation was a better vehicle than the traditional educational methods for conveying important managerial skills. The analysis presented in Chapter 9 shows that BSG was an effective tool for conveying key managerial skills to the Hungarian students. However, the effectiveness of the business games does not mean that active learning is the only appropriate educational form. Only a complex set of methods can convey the necessary set of skills (Teach and Govahi, 1993) that is required by participants.

Existing business simulations fulfil the role of the transition of necessary managerial skills with good effectiveness. However, different environments trigger different needs. The existing simulations are not designed to suit the needs of a country in transition from a command economy to a market economy. Consequently, the design of a new simulation must address the needs, emerging from the transitional economy.

A thorough examination of the existing papers and business simulations, together with new concepts and ideas, provided a sufficient base for the design of a new business simulation game. The simulation of a company requires modelling of different areas of a company which are related to each other. Additionally, the interrelationship of the subsystems has to be designed on a realistic basis. It is not sufficient only to design a business game, but it is necessary to validate and verify the accuracy and effectiveness of the business game in conveying business skills and knowledge. Steps taken in the validation of BSG were described in Chapter 8 and 9.

10.2. Aims and Objectives

The *primary aim* of the development work was to design an interactive learning tool that would facilitate effective acquisition of key business knowledge in the context of a firm and operating in competitive markets. To attain the aim of the research a number of objectives were established. These objectives were discussed in detail in Chapter 1, and are shown in brief below.

- to prepare and develop a game that allows the participants to understand the business processes in a competitive market;
- to design a game that operates in at least two languages, a key requirement for many countries where English is not widely understood;
- to create special subparts that function as pure explanatory parts, therefore enabling the participants to acquire knowledge regarding the functional areas of business management; and
- to design a game where there are practice *and* competitive modes.

To ensure the efficacy of the BSG, steps were taken to validate its effectiveness. The validation process contains three steps:

- to validate the new simulation game with real life data, as discussed in Chapter 8;
- to test the accuracy of the simulation against business reality, as discussed in Chapter 8; and
- to ascertain the effectiveness of the new game in classroom situations, as discussed in Chapter 9.

10.3. Basic Principles of the BSG

The guiding principles for the development of the BSG were implicit in the basic aim and objectives of this research and development work. These guiding principles provided the designer with a close set of theories and concepts to prepare the system plan. Establishment of a set of principles is a necessary first step in the development of an overall framework. This framework then guides the development of the simulation game.

The principles governing the development of the BSG were described in Chapter 1. These included:

1. a computerised simulation game;
2. an interactive simulation game;
3. modelling a strategic business unit;
4. modelling operations in a competitive business environment;
5. the development of a multifunctional game;
6. a simulation game with a high level of flexibility and variability;
7. application of white box system;
8. simulation, capable of operating in two languages;
9. the validation of the simulation using real data;
10. verification of the efficacy in classroom situation; and
11. provision of a three level manual.

The rational for the above principals were fully discussed in Chapter 1, and they are not repeated here. The basic principles promote the technical side of the system plan. In order to develop the BSG it was required to study existing literature and business simulations; modelling of the business processes and the functional parts; and the establishment of a validation methodology as discussed in the research methodology section.

10.4. Structure of the Dissertation

The chapters of this thesis are structured to mirror the development work undertaken, and consist of:

Part I, Introduction and survey provide a brief, but thorough overview of the thesis.

Part I - Introduction and survey

- introduction (Chapter 1)
- literature survey (Chapter 2)
- review of the existing business simulation games (Chapter 3)

Part II introduces the BSG program and the development of the functional parts, because Premise 5 states: A multifunctional game should be developed.

Part II - A new business simulation model

- outline of the model (Chapter 4)

- production (Chapter 5)
- marketing (Chapter 6)
- accounting and finance (Chapter 7)

Premise 8 and 9 comprise the validation and verification of the effectiveness of the BSG. Consequently Chapter 8 and 9 are devoted to these processes.

Part III - Validation

- validation of the BSG (Chapter 8)
- verification in classroom situation (Chapter 9)

10.5.Research Methodology

In the development of BSG, as discussed in Chapter 1, analytic research was used to break down the model into its functional parts. Mathematical modelling and algorithms were used to develop the functional models. These functional models are descriptive and explicative from the model characteristics point of view. Additionally, the BSG as a whole is a model of interrelated functional parts. It has simulation characteristic, because it clarifies the structural relations of functional parts and attempts to reveal the process relations among them. The validation procedure uses laboratory study, while the ascertainment of the effectiveness of the BSG is based on opinion research.

Response surface methodology was used as the means of evaluating the accuracy of the BSG. Ascertainment of the effectiveness of the BSG was based on questionnaires, discussed in Chapter 9. The validation and verification chapters used the following statistical procedures:

- univariate statistics;
- multiple linear regression analysis;
- discriminant analysis;
- factor analysis;
- cross tabulation;
- f-statistics; and
- t-statistics.

A selection of software was used in the validation procedure:

- SPSS for Windows (SPSS, 1993);
- REGAL, Expert System for Multivariate Regression Analysis (Kiss, 1991);
- PIMS Institute's own Regression Analysis Program;
- Continuous Probability Distribution Functions (Hajdu and Kiss, 1992);
- Factor Analysis Output Processing Program (Kiss and Jones, 1994);

- Crosstabulation Output Processing Program (Kiss, 1994, 1); and
- Independent Sample T-test Output Processing Program (Kiss, 1994, 2).

The realisation of the aims and objectives is discussed in the following section.

10.6.Realisation of the Aims and Objectives

A comparison between the original aims of the research and its accomplishment is presented below. The original aims are written in *italics*.

1. *To prepare and develop a game that allows the participant to understand the business processes in a competitive market.*

   Marketing, production, accounting and finance functions were simulated using the existing and accepted theories of each discipline area. However, necessary models for simulating the functional areas were modified to create new models based on broadly accepted existing concepts. An example is the market model applied in BSG that is based on existing response, aggregate and dynamic models.

   The interrelationship of the different functional parts resulted in a coherent simulation game. The decision variables (price, advertisement costs, sales promotion) - performance criterion (possible market share) relationship can be considered as a stable relationship, as discussed in Chapter 8. The participants' evaluation of the BSG showed that the simulation promoted a better understanding of the interrelationship between the functional areas. Consequently, the BSG allows the participants to form a better understanding of the business processes in a competitive market. This is an important point in the training of future generations of managers in a country with limited experience of a market economy.

2. *To design a game that operates in at least two languages.*

   The two language feature of the BSG allowed for the students to switch between the two languages. This enabled them to study the English equivalent of various business notions and relate them to their Hungarian environment.

3. *To create special subparts that function as pure explanatory parts to enable the participants to learn functional areas of business management.*

   This part of the BSG, according to the white box theory, has proved to be highly popular, as discussed in Chapter 9. The participants were always interested in the consequences of their decisions. This methodology improved the effectiveness of the learning process, as discussed in Chapter 9.

4. *To design a game where there are practice and competitive mode.*

   The practice mode has proved to be an appropriate tool for learning the rules and the behaviour of the model. The competitive mode provides exciting challenge for the participants.

5. *To validate the BSG with real life data.*

   Chapter 8 contains the face validation of the BSG. The arguments in that chapter showed that the BSG has sufficient face validity. However, a strict face validity of the BSG is not really necessary, because in practice there has not been any questions about the validity of parameters used. The game allows the characterisation of any type of business by making changes in the parameter file. The Umpire has control of the parameter file, as discussed in Chapter 4 and can therefore make changes to mirror any business characteristics. The flexibility of the BSG, therefore, as far as the initial parameter set is concerned, is used mainly to change the set of objectives to mirror a real company.

6. *To test the accuracy of the simulation against reality.*

   Statistical tests, presented in Chapter 8 showed that BSG is stable. Moreover, these tests showed that performance criterion was sensitive to changes in decision variables such as price, advertisement, sales promotion, and previous market share.

7. *To ascertain the effectiveness of the BSG in the classroom situation.*

   Results of the student appraisal surveys presented in Chapter 9, provide the empirical evidence showing the usefulness of the game. Firstly, the efficiency of the BSG to convey the set of forty-one managerial skills was established. The first questionnaire examined the importance of managerial skills from the viewpoint of the respondents. Univariate statistics were used for the evaluation of the different managerial skills. Secondly, the ability of the BSG to convey managerial skills was evaluated. The second investigation asked the participants to rate the same managerial skills from the viewpoint of teaching methods, such as lectures, seminars, case studies and business simulations. A comparison of the educational methods provides valuable information about the effectiveness of each educational form in conveying specific managerial skills. This examination showed that the BSG has an important role in management education in Hungary.

The experience of the Umpire indicates, that the participants usually enjoyed the simulation, and effective teamwork was forged in. In most western organisations, working together in teams is gaining importance. The skill, required to work in teams, is not covered by the current Hungarian syllabuses. Therefore, the experience of working in teams and the process required to establish effectiveness is of significant benefit to the students. The BSG enabled the participants to experience and better understand the requirements of working in a team. This point is broadly supported by the result of the structured observations presented in Chapter 9.

10.7. Relationship of the Research to the Previous Work in the Field

The main contribution of the research to the existing body of knowledge is the design and development of a unique interactive learning simulation game. The unique features of the BSG include the following:

- *A menu system designed to directly reveal the underlying economic model to the students.*

  Separate menu-parts within the main functional areas and the utilities, guide and enable the participants to further analyse their decisions.

- *The simulation provides the participants with the opportunity to follow the probable effect of their decisions.*

  This is accomplished by using and applying the white-box theory. Examples to use this opportunity can be found in the marketing and production models, where the probable effect of decisions taken can be reviewed by the participants.

- *Development and provision of two types of playing methods.*

  Practice and competitive modes are developed. Additionally, the practice method allows the participants to either start a new enterprise, or manage an existing enterprise. The learning here enables the participant to learn the operations of an existing system or to apply concepts learned in establishing a new one.

- *Development of a two language BSG.*

  A special menu-point provides the participants with the opportunity to switch between the two languages. This allows the students to relate new terms to their knowledge base.

- *Development of a highly flexible and variable simulation game.*

  Whilst other simulation games may have a high level of flexibility, the BSG provides practically unlimited flexibility and variability during one simulation game run. The provision to switch between two different country settings is unique to BSG. Therefore, the extent of flexibility and variability offered by the BSG is unique.

The unique features of BSG make the game especially useful in countries that are moving towards establishing market economies.

The new developments within functional areas of the BSG also contribute to the existing knowledge. These include:

- *A new market model.*

  A linear aggregate dynamic demand model has been developed on the basis of the existing market share, general attraction and aggregate models. Chapter 6 provides more information on the new model.

- *Validation of the new market model by real-life data.*

  An estimation of the initial market parameters is available from the PIMS database, as it was discussed in Chapter 8.

- *Application of a new approach of modelling short run production and cost function.*

  The BSG uses a simple approach for the short run production and cost function. The applied functions allow the study of economic theory in a simulated environment.

- *Activity run accounting system on modifiable set of accounting items.*

  The BSG applies a group of accounting items, instead of individual accounting items. The group is representative of a well-defined activity of the company, and allow for the usage of common parameters that are equivalently used by the individual accounting items.

The accounting rules, applied in the accounting process, are not permanently fixed in the program. The rules are recorded in a text file, and can be changed to apply different accounting environment rules.

- *complete methodology for the harmonisation of different accounting system.*

The BSG uses *automated model building process* to help the participant to learn about the different accounting environments. This program builds up the financial tables and ratios from a text file, that contains a company's general ledger data. Henceforth, the program is able to build up financial tables from any general ledger file, that are in text format. This facilitates an understanding of different country's financial tables. Chapter 7 provides more details regarding the harmonisation issue.

- *automatic evaluation.*

The BSG computes a weighted score from some of the more important factors of the firm. Evaluation of a company is accomplished by different factors and/or financial ratios. The score is calculated on the basis of the performance of the company.

10.8. Implications of the Impact of the BSG on Management Education

The impact of the BSG can be seen in two main areas in the development of management education. First, it has a direct impact on the subject areas of management education and their curriculum design. Second, it has an impact on the educational form (participants' learning styles) and the tutors that affect curriculum design. These two areas are closely related and it is a circular problem in nature. Changing the subject area curriculum requires the tutor to understand what changes are needed to move towards a market economy but no demonstrations and examples are available when the economy is in transition. As such, the BSG provides a bridge to closing down the gap in the immediate future.

The knowledge base of the countries with competitive markets has to be acquired by the countries with transitional economies if they are to compete effectively against them. However, knowledge alone is insufficient, because competency in executing skills and techniques is also needed by these countries. Skills and techniques are also needed for gaining competencies, and is therefore a circular problem. The real advantage of simulations and the BSG, is that not only the knowledge, but the important managerial skills are also taught and conveyed in the classroom. One of the core findings of the thesis was, the ability of BSG to convey managerial skills that research has shown to be very important in management education. In this area, the BSG out performs case study, seminar, and lecture platforms, because 26 out of 41 important managerial skills are best conveyed by BSG. Chapter 9 provided sufficient evidence to suggest extension and changes to the curriculum and the subjects of business education are needed. This is an important issue because it addresses the core problems against accepting change to the current curriculum of the transition economy environment.

The transmission of underpinning knowledge is accelerated by the active learning process of learners, backed by the curriculum design and development, provided by the Umpire. In the active learning process students have more freedom, and more activity then in the case of traditional education processes. Active learning is closer to the human nature of how learning occurs. The necessary form of working with business simulations is teamwork, as in the case of real company life. The most important skill, the decision making ability together with teamwork is a substantial element of the business daily activities.

Curriculum design can be further improved by the active learning process because it focuses on the learning needs of the student rather than the teaching needs of the tutor. Active learning can force additional improvements of the curriculum, resulting in a - hopefully - endless improvement process.

For curriculum design, the comparison of under- and postgraduate students in Section 9.3 revealed the important areas that the business practice really need. Findings of Section 9.4.1.3, summarised in Tables 9-8, 9-9 and 9-10, allow for considering the differences between the Hungarian and American experience for not only the business simulations, but for case studies and seminars as well.

Factor analysis provided evidence of broader grouping of the important managerial skills, that are decision making, planning, human factor and control. The four groups provide a clear picture of the practical and operational side of companies. Henceforth, they allow for concentrating on the key and main areas in the curriculum design.

Discriminant analysis determined functions that can specify the different educational forms: lectures, case studies, seminars and business simulations. The participating variables (skills) in the functions help to identify the educational forms where the difference in conveying skills is most specific. These results can generate a curriculum design process, where the educational forms will be referred to the required skills, e.g., business simulations to decision making skill.

Simulation is more relevant for the students of a country with a transition economy than for those from a competitive economy, because the behaviour in a competitive market is relatively new to those participants who are not accustomed to such types of business environment.

10.9. Deficiencies of the BSG

The BSG is not without its shortcomings. These are discussed below.

1. The global market model currently contains a simple calculation for determining the possible

market share. A linear programming method can provide a better and more sophisticated solution.

2. The production model uses short-run cost and production functions. The microeconomic theories comprise a more comprehensive model with short-run revenue and profit functions, where the connections amongst the functions provide a compact, theoretically sound system.

3. The main production screen does not apply mathematical methods for the distribution of products between the product lines and the type of product. Linear programming methods can be used in this area.

4. Other questionable assumptions can be found in the BSG. These include the lack of overtime; the immediate introduction of product and product lines; and the impossibility of bankruptcy in competition mode.

5. The competition mode has shown that sometimes separation from the real life can be useful. For example, if a group has gained significant advantage in relationships to other teams' position, this can act as a demotivator to the efforts of the other teams. However, if the game does not allow for a large gap between the teams,

then the learning effect for the teams will remain intense.

The above issues will be addressed in future versions of BSG. The chapters, dealing with validation showed that in spite of the deficiencies of the BSG, the development work resulted in a business simulation that can convey important managerial skills.

10.10. Future Developments

Future developments are based partly on the deficiencies identified in the BSG. These developments include three main areas. These are: methodological design; content; and the platform of the program.

Methodological design:

- A linear programming method for the final evaluation of the market influential factors of companies.
- A comprehensive model with short-run revenue and profit functions, that also exert influence on the production model of the BSG.
- Linear programming methods to optimise the product distribution amongst the product lines.

Content of the program:

The main development work in the future with all of the functional parts will include the topic of sustainable development.

Platform:

Application to the Windows operation environment.

10.11. References

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APPENDICES

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LIST OF TABLES

Appendix I - Questionnaire 1.

Following is a list of 41 attributes that have proven to be critical in effective management. First, read the entire list. Second, select about 8 attributes which you consider to be the most important in your current position and circle the "1" beside each. Next select about 8 more attributes which you consider to be slightly less important and circle a "2". Continue selecting sets of about 8 attributes in descending order of importance until you have exhausted the list (the last set will have a rating of 5). If you have some sets with 9 and a few 7, that is OK, but be sure to use all 5 scale values.*

Skills					
Adapt to new tasks	1	2	3	4	5
Make Decision	1	2	3	4	5
Organize	1	2	3	4	5
Assess a situation quickly	1	2	3	4	5
Gather pertinent information	1	2	3	4	5
See the "big picture"	1	2	3	4	5
Analyze problems	1	2	3	4	5
Prioritize tasks	1	2	3	4	5
Analyze data	1	2	3	4	5
Manage time	1	2	3	4	5
Write effectively	1	2	3	4	5
Think creatively	1	2	3	4	5
Reflective listening	1	2	3	4	5
Plan	1	2	3	4	5
Set objectives	1	2	3	4	5
Motivate others	1	2	3	4	5
Solve problems creatively	1	2	3	4	5
Schedule and coordinate	1	2	3	4	5
Set goals	1	2	3	4	5
Lead	1	2	3	4	5
Conceptualize	1	2	3	4	5
Solve problems systematically	1	2	3	4	5
Exert influence	1	2	3	4	5
Make presentation	1	2	3	4	5
Persuade	1	2	3	4	5
Manage people	1	2	3	4	5
Mange stress	1	2	3	4	5
Delegate responsibility	1	2	3	4	5
Ascertain performance	1	2	3	4	5
Resolve conflict	1	2	3	4	5
Put structure to unstructured problems	1	2	3	4	5
Develop people/team	1	2	3	4	5
Forecast	1	2	3	4	5
Direct the work of others	1	2	3	4	5
Measure objectives	1	2	3	4	5
Speak in public	1	2	3	4	5
Supervise	1	2	3	4	5
Enforce rules	1	2	3	4	5
Develop consensus	1	2	3	4	5
Conduct interviews	1	2	3	4	5
Form coalition	1	2	3	4	5

* The Hungarian experiment was asked to use groups of 8-8-8-8-9.

Appendix II - Questionnaire 2.

Below is the same set of attributes once again. This time we would like you to consider the different teaching techniques that you have experienced in learning these sets of skills. These teaching techniques include: Lectures, Case Study, Seminars*, Business Simulations (Business Games). For each attribute, please rate each teaching technique on its importance in your learning the skill. Please use a "5" ** for the very best teaching method down to a "1" for the worst teaching method. If you gave not experienced one of these methods, please insert an "N" in the appropriate column(s).

Skills	Lectures	Seminars	Cases	BSG
Adapt to new tasks				
Make Decision				
Organize				
Assess a situation quickly				
Gather pertinent information				
See the "big picture"				
Analyze problems				
Prioritize tasks				
Analyze data				
Manage time				
Write effectively				
Think creatively				
Reflective listening				
Plan				
Set objectives				
Motivate others				
Solve problems creatively				
Schedule and coordinate				
Set goals				
Lead				
Conceptualize				
Solve problems systematically				
Exert influence				
Make presentation				
Persuade				
Manage people				
Mange stress				
Delegate responsibility				
Ascertain performance				
Resolve conflict				
Put structure to unstructured problems				
Develop people/team				
Forecast				
Direct the work of others				
Measure objectives				
Speak in public				
Supervise				
Enforce rules				
Develop consensus				
Conduct interviews				
Form coalition				

* The original "Experiential Learning Exercises" was replaced by "Seminars"

** This value is 5 in the original experiment as well, but here "9" was written.

Appendix III - Regression Statistics of Different Industries

Independent variables - Industry 2	**Regr. Coeffi- cients**	**Stan- dard error**	**Proba- bility value**
Constant	0.000	0.042	
Previous Market Share	0.752	0.042	0.000
Other Sales Promotion	-0.053	0.042	0.115
Advertising	0.024	0.042	0.288
Relative Product Quality	-0.007	0.042	0.435
Relative Price	-0.022	0.042	0.304

R SQUARE: 0.9766, F = 109 (5,13 DF): P = 0.000

TABLE A/3-1 REGRESSION STATISTICS - INDUSTRY 2.

Independent variables - Industry 3	**Regr. Coeffi- cients**	**Stan- dard error**	**Proba- bility value**
Constant	0.000	0.079	
Previous Market Share	0.253	0.079	0.015
Other Sales Promotion	-0.108	0.079	0.123
Advertising	0.007	0.079	0.468
Relative Product Quality	0.120	0.079	0.102
Relative Price	0.026	0.079	0.381

R SQUARE: 0.9749, F = 31.1 (5,4 DF): P = 0.003

TABLE A/3-2 REGRESSION STATISTICS - INDUSTRY 3

Independent variables - Industry 4	**Regr. Coeffi- cients**	**Stan- dard error**	**Proba- bility value**
Constant	0.000	0.020	
Previous Market Share	0.512	0.020	0.000
Other Sales Promotion	-0.107	0.020	0.000
Advertising	-0.004	0.020	0.421
Relative Product Quality	-0.000	0.020	0.494
Relative Price	-0.030	0.020	0.087

R SQUARE: 0.9967, F = 490 (5,8 DF): P = 0.000

TABLE A/3-3 REGRESSION STATISTICS - INDUSTRY 4

Independent variables - Industry 5	Regr. Coeffi-cients	Stan-dard error	Proba-bility value
Constant	0.000	0.026	
Previous Market Share	0.771	0.026	0.000
Other Sales Promotion	-0.030	0.026	0.129
Advertising	0.023	0.026	0.189
Relative Product Quality	0.021	0.026	0.212
Relative Price	0.012	0.026	0.317

R SQUARE: 0.9754, F = 293 (5,37 DF): P = 0.000

TABLE A/3-4 REGRESSION STATISTICS - INDUSTRY 5

Independent variables - Industry 6	Regr. Coeffi-cients	Stan-dard error	Proba-bility value
Constant	0.000	0.061	
Previous Market Share	0.828	0.061	0.000
Other Sales Promotion	-0.046	0.061	0.236
Advertising	0.022	0.061	0.365
Relative Product Quality	0.058	0.061	0.185
Relative Price	0.035	0.061	0.289

R SQUARE: 0.9741 F = 52.7 (5,7 DF): P = 0.000

TABLE A/3-5 REGRESSION STATISTICS - INDUSTRY 6

Independent variables - Industry 7	Regr. Coeffi-cients	Stan-dard error	Proba-bility value
Constant	0.000	0.049	
Previous Market Share	0.720	0.049	0.000
Other Sales Promotion	-0.096	0.049	0.030
Advertising	0.061	0.049	0.113
Relative Product Quality	0.085	0.049	0.047
Relative Price	-0.023	0.049	0.318

R SQUARE: 0.9249 F = 76.3 (5,31 DF): P = 0.000

TABLE A/3-6 REGRESSION STATISTICS - INDUSTRY 7

Independent variables - Industry 8	Regr. Coeffi-cients	Stan-dard error	Proba-bility value
Constant	0.000	0.049	
Previous Market Share	0.720	0.049	0.000
Other Sales Promotion	-0.096	0.049	0.030
Advertising	0.061	0.049	0.113
Relative Product Quality	0.085	0.049	0.047
Relative Price	-0.023	0.049	0.318

R SQUARE: 0.9249 F = 76.3 (5,31 DF): P = 0.000

TABLE A/3-7 REGRESSION STATISTICS - INDUSTRY 8

Appendix IV - Parameter File of the BSG

A	{ A = Automatic individual game V = competition }
3	{ Number of firms }
100000000	{ Value of Property }
50000000	{ Sum of Starting Cash }
1000	{ Number of Shares }
200000000	{ Estimated value of the firm }
2.80	{ price of A material }
2.80	{ price of B material }
3.10	{ price of C material }
3.00	{ price of D material }
3.10	{ price of E material }
3.20	{ price of F material }
6	{ %, Long term Loan Interest, year }
36	{ %, Long term Loan expiry, month }
9	{ %, Short term Loan Interest, year }
10	{ %, Short term Loan expiry, month }
20	{ %, Immediate Loan Interest, year }
2	{ %, Immediate Loan expiry, month }
100000	{ Average number of product of all market for 1 firm}
-2	{ Developing Countries - Economic Index }
5	{ Developing Countries - Rate of Inflation }
15	{ Developing Countries - % from the whole market share }
7	{ Developing Countries - first optimal value of parameter }
7	{ Developing Countries - second optimal value of parameter }
7	{ Developing Countries - third optimal value of parameter }
-5	{ Post - Socialist - Economic Index }
15	{ Post - Socialist - Rate of Inflation }
25	{ Post - Socialist - % from the whole market share }
8	{ Post - Socialist - first optimal value of parameter }
9	{ Post - Socialist - second optimal value of parameter }
7	{ Post - Socialist - third optimal value of parameter }
-2	{ Domestic - Economic Index }
15	{ Domestic - Rate of Inflation }
35	{ Domestic - % from the whole market share }
9	{ Domestic - first optimal value of parameter }
9	{ Domestic - second optimal value of parameter }
9	{ Domestic - third optimal value of parameter }
5	{ Competitive - Economic Index }
5	{ Competitive - Rate of Inflation }
25	{ Competitive - % from the whole market share }
9	{ Competitive - first optimal value of parameter }
10	{ Competitive - second optimal value of parameter }
9	{ Competitive - third optimal value of parameter }
25	{ %, ROI as strategic goal of the firm - 1 firm}
25	{ %, Value of Shares as strategic goal of the firm - 1 firm}
25	{ %, Profit as strategic goal of the firm - 1 firm}

25	{ %, Market Share as strategic goal of the firm - 1 firm}
25	{ %, ROI as strategic goal of the firm - 2 firm}
25	{ %, Value of Shares as strategic goal of the firm - 2 firm}
25	{ %, Profit as strategic goal of the firm - 2 firm}
25	{ %, Market Share as strategic goal of the firm - 2 firm}
25	{ %, ROI as strategic goal of the firm - 3 firm}
25	{ %, Value of Shares as strategic goal of the firm - 3 firm}
25	{ %, Profit as strategic goal of the firm - 3 firm}
25	{ %, Market Share as strategic goal of the firm - 3 firm}
25	{ %, ROI as strategic goal of the firm - 4 firm}
25	{ %, Value of Shares as strategic goal of the firm - 4 firm}
25	{ %, Profit as strategic goal of the firm - 4 firm}
25	{ %, Market Share as strategic goal of the firm - 4 firm}
25	{ %, ROI as strategic goal of the firm - 5 firm}
25	{ %, Value of Shares as strategic goal of the firm - 5 firm}
25	{ %, Profit as strategic goal of the firm - 5 firm}
25	{ %, Market Share as strategic goal of the firm - 5 firm}
25	{ %, ROI as strategic goal of the firm - 6 firm}
25	{ %, Value of Shares as strategic goal of the firm - 6 firm}
25	{ %, Profit as strategic goal of the firm - 6 firm}
25	{ %, Market Share as strategic goal of the firm - 6 firm}
20	{ %, Previous market share as a factor determining shares }
20	{ %, Quality as a factor determining share }
20	{ %, Price as a factor determining share }
20	{ %, Advertisement as a factor determining shares }
20	{ %, Sales Promotion as a factor determining shares }
20	{ %, Price, Adv or SP changes more, penalty }
1	{ %, Penalty, after every plus % from Market Share }
9000000	{ Normal Stock-Capacity }
43	{ Social Liability }
0.05	{ Stock price on every Kg - material }
25000	{ Cost of Firing }
8	{ Free Days Percent - in one term }
0.8	{ Quitting Percent - in one term}
200	{ Monthly Working Hours }
20000	{ Salary of Officers (monthly) }
60	{ Minimal Hourly wage }
25	{ VAT, percentage }
2.80	{ A material book value }
2.80	{ B material book value }
2.80	{ C material book value }
3.00	{ D material book value }
3.00	{ E material book value }
3.00	{ F material book value }
100.0	{ 1. product book value }
100.0	{ 1. product book value }
100.0	{ 1. product book value }

229	{ material price - difference account }
299	{ Product price - difference account }
442	{ Accounts Payable domestic }
444	{ Accounts Payable foreign }
31	{ Accounts Receivable }
466	{ VAT Payable}
467	{ VAT Receivable}
468	{ Transfer account of VAT }
61	{ General expenses }
114	{ Value of Developments }
474	{ Dividends }
16	{ Serial number of net. profit in Income statement(start.fle)}
5	{ Life time of machines (year) }
20	{ Life time of buildings (year) }
100	{ Office workers 's number }
430	{ Opening Manual workers }
200	{ Possible maximal Price }
100000	{ Possible maximal Advert}
80000	{ Possible maximal SP }
100	{ %, measure of gross loan as a % of estimated value of firm }
20	{ %, measure of loss as a % of estimated value of firm }
5	{ %, Good will - weight of wages }
20	{ %, Good will - weight of profit }
25	{ %, Good will - weight of shares }
15	{ %, Good will - weight of dividend }
20	{ %, Good will - weight of ROI }
15	{ %, Good will - weight of Market share }
3.5	{ average mark for the group }
1.5	{ average mark for the group ñ this value as a top and bottom}

Appendix V - Report File of the BSG

General information about the firm:

° Number of firms	:	3 °
° The Value of Building of Factory and Stock	:	100000000 °
° The sum of Starting money	:	20000000 °
° Estimated value of the firm	:	50000000 °
° Number of Shares	:	1000 °
° Interest of Long term credit, %/year	:	6 °
° Expiry of Long term credit, month	:	36 °
° Interest of Short term credit, %/year	:	9 °
° Expiry of Short term credit, month	:	10 °
° Interest of Immediate credit, %/year	:	20 °
° Expiry of Immediate credit, month	:	2 °
° Normal Capacity of Stock	:	9000000 °
° Charge of Salaries	:	43 °
° Cost of Stock of Materials / kg	:	0 °
° Cost of Dismissal	:	25000 °
° Holiday in percents in one month	:	8 °
° Withdrawal percents in one month	:	1 °
° Monthly working hour	:	200 °
° Salary of White collar workers	:	20000 °
° Minimal hourly rate	:	80 °
° VAT	:	25 °
° Lifetime of Machines in years	:	5 °
° Lifetime of Building	:	20 °

Results of Market Research

° The maximum capacity of all markets	:	600000 °

The main characteristics of markets. Parameters are in connection with the product-development

° Developing Countries - Economic Index	:	-2 °
° Developing Countries - Rate of Inflation	:	5 °
° Developing Countries - % from the whole Market Shares	:	15 °
° Developing Countries - Optimal Value of first Parameter	:	7 °
° Developing Countries - Optimal Value of second Parameter	:	7 °
° Developing Countries - Optimal Value of third Parameter	:	7 °
° Post - Socialist - Economic Index	:	-5 °
° Post - Socialist - Rate of Inflation	:	15 °
° Post - Socialist - % from the whole Market Shares	:	25 °
° Post - Socialist - Optimal Value of first Parameter	:	8 °
° Post - Socialist - Optimal Value of second Parameter	:	9 °
° Post - Socialist - Optimal Value of third Parameter	:	7 °
° Domestic - Economic Index	:	-2 °
° Domestic - Rate of Inflation	:	15 °
° Domestic - % from the whole Market Shares	:	35 °
° Domestic - Optimal Value of first Parameter	:	9 °
° Domestic - Optimal Value of second Parameter	:	9 °
° Domestic - Optimal Value of third Parameter	:	9 °
° Competitive - Economic Index	:	5 °
° Competitive - Rate of Inflation	:	5 °
° Competitive - % from the whole Market Shares	:	25 °
° Competitive - Optimal Value of first Parameter	:	9 °

- Competitive - Optimal Value of second Parameter : 10 °
- Competitive - Optimal Value of third Parameter : 9 °

The Objectives of your firm :-

- Return of Investment as strategic objective : 20 °
- Value of Shares as strategic objective : 30 °
- Profit as strategic objective : 20 °
- Market Share as strategic objective : 30 °

Appendix VI - Short Manual for the BSG

Welcome to BSG!

This Business Simulation Game simulates a company life for twelve months. You can be the managers of the company. The game simulates marketing, production, accounting and financial processes.

Two parallel processes are simulated. The first process is the production process; the second process is the marketing activity. In the production process the factory *produces products and delivers them to existing warehouses* of different markets. The parallel process is to *sell the existing stock of products* in different markets from the warehouses. Therefore the market influential factors affect the stock in the warehouses to sell them, while the production process is directed to producing an amount of products that will be delivered to the warehouses to the end of the period.

The simulation provides the opportunity of product development, investment and other necessary processes of a company life. Moreover, the details of the decisions can be followed. In automatic mode the computer simulates two artificial competitors, while in competitive mode the members of your groups are your competitor. On-line help provides information about the basic knowledge in connection with the rules of the game. Start the game with the command of "BSG" (Enter).

Enjoy the BSG!

Welcome to BSG!

This Business Simulation Game simulates a company life for twelve months. You can be the managers of the company. The game simulates marketing, production, accounting and financial processes.

Marketing

The marketing part includes products, that can be distinguished from the other products. STP marketing is supported, because four markets exist with different features that allow the participants to segment, target and position markets. The elements of marketing mix are applied as market influential factors. An additional factor is the previous market share. A "Trial" method allows a participant to follow the effect of the decisions of the firm. A market research report provides information about the competitor's position.

Production

The production model includes production planning, research and development (R&D), material, labour and equipment parts. The production model allows the understanding of the meaning and interaction of such theoretical notions as marginal and average production and cost functions. Production activity control for the BSG can take place on one screen, collecting all important information about the shop floor activities and presenting the participant with a single input screen for their decisions. A unique capacity planning means provide an interactive tool to the participants to follow the consequence of their decisions. The production model also provides the details about the consequences of the firm's decisions.

Finance

The financial part of the BSG provides the opportunity to raise short and/or long term loans, issue shares and pay dividends.

Accounting

An activity run accounting system on a modifiable set of accounting items eliminates the necessity of recording the different accounting items and helps to identify different sets of accounting elements. Active learning processes are promoted by immediate access to the accounting part of business processes.

The BSG is a two language simulation. The accounting model allows a participant to evaluate the financial tables in both languages eliminating the problem of different cultures and regulations.

Throughout the game, the details of the decisions can be followed.

Two parallel processes are simulated. The first process is the production process, the second process is the marketing activity. In the production process the factory produces products and delivers them to existing warehouses of different markets. The parallel process is to sell the existing stock of products in different markets from the warehouses. Therefore the market influential factors affect the stock in the warehouses to sell them, while the production process is directed to producing an amount of products that will be delivered to the warehouses to the end of the period.

In automatic mode the computer simulates two artificial competitors, while in competitive mode the members of your groups are your competitor.

On-line help provides information about the basic knowledge in connection with the rules of the game.

Start the game with the command of "BSG" (Enter).

Enjoy the BSG!

Appendix VIII - Detailed Description of the Financial Table Building Process of BSG

General Ledger as a Basic File

The basic file is a general ledger. It can be stored in normal text (ASCII) file. An example is shown in Table A/8-1.

{Number	Name		
DBalance	Cbalance}		
{xxxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxx	xxxxxxxxxxxxxx|}
111	Rights as Possessions	0	0
112	Value of Firm	0	0
113	Mental Products (Software)	0	0
1141	1.prod. Value of Developments	738906	0
1142	2.prod. Value of Developments	0	0
1143	3.prod. Value of Developments	0	0
119	Immaterial assets depreciation	0	61575
123	Properties, Plants	100000000	0
129	Depreciation of Properties	0	2083335
131	Machines and equipment.	26000000	0
139	Depreciation of Equipment	0	1299999
151	Investments	0	0
211	"A" Material	4666721	0
212	"B" Material	0	0
213	"C" Material	0	0
214	"D" Material	5000060	0

TABLE A/8-1. PART OF THE GENERAL LEDGER

All accounts usually have an account number (Nilsson, 1994). These are numbers, used by companies like Excel and Datastream to identify and group different items on a financial statement. If a company in a country (for example in England) does not have or use account numbers in the normal accounting process, the problem can be solved by the introduction of a numbering system used by Continental Europe.

The first column comprises the numeric identifier of the account in a maximum of ten digits. The second column is the name of the accounts in 29 positions.

The third and forth columns are the Debit and Credit balance in 15 digits.

Programming Rules to Build Accounting Rules

The program permits the user to build rules with regard to the relationship of accounting items in different countries. The rules are only broadly common to all countries, for example how total manufacturing cost is arrived at. The transcription of the rules is also made possible due to the development of a higher level language which the program use. The user will give instructions to the program on this higher level language to instruct the base programs to create the financial statements in accordance to the country's specification. An example of this is the cost of sales in Table A/8-2. Initially the program builds up a set of basic accounting terms.

```
3. Cost of Sales
 811*.E - Domestic market cost
 8311.E - P.Soc. market cost
 8312*.T - Developing market cost
 8313*.E - Competitive market cost
```

TABLE A/8-2. HOW TO BUILD THE COST OF SALES FROM THE GENERAL LEDGER FILE.

The number of "3" following by a dot in the first row of Table A/8-2 means that this is the third element of the set of basic terms to build up from the general ledger. The digit of "3" is followed by the name of the factor.

The next line of the table starts with a space and after it there is a number followed by a star. This means that this line will comprise the values of all the accounts where the identifier of the account starts with "811". After the dot the sum type "E" is situated; that will be considered later in more detail. After the '-' sign there is the summary name of the group of accounts. The third line of the table shows that if there is only one account, the user can refer to it directly. The fourth line of the table comprises a different kind of value, marked by "T". This is another form of the account. Different types of values can be used during the process of model building. The type of values is determined by the letter before it, like the "T" in the previous example. In Table A/8-3 all types of values are shown.

T	Debit side
K	Credit side
E	Balance - absolute value
F	Debit balance - may be negative
G	Credit balance - may be negative
H	If Debit side > Credit side then Debit - Credit, otherwise : 0
I	If Credit side > Debit side then Credit - Debit, otherwise : 0

TABLE A/8-3. DIFFERENT KIND OF VALUES USED IN TABLE BUILDING

"T:" indicates the debit side, "K" the credit side of the account. The "E" means the absolute value of the balance. "F" indicates the necessary debit balance independent from the negative or positive sign of the value, while the letter "G" means the same in the case of a credit balance. The letter "H" means that if the debit side is bigger than the credit side of the account this value will be "Debit - Credit", otherwise zero. The letter "I" expresses the same meaning with regard to the credit side. These two letters allow the introduction of conditional accounts. An example of this would be, if an account could be situated either in the assets, or in the liabilities side, depending on the sign of the value of it. In the case of a greater debit side the account has to be in the assets side of the balance sheet, while in the case of greater credit side it has to be in the liabilities side. The user can build the same account into both sides of the balance sheet applying the letters of "H" and "I". The next example is about the deduction in Table A/8-4.

```
12. Creditors
 44*.E Creditors
 466.E- VAT Payed
 467.E  VAT Payable
 468.T- VAT Balance
 468.K VAT Balance
```

TABLE A/8-4. DEDUCTION FROM THE SUM

"Creditors" are composed of different elements. Some of them have to be deducted, and some of them have to be added to the main group. In this example the balance of the account of 466 and the debit side of the account of 468, (VAT balance) have to be deducted. For this purpose the user can use the "-" sign. This minus sign has to follow immediately the kind of sum. In this way the users can build basic factors from the general ledgers. Table A/8-5 presents the overall process.

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
{A - Basic data }
1. Revenue
 911*.E Domestic market revenue
 932*.E Developing market revenue
 933*.E Competitive market revenue
 467.E- VAT
2. Other revenue
 96.E Other revenue
3. Cost of Sales
 811*.E - Domestic market cost
 8311.E - P.Soc. market cost
 8312*.T - Developing market cost
 8313*.E - Competitive market cost
4. Not divided costs
 85.E - Not divided costs
.
.
.28. Issued Shares' capital
 302.E Shares
29. Intangible assets
 114*.E Values of Developed products
```

TABLE A/8-5. OVERALL STRUCTURE OF BASIC DATA

In the first line after the character of "{" there is a letter "A". This compulsory character has to remain there. It means that the following lines will refer to the Basic data. In the next section there will be a letter "C" after "{", that will indicate the Computed data, and so on.

Following the process of developing the basic factors, there is the possibility of creating more comprehensive groups that will be the different parts of the financial statements and ratios. An example is presented in Table A/8-6.

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
{C - Computed data }
C1. Short term Liabilities
 12. Creditors
 13. Wages and Salaries
C2. Assets
 29. Intangible Assets
 8. Machinery, equipment
 9. Build. & Equipm.
 10. Stocks
 11. Cash and Bank accounts
 12. Accounts Payable
```

TABLE A/8-6. BUILDING GROUPS FROM BASIC FACTORS

In this process only the factors, previously built in, can be used in a similar way. The deduction of factors is also possible, as before. An additional characteristic is the usage of outer parameters. Table A/8-7 depicts an example for both characteristics.

```
C7. Growth in Shares
 28. Issued Shares' Capital
 P7-. Opening value in Shares' Capital
```

TABLE A/8-7. USAGE OF OUTER PARAMETERS

In an outer parameter file the user can define separate data, not available in the general ledger. An example may be a regulation, that can consider the accounts receivable as loss after three month delay.

An example is shown for the deduction in Table A/8-8. In C3 the opening balance of debtors is deducted from the value of debtors.

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
{C - Computed data }
C1. Short term Liabilities
 12. Creditors
 13. Wages and Salaries
C2. Assets
 29. Intangible Assets
 8. Machinery, equipment
 9. Build. & Equipm.
 10. Stocks
 11. Cash and Bank accounts
C3. Growth in Debtors
 15. Debtors
 P3-. Debtors - Opening Balance
   ...
C7. Growth in Shares
 28. Issued Shares' Capital
 P7-. Opening value in Shares' Capital
```

TABLE A/8-8. OVERALL PICTURE OF COMPUTED DATA

After the basic data building the different statements and ratios can be built up.

Profit and Loss Account and Retained Earnings Statements

The process is mainly the same as before. Table A/8-9 depicts the first three rows of the Profit and Loss Account.

```
I1. Turnover or Sales
 1. Revenue
I2. Other Revenues
 2. Other Revenues
I3.   Total Sales
 I1+I2
```

TABLE A/8-9. PART OF THE PROFIT AND LOSS ACCOUNT

All the rows, beginning immediately with the character "I" will be the rows of Profit and Loss Account with exactly the same text. The number after it shows the serial number of the row. In the following line(s) there is a list of subparts of this overall value. Table A/8-5 contains the "Revenue" as the only element of the first row, the "Turnover or Sales" of income statement.

The text of "Total Sales" that begins with two additional plus spaces provides the opportunity to distinguish the values of rows from subtotals, or totals. In this example the value of "Total Sales" will be situated in different column. The possibility of addition (or deduction) is shown in the last row of Table A/8-9.

In Table A/8-10 some additional characteristics of Statement-building are presented.

```
I10.   Income Taxes
 14. Income Taxes
--
I11. Normalised profit after tax
 I9-I10
-
=Retained Earnings - Statement
```

TABLE A/8-10. OTHER CHARACTERISTICS OF MODEL BUILDING

If a row starts with the character "–", then the output list will underline the previous values, because of a part sum. See the row below "14". Below the "I11" there is an example of deduction. After this line there is a stand alone "-" character that means a line feed in the table. After it the "=" sign presents a main label in the statement. If somebody does not want the hyphen in the text, it is possible to delete it. These technical details have importance because of formal requirements.

In Table A/8-11 the overall picture of the model of the Profit and Loss Account is shown.

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
{I - Income- and Retained Earnings Statement }
I1. Turnover or Sales
 1. Revenue
I2. Other Revenues
 2. Other Revenues
I3.   Total Sales
 I1+I2
.
.
.
I14.   Total Revenue
 I12+I13
I15.   Dividends
 16. Dividends
--
I16.   Normalised Retention (Retained Earnings)
 I14-I15
```

TABLE A/8-11. OVERALL PICTURE OF PROFIT AND LOSS ACCOUNT

The output of Profit and Loss Account and Retained Earnings Statement are shown in Table A/8-12.

```
*************************************************************
                    PROFIT AND LOSS ACCOUNT
              For the year Ended 31 December, 1993
                   in thousands (Pounds)
*****************************************************************
 Turnover or Sales                          109126845
 Other Revenues                                     0
   Total Sales                                        109126845
 Costs of Sales                              91024019
 Other costs                                 45654960
   Total cost                                         136678979
                                                    ---------------
   Earnings before interest and tax                  (27552134)
 Interest paid                                      0
 Normalised pre-tax profit                  (27552134)
   Income Taxes                                               0
                                                    ---------------
 Normalised profit after tax                (27552134)

Retained Earnings - Statement
 Retained Earnings - Opening Balance                0
 Net Income                                 (27552134)
   Total Revenue                                      (27552134)
   Dividends                                                  0
                                                    ---------------
   Normalised Retention (Retained Earnings)           (27552134)
```

TABLE A/8-12. OUTPUT OF PROFIT AND LOSS ACCOUNT AND RETAINED EARNING STATEMENT

Balance Sheet

Some new forms are introduced in this part, that are also equally applicable in the case of the Profit and Loss Account, as depicted in Table A/8-13.

```
B9. Build. & Equipm. Depreciation
 7(. Build. & Equipm. Depreciation
 5(. Intangible assets Depreciation
B10.   Build. & Equipm.' net value
 B8-B9
B11.   Total Machinery, equipment and Build.
& Equipm.
 B7+B10
-Goodwill
B12.   Goodwill
```

TABLE A/8-13. NEW ELEMENTS IN THE FORM OF MODEL BUILDING

After the number 7 and 5 there is a "(" character. It means that these sums, created in point 7 and 5 will be in parenthesis, indicating a deduction. In the next row the sum of B9 is really deducted from the value of B8. Before the Goodwill there is a "-" sign that means practically the same as the "=" sign, but it is not a main label. There may be more "-" characters under one main label.

In Table A/8-14 there is an overall picture of the rules of the balance sheet.

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
{B -  Balance Sheet }
=Assets
-Current Assets
B1. Cash and Bank accounts
 11. Cash and Bank accounts
.
.
.
B13.   Total Assets
 B4+B11+B12
=Liabilities and Owner's equity
-Current Liabilities
B14. Creditors
 12. Creditors
.
.
.
B23.   Total Owner's equity
 B20+B21+B22
--
B24.   Liabilities and Owner's equity
 B17+B19+B23
-=================================
B25.   Working Capital
 B2+B3-B14
B26.   Capital Employed
 B13-B17+B16
```

TABLE A/8-14. OVERALL PICTURE OF BALANCE SHEET RULES

A double line with '=' separate the balance sheet from the two other factors. Table A/8-15 contains the output of the balance sheet.

**		
BALANCE SHEET For the year Ended 31 December, 1993 in thousands (Pounds)		
**		
Assets		
Current Assets		
Cash and Bank accounts	121215361	
Debtors	5572950	
Stocks	6444372	
Total Current Assets		232683
Machinery, equipment and Build. & Equipm.		
Machinery, equipment	26000000	
Machinery, equipment Depreciation	1299999	
Machinery, equipment net value		24700001
Build. & Equipm. and Intangible assets	100738906	
Build. & Equipm. Depreciation	2144910	
Build. & Equipm.' net value		8593996
Total Machinery, equipment and Build. &		123293997
Goodwill		
Goodwill		0

Total Assets		262526680
**		
Liabilities and Owner's equity		
Current Liabilities		
Creditors	156953889	
Wages, Salaries	0	
Short term loans	0	
Total Current Liabilities		156953889
Long term Liabilities		
Long term loans	0	
Total Long term Liabilities		0
Owner's equity		
Owner's equity	120000000	
Share Capital	13124925	
Retained Earnings	(27552134)	
Total Owner's equity		105572791

Liabilities and Owner's equity		262526680
==============================		
Working Capital		59812824
Capital Employed		250322182

TABLE A/8-15. BALANCE SHEET

Cash Flow Statement

Cash flow statement introduces a new form in Table A/8-16.

F9. Machine purchase (cash), product development
27-. Machine purchase (cash)
29-. Product development
F10. Cash Flow from investment activity
F9
-Cash Flow from financial activity
F11. Revenue from Issuing Shares (+)
C7. Growth in Shares
F12. Paying Dividends (-)
16(. Dividends

TABLE A/8-16. NEW FORMS IN CASH-FLOW STATEMENTS

In F9 there are two factors, the 27. and 29. basic data groups. They will have a negative sign in the statements later. It differs from the '(' sign (last row) because it is a negative value, not only written in parenthesis, as discussed in connection with Table A/8-13. The overall picture of the rules of cash flow statement is shown in Table A/8-17.

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
{F - Cash - Flow Statement }
-Net Cash Flow from current activity:
F1. Net Income
 I9
-Non Cash changes in Net Income
F2. Equipment' Depreciation               (+)
 6. Equipment' Depreciation
F3. Buildings  Depreciation                 (+)
 7. Buildings  Depreciation
F4. Growth in Debtors                       (-)
 C3(. Growth in Debtors
F5. Growth in Creditors                     (+)
 C4. Growth in Creditors
F6. Growth in Stocks                        (-)
 C5(. Growth in Stocks
F7. Growth in S.T.L. not Creditors          (+)
 C6. Growth in S.T.L. not Creditors
F8.   Net Cash-Flow from current activity
 F1+F2+F3-F4+F5-F6+F7
-Cash Flow from investment activity
F9. Machine purchase (cash), product development
 27-. Machine purchase (cash)
 29-. Product development
F10.   Cash Flow from investment activity
 F9
-Cash Flow from financial activity
F11. Revenue from Issuing Shares            (+)
 C7. Growth in Shares
F12. Paying Dividends                       (-)
 16(. Dividends
F13. Long term Loans
 22(. Long term Loans
F14.   Cash Flow from financial activity
 F11-F12+F13
--
F15.   Net Growth in Cash
 F8+F10+F14
```

TABLE A/8-17. OVERALL PICTURE OF CASH-FLOW STATEMENTS

The output of Cash Flow Statement is shown in Table A/8-18.

CASH - FLOW STATEMENT
For the year Ended 31 December, 1993
in thousands (Pounds)

Net Cash Flow from current activity:			
Net Income		(27552134)	
Non Cash changes in Net Income			
Equipment' Depreciation	(+)	1299999	
Buildings Depreciation	(+)	2083335	
Growth in Debtors	(-)	35572950	
Growth in Creditors	(+)	12204498	
Growth in Stocks	(-)	36444372	
Growth in S.T.L. not Creditors	(+)	0	
Net Cash-Flow from current activity			(83981624)
Cash Flow from investment activity			
Machine purchase (cash), product development		(26738906)	
Cash Flow from investment activity			(26738906)
Cash Flow from financial activity			
Revenue from Issuing Shares	(+)	90000000	
Paying Dividends	(-)	0	
Long term Loans		0	
Cash Flow from financial activity			90000000
Net Growth in Cash			(20720530)

TABLE A/8-18. CASH-FLOW STATEMENTS

Financial Ratios

The overall picture of the rules of Financial Ratios is shown in Table A/8-19.

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
{R - financial ratios }
= Liquidity ratios
R1. Current ratio
 B4/C1     { Total Current Assets /  Total Current
Liabilities }
R2. Acid test ratio
 B1/C1     { Cash and Bank account / Total Current
Liabilities }
 ...-
= Turnovers
R7. Debtors turnover
 I3/B2     { Total Revenue /  Debtors    }
R8. Stocks turnover
 I4/B3     { Cost of Sales / Stocks }
R9. Return of Fixed Assets
 I3/B11    { Total Revenue / Fixed Assets }
```

TABLE A/8-19. PART OF OVERALL RULES OF FINANCIAL RATIO

In the case of financial ratios the only new form is the possibility of division. The users have to write in brackets of "{}" the name of the elements to recognise the factors immediately.

The output of Financial Ratios is given in Table A/8-20.

```
*****************************************************************
                    FINANCIAL RATIOS
          For the year Ended 31 December, 1993
*****************************************************************
 Liquidity ratios
Current ratio                          1140.83%
Acid test ratio                         550.74%
Sales / Working Capital                  56.06%

 Return of Capital
Return of Investments (ROI)             (11.96%)
Income / Returns                        (25.25%)
Average  turnover of Assets              47.36%

 Turnovers
Debtors turnover                        306.77%
Stocks turnover                         249.76%
Return of Fixed Assets                   88.51%
```

TABLE A/8-20. FINANCIAL RATIOS

To express the statements in appropriate form, information about the companies is required. This set of information is designated identifiers.

Identifiers

The identifiers include the name of the country, the name of the company, the currency ratio (discussed later in this section) and the headers of the different financial statements and ratios. This additional set of information is shown in Table A/8-21.

{ These rows are valid if they begin with '=' sign, until the sign of '{'}
{ All rows beginning with '{' are comments.}
{ I means Income Statement, B = Balance Sheet, F = Cash Flow, R = Ratios }
=GREAT BRITAIN { Country }
=SAMPLE COMPANY { Name of the company }
=1 { Ratio, this currency/host currency }
=I { from this row to the next '=' sign an arbitrary heading }
PROFIT AND LOSS ACCOUNT
For the year Ended 31 December, 1993
in thousands (Pounds)
=B { from this row to the next '=' sign an arbitrary heading }
BALANCE SHEET
For the year Ended 31 December, 1993
in thousands (Pounds)
=F { from this row to the next '=' sign an arbitrary heading }
CASH - FLOW STATEMENT
For the year Ended 31 December, 1993
in thousands (Pounds)
=R { from this row to the next '=' sign an arbitrary heading }
FINANCIAL RATIOS
For the year Ended 31 December, 1993
in thousands (Pounds)

TABLE A/8-21. IDENTIFIER FILE

The ratio of the host and guest country's currency needs more explanation. If the General Ledger file contains data in the same currency that the financial tables need, the ratio is 1. In the case of different countries and rules the user has to determine the ratio of the two currencies. Let us assume that the ledger file contains data in pound sterling, and the guest country needs USA type financial tables (the rules are based on USA regulations). If one US dollar is sixty pence, the ratio is 1/0.6 = 1.667.

The software solution introduced in Section 7.6 of the theses allows the program to build up two countries financial statements with the program, specially designed for the BSG.

Reference

Nilsson, Stellan (1994) *Elements, User Groups and Qualitative Characteristics of Financial Statements*. University of UMEA, Sweden, Working Paper Series in Accounting and Auditing, Number 1, April.

Appendix IX - Share Transactions - Examples

These examples use parameters in Table 7-5, as basic figures.

Estimated value of the firm: 50.000.000;

Percentage for maximum sum of loans: 100.0;

Percentage for maximum loss: 20;

Goodwill value of this firm: 0.8958

An example of the determination of the value of shares, discussed in Section 7.9.4 is given below.

Maximum sum of loan = 50.000.000 * 1.00 = 50.000.000.

Maximum loss = 50.000.000 * 0.2 = 10.000.000.

Value of share = 50.000.000/1000 = 50.000.

The next example shows the issues of 200 shares. Transactions will take place, so that the estimated value of the firm will be modified with goodwill value:

50.000.000 * 0.8958 = 44.790.000.

Value of share = 44.790.000 / (1000+200) = 37.325.

Cash, derived from the transaction: 200 * 37.325 = 7.465.000.

If 200 shares are bought back:

Modified estimated value:

50.000.000 * 0.8958 = 44.790.000.

Value of share = 44.790.000 / (1000-200) = 55.987.

Cash, spent for the transaction: 200 * 55.987 = 11.197.400.

The financial model of the BSG ensures the basic financial possibilities to the company. The tools applied in the BSG promote the participants to practise the basic skills needed in a company in connection with shares and loans.

Umpire's guideline

Structure of the Game

The BSG is stored in the **DJ** subdirectory that is the abbreviation of the Hungarian name of the Business Game ("Döntési Játék"). All the other subdirectories (Adat, kepek, etc.) are stored under the **DJ** subdirectory. Six groups are allowed to play the BSG, and six companies can play in each group. At the initialisation process each company can settle to each computer, so each computer contains the places for all groups. **Adat**x subdirectory within the **DJ** contains the files to initialise the BSG for either the automatic or the competitive mode. The initialisation process copies the necessary files into **Adatok**x subdirectory. If there is only one group who wants to play the BSG, than the **Adat1** and **Adatok1** subdirectories are enough for storing data for the companies. The BSG can operate up to 6 companies, and the information about the company-number is stored in the appropriate files, as key variable.

Adatx subdirectory contains the following files:

- **o*.btr** - the initialisation files in case of a existing firm

- **u*.btr** - the initialisation files in case of a new firm
- **tm00.dta** - file for the division of production of the company amongst the product lines and types of products (not text file).
- **tterv00.dta** - file for the aggregate production planning of the company (not text file).
- **ac.fle** - file that shows the necessity of detailed accounting information ("y" or "n").
- **c_numb.fle** - contains all the important parameters that a game uses during the game.
- **crt.fle** - determines the place for the financial tables. "1" means the screen, "2" the printer (lpt1).
- **gw.fle** - file for initial goodwill for the companies, 1 for each.
- **gwm.fle** - file for initial goodwill of the existing companies, in automatic mode.
- **lang.fle** - the name of the country, initialised for the game.
- **param.fle** - necessary outer parameters for the game, especially for the financial tables
- ***.stm** - statement files for the existing firm.
- ***.tbl** - evaluation files for the existing firm

- **acdet.txt** - the detailed information of accounting process for the existing firms
- **ce.txt** - Control file that contains "Cash" if the firm has enough money to continue the game and "NoCash" otherwise.
- **curfok.txt** - the general ledger in a text file
- **detail.txt** - the details of the computation of financial statements of the company
- **rpm.txt** - details and explanations of the market behaviour
- **term.txt** - details and explanations of the production section
- **veh.veh** - the year and the month of the initialisation date (e.g., "1996 01")
- All the files are text files except for those where "not text file" is written.

Adatok*x* subdirectory contains the following files:

- ***.btr** - the files, necessary of the firm during the game
- **tmx.dta** - file for the division of production of the company *x* amongst the product lines and types of products (not text file).

- **tterv*x*.dta** - file for the aggregate production planning of the company *x* (not text file).
- **trans.f0*y*** and r.s0*y* - files for the goodwill and financial situation for each firm, where the *y* is the number of firm.
- ***.fok** - realisation for the accounting events

All the files are copied from the **Adat*x*** subdirectories. The other files in **Adatok*x*** have the same name then the others in **Adat*x***, with the same meaning.

Kepek subdirectory contains the language-dependent files of the BSG, from the viewpoint of the first language (default: Hungarian).

- ***.win** files - the help screens and menu information are stored in this file
- **AccBas**.fle contains the serial number and name of the accounts.
- **Acc_item.fle** comprises the accounting rules for the given country.
- **c_txt.fle file** - the texts, used during the game, are stored in the file.
- **lang.fle** - the name of the country

All the four files are text files and can be edited by a simple text editor, and they have to be saved again, as ASCII file.

Akepek subdirectory contains similar information for the second country.

Btrieve and Tplus subdirectories are the places for additional working files that are necessary for the operation of the BSG.

Operation of the Game

The construction of the game needs a floppy disk for the companies to be constantly in the driver. This floppy is used for storing the information of the companies. The saving procedure copies every file to the floppy disk. The reloading procedure can be applied in case of any failure.

Automatic Mode

The *Automatic mode* ensures a competition against two computer created competitors who are generated from the decisions of the company. They are planned to be sufficiently weak to be beatable to enhance the learning and motivation objectives of the BSG. The "auto-running" mode menu-point in the "Running" part of the BSG accomplishes the market-evaluation and the period's other activities, such as production, paying interest, wages. At the end of the "auto-running" there is an automatic saving to the floppy.

Competition Mode

The *competition mode* allows a competition against the other member of the group.

At the initialisation process the "jel.fle" file is generated (see more details in "Initialisation / Mode of the game") that ensures the co-ordinated process of the game.

- After the period's decision the "Preparing" menu-point copies the necessary files of the company into the floppy disk.
- The Umpire collects the disks where the number of the company is indicated on the floppy disk
- The "Running" menu-point is used to run the period and evaluate the firm's decisions. **It is imperative, that the computer, applied** for this purpose, **is one that the company use during the game!** The program asks for the number of companies participate in the business game at first. After this number the

running process starts with collecting the information from the disks. The period's decisions will be evaluated, and the information will be copied back to the floppies.

- The participants receive back the floppies and they have to use the "Renewing" menu-point to use all common information and to build the information needed into the company's management system.

Initialisation Process

The main information files are stored in the **dj\adat***x* subdirectory. The *x* means the group number. The group consists of the (maximum of) six companies. The "c_numb.fle" is stored with all the important parameters of the game.

Type of Game

The first letter in the "c_numb.fle" file determines the type of the game, "A" means *automatic* individual game and "V" means *competition*.

Automatic mode allows a participant to start a new and an existing enterprise in case of group 1 and firm 1.

In *competitive mode* the program places to the floppy disk of the user a "jel.fle" file that ensures the continuos and safe game.

The "jel.fle" contains the group number; company number and the number of month (+1).

In the second group at company 5 and in month 2 the "jel.fle" file is the following: 2053.

Password

In case of *competition*, only the Umpire is allowed to initialise the game, and at the beginning the program asks for the password of the Umpire. In the case of *automatic* mode the participants can initialise the game with their own password.

Password Modification

In the "Modifying password" menu-point the participants can modify their password to ensure that other persons can not change the decisions or can not gain unauthorised information about the firm. The default password is an empty string in case of each firm, that is a simple **Return** is sufficient to enter the game.

The Umpire can always enter every company's game with the umpire's password. The Umpire's password is set when the BSG is distributed to the Institution.

At the beginning of the password modification the group number is asked for. Entering the group number, the text of "Modifying password of the firm" appears on the screen. After this sentence the following possibilities are given:

Alt-F7: the Umpire can ask for the all passwords of the companies.

Alt-F8: the Umpire can ask for the all passwords of the companies and the Umpire's password.

Alt-F9: the Umpire can modify the Umpire's password.

Any other key: Modification of the companies' password.

Modification of the companies' password:

After entering the number of firm the password is has to be entered. If the original password is correct, the new password can be typed.

Appendix XI - Tables of Variables with Educational Forms

MAKE_DEC Make Decision by FORM Educational Form

FORM — Page 1 of 1

Count	Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
1 Not at all	23	1			24 10.9
2 Not	24	15	6	1	46 20.9
3 Neutral	5	24	9	2	40 18.2
4 Well	3	15	26	7	51 23.2
5 very well			14	45	59 26.8
Column Total	55 25.0	55 25.0	55 25.0	55 25.0	220 100.0

Chi-Square	Value	DF	Significance
Pearson	235.59486	12	.00000
Likelihood Ratio	239.35764	12	.00000
Mantel-Haenszel test for linear association	143.37017	1	.00000

Minimum Expected Frequency - 6.000

Number of Missing Observations: 0

TABLE A/11-1 CROSS TABULATION OF "MAKE DECISION" AND "EDUCATIONAL FORMS"

ASS_SITU Assess situation by FORM Educational Form

FORM — Page 1 of 1

ASS_SITU Count	Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
1 Not at all	27	4	3	3	37 16.8
2 Not	20	10	3	1	34 15.5
3 Neutral	7	25	14	1	47 21.4
4 Well	1	15	22	15	53 24.1
5 very well		1	13	35	49 22.3
Column Total	55 25.0	55 25.0	55 25.0	55 25.0	220 100.0

Chi-Square	Value	DF	Significance
Pearson	181.05773	12	.00000
Likelihood Ratio	189.65950	12	.00000
Mantel-Haenszel test for linear association	114.50394	1	.00000

Minimum Expected Frequency - 8.500

Number of Missing Observations: 0

TABLE A/11-2 CROSS TABULATION OF "ASSESS SITUATION" AND "EDUCATIONAL FORMS"

PRI_TSK Prioritaze task by FORM Educational Form

Page 1 of 1

Count / PRI_TSK	Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
1 Not at all	19	6	2	2	29 13.2
2 Not	12	12	4	5	33 15.0
3 Neutral	14	18	27	21	80 36.4
4 Well	9	16	13	17	55 25.0
5 very well	1	3	9	10	23 10.5
Column Total	55 25.0	55 25.0	55 25.0	55 25.0	220 100.0

Chi-Square	Value	DF	Significance
Pearson	51.27643	12	.00000
Likelihood Ratio	50.40480	12	.00000
Mantel-Haenszel test for linear association	34.40678	1	.00000

Minimum Expected Frequency - 5.750

Number of Missing Observations: 0

TABLE A/11-3 CROSS TABULATION OF "PRIORITISE TASK" AND "EDUCATIONAL FORMS"

MAN_TIME Managing Time by FORM Educational Form

Page 1 of 1

Count / MAN_TIME	Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
1 Not at all	22	9	8	5	44 20.0
2 Not	13	9	10	6	38 17.3
3 Neutral	14	20	16	12	62 28.2
4 Well	6	13	17	10	46 20.9
5 very well		4	4	22	30 13.6
Column Total	55 25.0	55 25.0	55 25.0	55 25.0	220 100.0

Chi-Square	Value	DF	Significance
Pearson	64.79636	12	.00000
Likelihood Ratio	61.98649	12	.00000
Mantel-Haenszel test for linear association	38.94831	1	.00000

Minimum Expected Frequency - 7.500

Number of Missing Observations: 0

TABLE A/11-4 CROSS TABULATION OF "MANAGING TIME" AND "EDUCATIONAL FORMS"

EFF_WRIT Effective writing FORM Educational Form

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EFF_WRIT	Count	Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
Not at all	1	12	5	15	22	54 25.0
Not	2	10	14	5	16	45 20.8
Neutral	3	10	18	14	11	53 24.5
Well	4	9	10	11	3	33 15.3
very well	5	13	7	9	2	31 14.4
Column Total		54 25.0	54 25.0	54 25.0	54 25.0	216 100.0

Chi-Square	Value	DF	Significance
Pearson	33.04420	12	.00095
Likelihood Ratio	36.63721	12	.00026
Mantel-Haenszel test for linear association	13.96199	1	.00019

Minimum Expected Frequency - 7.750

Number of Missing Observations: 4

TABLE A/11-5 CROSS TABULATION OF "EFFECTIVE WRITING" AND "EDUCATIONAL FORMS"

REFL_LIS Reflective listening by FORM Educational Form

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REFL_LIS	Count	Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
Not at all	1	16	4	11	14	45 20.7
Not	2	7	11	14	19	51 23.5
Neutral	3	6	19	15	14	54 24.9
Well	4	10	11	12	6	39 18.0
very well	5	16	9	2	1	28 12.9
Column Total		55 25.3	54 24.9	54 24.9	54 24.9	217 100.0

Chi-Square	Value	DF	Significance
Pearson	42.76667	12	.00002
Likelihood Ratio	46.57446	12	.00001
Mantel-Haenszel test for linear association	13.07350	1	.00030

Minimum Expected Frequency - 6.968

Number of Missing Observations: 3

TABLE A/11-6 CROSS TABULATION OF "REFLECTIVE LISTENING" AND "EDUCATIONAL FORMS"

SET_OBJ Set Objectives by FORM Educational Form

Count		Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
SET_OBJ						
Not at all	1	11	5	4		20 9.2
Not	2	17	10	5	2	34 15.6
Neutral	3	13	15	11	6	45 20.6
Well	4	12	19	22	25	78 35.8
very well	5	2	5	12	22	41 18.8
Column Total		55 25.2	54 24.8	54 24.8	55 25.2	218 100.0

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Chi-Square	Value	DF	Significance
Pearson	58.98146	12	.00000
Likelihood Ratio	64.38312	12	.00000
Mantel-Haenszel test for linear association	53.03923	1	.00000

Minimum Expected Frequency - 4.954
Cells with Expected Frequency < 5 - 2 OF 20 (10.0%)

Number of Missing Observations: 2

TABLE A/11-7 CROSS TABULATION OF "SET OBJECTIVES" AND "EDUCATIONAL FORMS"

CRE_PSOL Creative problem solving by FORM Educational Form

Count		Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
CRE_PSOL						
Not at all	1	18	1		1	20 9.1
Not	2	15	6	4	1	26 11.9
Neutral	3	15	19	11	5	50 22.8
Well	4	6	18	21	29	74 33.8
very well	5	1	11	19	18	49 22.4
Column Total		55 25.1	55 25.1	55 25.1	54 24.7	219 100.0

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Chi-Square	Value	DF	Significance
Pearson	102.07268	12	.00000
Likelihood Ratio	105.61853	12	.00000
Mantel-Haenszel test for linear association	70.91378	1	.00000

Minimum Expected Frequency - 4.932
Cells with Expected Frequency < 5 - 1 OF 20 (5.0%)

Number of Missing Observations: 1

TABLE A/11-8 CROSS TABULATION OF "CREATIVE PROBLEM SOLVING" AND "EDUCATIONAL FORMS"

SET_GOAL Set goals by FORM Educational Form

SET_GOAL (Count)	FORM: Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
1 Not at all	14	5	3	2	24 11.1
2 Not	13	8	13	6	40 18.4
3 Neutral	6	26	15	12	59 27.2
4 Well	14	12	15	26	67 30.9
5 very well	8	3	8	8	27 12.4
Column Total	55 25.3	54 24.9	54 24.9	54 24.9	217 100.0

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Chi-Square	Value	DF	Significance
Pearson	42.82207	12	.00002
Likelihood Ratio	41.32956	12	.00004
Mantel-Haenszel test for linear association	12.97153	1	.00032

Minimum Expected Frequency - 5.972

Number of Missing Observations: 3

TABLE A/11-9 CROSS TABULATION OF "SET GOALS" AND "EDUCATIONAL FORMS"

SOL_PSYS Solve problems systematically by FORM Educational Form

SOL_PSYS (Count)	FORM: Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
1 Not at all	13	2	3	4	22 10.1
2 Not	15	9	5	2	31 14.3
3 Neutral	11	19	10	10	50 23.0
4 Well	11	17	25	25	78 35.9
5 very well	5	7	11	13	36 16.6
Column Total	55 25.3	54 24.9	54 24.9	54 24.9	217 100.0

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Chi-Square	Value	DF	Significance
Pearson	42.12673	12	.00003
Likelihood Ratio	41.16028	12	.00005
Mantel-Haenszel test for linear association	25.69716	1	.00000

Minimum Expected Frequency - 5.475

Number of Missing Observations: 3

TABLE A/11-10 CROSS TABULATION OF "SOLVE PROBLEMS SYSTEMATICALLY" AND "EDUCATIONAL FORMS"

MAK_PRES Make presentation by FORM Educational Form

MAK_PRES	Count	Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
Not at all	1	22	2	11	23	58 26.6
Not	2	9	10	12	12	43 19.7
Neutral	3	12	12	13	14	51 23.4
Well	4	8	17	14	5	44 20.2
very well	5	4	14	4		22 10.1
	Column Total	55 25.2	55 25.2	54 24.8	54 24.8	218 100.0

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Chi-Square	Value	DF	Significance
Pearson	48.79736	12	.00000
Likelihood Ratio	56.03320	12	.00000
Mantel-Haenszel test for linear association	4.41876	1	.03555

Minimum Expected Frequency - 5.450

Number of Missing Observations: 2

TABLE A/11-11 CROSS TABULATION OF "MAKE PRESENTATIONS" AND "EDUCATIONAL FORMS"

PERSUAD Persuade by FORM Educational Form

PERSUAD	Count	Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
Not at all	1	17	2	4	6	29 13.4
Not	2	12	6	9	11	38 17.5
Neutral	3	13	13	17	13	56 25.8
Well	4	11	22	15	19	67 30.9
very well	5	2	11	9	5	27 12.4
	Column Total	55 25.3	54 24.9	54 24.9	54 24.9	217 100.0

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Chi-Square	Value	DF	Significance
Pearson	32.76963	12	.00105
Likelihood Ratio	32.22656	12	.00128
Mantel-Haenszel test for linear association	5.29972	1	.02133

Minimum Expected Frequency - 6.719

Number of Missing Observations: 3

TABLE A/11-12 CROSS TABULATION OF "PERSUADE" AND "EDUCATIONAL FORMS"

MAN_PEOP Managing people by FORM Educational Form

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MAN_PEOP	Count	FORM: Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
Not at all	1	24	11	16	18	69 31.8
Not	2	10	2	6	13	31 14.3
Neutral	3	9	15	17	10	51 23.5
Well	4	10	18	8	10	46 21.2
very well	5	2	8	7	3	20 9.2
	Column Total	55 25.3	54 24.9	54 24.9	54 24.9	217 100.0

Chi-Square	Value	DF	Significance
Pearson	27.73814	12	.00604
Likelihood Ratio	28.88257	12	.00410
Mantel-Haenszel test for linear association	.01693	1	.89647

Minimum Expected Frequency - 4.977
Cells with Expected Frequency < 5 - 3 OF 20 (15.0%)

Number of Missing Observations: 3

TABLE A/11-13 CROSS TABULATION OF "MANAGING PEOPLE" AND "EDUCATIONAL FORMS"

APP_PERF Appraise performance by FORM Educational Form

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APP_PERF	Count	FORM: Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
Not at all	1	18	5	4	4	31 14.5
Not	2	13	8	3	2	26 12.1
Neutral	3	14	17	19	10	60 28.0
Well	4	7	16	20	19	62 29.0
very well	5	2	7	7	19	35 16.4
	Column Total	54 25.2	53 24.8	53 24.8	54 25.2	214 100.0

Chi-Square	Value	DF	Significance
Pearson	57.36565	12	.00000
Likelihood Ratio	55.67272	12	.00000
Mantel-Haenszel test for linear association	40.76516	1	.00000

Minimum Expected Frequency - 6.439

Number of Missing Observations: 6

TABLE A/11-14 CROSS TABULATION OF "APPRAISE PERFORMANCE" AND "EDUCATIONAL FORMS"

DEV_PEOP Developing people by FORM Educational Form

DEV_PEOP (Count)		FORM: Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
Not at all	1	27	5	8	5	45 20.5
Not	2	15	3	11	5	34 15.5
Neutral	3	6	14	14	10	44 20.1
Well	4	6	20	9	20	55 25.1
very well	5	1	13	12	15	41 18.7
Column Total		55 25.1	55 25.1	54 24.7	55 25.1	219 100.0

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Chi-Square	Value	DF	Significance
Pearson	67.67466	12	.00000
Likelihood Ratio	70.19678	12	.00000
Mantel-Haenszel test for linear association	31.27706	1	.00000

Minimum Expected Frequency - 8.384

Number of Missing Observations: 1

TABLE A/11-15 CROSS TABULATION OF "DEVELOPING PEOPLE" AND "EDUCATIONAL FORMS"

FORECAST Forecasting by FORM Educational Form

FORECAST (Count)		FORM: Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
Not at all	1	15	8	9	3	35 16.1
Not	2	13	13	9	6	41 18.9
Neutral	3	12	12	17	13	54 24.9
Well	4	13	18	13	22	66 30.4
very well	5	2	3	6	10	21 9.7
Column Total		55 25.3	54 24.9	54 24.9	54 24.9	217 100.0

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Chi-Square	Value	DF	Significance
Pearson	23.74739	12	.02201
Likelihood Ratio	24.26601	12	.0187:
Mantel-Haenszel test for linear association	17.51662	1	.00003

Minimum Expected Frequency - 5.226

Number of Missing Observations: 3

TABLE A/11-16 CROSS TABULATION OF "FORECASTING" AND "EDUCATIONAL FORMS"

MEAS_OBJ Measuring objectives by FORM Educational Form

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MEAS_OBJ	Count	Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
Not at all	1	15	6	10	2	33 15.2
Not	2	10	9	10	5	34 15.7
Neutral	3	15	20	17	8	60 27.6
Well	4	12	15	13	24	64 29.5
very well	5	3	4	4	15	26 12.0
Column Total		55 25.3	54 24.9	54 24.9	54 24.9	217 100.0

Chi-Square	Value	DF	Significance
Pearson	38.99891	12	.00011
Likelihood Ratio	38.11083	12	.00015
Mantel-Haenszel test for linear association	21.56505	1	.00000

Minimum Expected Frequency - 6.470

TABLE A/11-17 CROSS TABULATION OF "MEASURING OBJECTIVES" AND "EDUCATIONAL FORMS"

SPE_PUBL Speak in public by FORM Educational Form

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SPE_PUBL	Count	Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
Not at all	1	23	2	7	17	49 22.5
Not	2	16	1	2	13	32 14.7
Neutral	3	12	14	17	15	58 26.6
Well	4	3	19	17	4	43 19.7
very well	5	1	19	11	5	36 16.5
Column Total		55 25.2	55 25.2	54 24.8	54 24.8	218 100.0

Chi-Square	Value	DF	Significance
Pearson	84.60127	12	.00000
Likelihood Ratio	95.21282	12	.00000
Mantel-Haenszel test for linear association	.87792	1	.34877

Minimum Expected Frequency - 7.927

Number of Missing Observations: 2

TABLE A/11-18 CROSS TABULATION OF "SPEAK IN PUBLIC" AND "EDUCATIONAL FORMS"

CONSNSUS Consensus by FORM Educational Form

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CONCNSUS (Count)		Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
Not at all	1	17	4	6	2	29 13.4
Not	2	17	6	7	5	35 16.1
Neutral	3	11	14	14	6	45 20.7
Well	4	10	17	19	25	71 32.7
very well	5		13	8	16	37 17.1
Column Total		55 25.3	54 24.9	54 24.9	54 24.9	217 100.0

Chi-Square	Value	DF	Significance
Pearson	54.94579	12	.00000
Likelihood Ratio	61.15119	12	.00000
Mantel-Haenszel test for linear association	35.99491	1	.00000

Minimum Expected Frequency - 7.217

Number of Missing Observations: 3

TABLE A/11-19 CROSS TABULATION OF "CONSENSUS" AND "EDUCATIONAL FORMS"

COALITON Form coalition by FORM Educational Form

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COALITON (Count)		Lecture 1	Seminar 2	Case Studies 3	Business Simulation 4	Row Total
Not at all	1	27	4	9	6	46 21.2
Not	2	11	9	11	13	44 20.3
Neutral	3	12	15	17	11	55 25.3
Well	4	4	19	14	15	52 24.0
very well	5	1	7	3	9	20 9.2
Column Total		55 25.3	54 24.9	54 24.9	54 24.9	217 100.0

Chi-Square	Value	DF	Significance
Pearson	48.37689	12	.00000
Likelihood Ratio	48.15263	12	.00000
Mantel-Haenszel test for linear association	17.38027	1	.00003

Minimum Expected Frequency - 4.977
Cells with Expected Frequency < 5 - 3 OF 20 (15.0%)

Number of Missing Observations: 3

TABLE A/11-20 CROSS TABULATION OF "FORM COALITION" AND "EDUCATIONAL FORMS"