Using Business Games in Teaching DSS

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ABSTRACT

In this study a business game is used as a vehicle for implementing decision support systems (DSS). Eighteen companies, consisting of ninety graduating M.B.A. students, participating in a business game were required to develop DSS and to report on the systems developed. Each of the eighteen companies developed a system of their own choosing, without external guidance. Individual questionnaires were later used to evaluate a number of relevant variables: use of systems, contribution of systems, association with systems and user satisfaction. Findings, compared with reported results of previous empirical study, exhibit differentiations in success of DSS between companies. This indicates the potential of using business games as an educational tool for teaching management information systems (MIS) and DSS.

Keywords: Business Game, Education, Teaching, Decision Support Systems, Simulation

1. INTRODUCTION

"You learn more about a person in an hour of play than in a year of conversation". This Plato's adage of learning from games is truly captured when games are employed as an educational tool. In the last decade, many business schools have been demanding major changes in the way of teaching: use of real-world applications, cases, spreadsheets, and collaboration with other functional areas, which can be described as "Learning by Doing". Teaching has also been experiencing a number of revolutions simultaneously: end-user computing, the world-wide-web, distance learning and cooperative learning (Erkut, 2000).

One of the contemporary used methods of teaching is learning with simulations or business games. Sometimes, the complexity and the cost involved in creating simulated environments encourage teachers to use the traditional learning methods rather than simulations or games. However, the educational effectiveness of business simulations is widely accepted and has been recognized in previous research (Cox, 1999; Michaelson et al., 2001; Parker and Swatman, 1999; Tomlinson and Masuhara, 2000; Yeo and Tan, 1999). With the improvement of technology, simulation exercises have become more sophisticated and user friendly. The student can now concentrate on the content and learning in the gaming exercise without getting too diverted by the mechanics of playing the game (Pillutla, 2003). Therefore, a method of learning through games, when adrenalin rush, active involvement and motivation are at their peak, may be used as a vehicle to get students to be excited about and to internalize the studied subject (Harper et al., 2000; Rieber, 1996; Parker and Swatman, 1999; Rafaeli and Ravid, 2003).

Furthermore, in the practical and field related MIS domain, the teaching of information systems is mainly based on lectures and cases and ignores important practice and implementation topics. Although the transition from theory to the ability and propensity to implement knowledge in an abstract area like management is not simple (Rafaeli et al., 2003), management students usually do not have the time and ability during their curriculum to take advanced courses in MIS and DSS design and where they can get a full appreciation of the MIS perspective and develop some practical skills. However, today's managers must become more familiar with the competences of contemporary hardware and software systems to better grasp the managerial viewpoint of MIS problems. We believe that the approach of using simulations to teach MIS to management students has significant advantages over other approaches (see also Courtney and Jenson, 1981; Courtney et al., 1978; Martin, 2000). The objective of this paper is to suggest general-purpose business games as an educational environment for learning and implementing MIS and DSS and to report on an experiment with one such game.

The paper is organized as follows: Section 2 reviews business game simulations. Section 3 explores the game employed in this study. In Section 4 we examine the implementation of DSS in the proposed game and analyze some related variables. In Section 5 we discuss the applicability of this study and draw some conclusions.

2. BUSINESS GAME SIMULATIONS

A general-purpose business game is, by definition, a highly complex man-made environment. Business simulation games are occasionally described in the literature. In 2001, a special issue of *Simulation & Gaming* (Volume 32, no. 4, 2001) was dedicated to the state of the art and science of simulation and gaming. Wolfe and Crookall (1998) assessed the state of simulation and gaming as a scientific discipline.

The objective of a business game is to offer students the opportunity to learn by doing in as authentic a management situation as possible and to engage them in a simulated experience of the real world (e.g., Garris et al., 2002; Martin, 2000). In most cases; this makes the business game impractical for controlled experimentation. However, it enhances the characteristics of the game as a simulation of real life, and behavior observed may be generalized to reality (e.g., Babb et al., 1966; Lainema and Makkonen, 2003).

In 2003, a special issue of *Communications of the ACM*, named "A Game Experience in Every Application", was dedicated to simulation games in diverse applications. Furthermore, over the years, researchers have reported the extent of usage of simulation games in academe and business (e.g., Asakawa and Gilbert, 2003; Dasgupta, 2003; Dickinson et al., 2004; Dickson et al., 1977; Eldredge and Watson, 1996; Faria, 1987, 1998; Haapasalo and Hyvonen, 2001; Larréché, 1987; Lucas and Nielson, 1980; Muhs and Justis, 1981). However, simulations created especially for research purposes are usually oversimplified and less realistic. Most involve only a single decision maker interacting with the computer program facing rather uncomplicated structured problems in a relatively restricted time period. For example, Brozik and Zapalska (2000) explored the "Restaurant Game", a single-period simulation that provides students the opportunity to plan and implement a strategy in a competitive environment. When playing the game, the game instructor can demonstrate how mathematical modeling leads to an optimal solution.

Furthermore, literature is mixed concerning empirical study results of DSS effectiveness in business games. Some researches provide no support for the premise that the use of Decision Support Systems improves group decision making effectiveness (Affisco and Chanin, 1989; Goslar et al., 1986; Kasper, 1985). For example, Many subjects, who played the Business Management Laboratory (BML) game, felt that it was not easy to comprehend and that "many of the decisions were ill-structured" (Courtney and Paradice, 1993). They also reported that too much time was dedicated for practicing the use of the system rather than the decision making.

Although the BML did not significantly affect group decision making performance, the business game method in general enables students to "learn by doing" (Garris et al., 2002). A business game provides students the opportunity to take on the roles and responsibilities of executives, to become deeply involved in decisions faced by real people in real organizations, to feel the pressure and to recognize the risks. Moreover, this method is an excellent tool to test the understanding of theory, to connect theory with application, and to develop theoretical insights.

Learning DSS with business games provides the students the opportunity to develop some useful skills: The game enables the students to develop analytical decision making skills by forming appropriate frameworks to analyze business situations, including problem identification skills; data handling skills and thinking skills. They can learn, using the DSS, how to generate different alternatives, to select decision criteria, to evaluate alternatives, to choose the best one and implement it. Moreover, they are forced to reason clearly and logically in sifting carefully through the available data. Furthermore, the game provides an opportunity to practice the tools, techniques and theories they have learned in previous classes.

As the game becomes the platform for the students to experience DSS, this study investigates these DSS with a focus on factors that affect their effectiveness. We also examine the dissimilarity between the developed systems. Information systems studies have used a variety of instruments to measure information systems effectiveness (e.g., Bharati and Chaudhury, 2004; DeLone and McLean, 1992, 2003; Goodhue, 1992; Ives and Olson, 1984; Reinig, 2003; Srinivasan, 1985). This study follows the procedure set by Ein-Dor and Segev (1984) in their study of an Israeli version of a business game known as the New York University Graduate School of Business Administration Management Game. Their study was conducted with only 6 companies during the fall of 1982. We follow their investigation and update their findings by extending their studied game to a much larger group. Although this study considers a different game, both games hold the same basic characteristics (e.g., a variety of executive functions, simulated environment, etc.).

3. HYPOTHESES AND METHODOLOGY

3.1 The game employed

This study employs the international version of a widely used business game developed in the United States and commonly known as the International Operations Simulation Mark/2000 (hereafter INTOPIA™). The prime purpose of this business game is to increase students' understanding of strategic management of international operations in general and those of the multinational corporation in particular. Furthermore, the game is designed to yield substantial payoff in general management training. It forces participants into a stream of truly entrepreneurial top management decisions of business philosophy and a search for logic and synergy in the business objectives-strategy-implementation sequence (Thorelli et al., 1995). We use the game to establish a managerial decision-making context: The game involves the students in the executive process, motivates their need for decision-making aids and forces them to adopt a managerial viewpoint associated with MIS and DSS.

The game is played for a full semester and is operated by up to 25 competing companies; the markets are similar to the markets in the United States (US), the European Union (EU) and Brazil, wherein each company can operate a local branch. "Operated" is a broad concept and covers any one or any combination of the functions of manufacturing, marketing of one's own products or selling to overseas distributors, serving as a distributor or a subcontractor, exporting, importing, financing and licensing. The incoming participants enter a "going concern" with 4 periods of simulated history and play 6 to 10 additional game-periods. The task of the companies is to make decisions which will guide operations (simulated by the easy to realize computerized system) in the forthcoming period and which will affect operations in subsequent periods.

Decisions are made once a week and are e-mailed to the game administrator to be fed to the computer program. After the program runs the data, it generates company outputs that include financial reports (e.g., a balance sheet, an income statement), production reports and market researches. These outputs are then e-mailed to the companies and are used for decision making in sequential periods. The length of the each time period simulated is usually referred to as one year. Dozens of decisions, covering the entire range of a typical business, are required of a company in each period. The decision-making process is based on an analysis of the company's history as presented to players at the beginning of the game, interaction with other companies and external agents of the game (e.g., bankers, board of directors), and the constraints stated in the player's manual (e.g., procedures for production, types of marketing channels available). Usually, each student is taking an executive role and is responsible for the decision making in his/her expertise domain and for the decision coordination with his/her colleagues in adjacent areas (e.g., the chief operations officer makes operation decisions and coordinates them with both the chief financial officer and the chief marketing officer).

The performance of a company in each period is affected by its past decisions and performance, the current decisions, simulated customer behavior, and the competition – the other companies in the industry.

The game has become highly realistic as a result of the efforts invested in it to simulate the total environment. Students participating in the game immerse themselves in this artificially created world. They form small teams, allocate responsibilities for specific functions, and work to achieve common goals which they themselves define. While each of them becomes a specialist in his or her function, a joint effort is required to pursue the common objectives of the company.

3.2 Subjects

The study was conducted at the Faculty of Management, Leon Recanati Graduate School of Business Administration, Tel-Aviv University. The participants were senior M.B.A. candidates. The sample studied was the entire group of 90 students who participated in the game during the spring semester of 2005. The students were divided into 18 companies, each with 5 participants.

The formation of the companies and allocation of executive roles within companies proceeded without external intervention or manipulation, and were reported to the game administrator before the game itself began. Our game experience shows that executive roles are usually allocated according to the participants' expertise in certain functional areas (e.g., accountants and bankers are usually assigned the role of chief financial officers).

3.3 Hypotheses

The main goal of this study is to measure the ability of business games to be used as an education tool for teaching DSS. However, we execute this research in an indirect way, i.e. by measuring the students' perceived benefits from using a DSS that supports business decisions. We focus this study on practical aspects of DSS and measure variables related to their use, user satisfaction, and success. Then, conclusions may be derived from the simulation to real businesses.

As we use a business game as a tool for teaching and implementing MIS and DSS to management students, we follow hypotheses examined by Ein-Dor and Segev (1984). The first hypothesis in this study relates variables in DSS studies to DSS effectiveness.

Many researchers in MIS have studied the effect of various variables on the success and failure of MIS (e.g., Bharati and Chaudhury, 2004; Ein-Dor and Segev, 1981; Goodhue, 1992; Ives and Olson, 1984; Reinig, 2003). In the DSS field, some studies have focused on the design, implementation and use of DSS (e.g., Ariav and Ginzberg, 1985; Keen, 1980). Common measured criteria of DSS success include system's reliability and flexibility (Srinivasan, 1985), the ability of a system to support decision-making and problem-solving activities (Garrity and Sanders, 1998), decision confidence (Goslar et al., 1986), use and user satisfaction (Baroudi et al., 1986; DeLone and McLean, 1992, 2003), and user perception of the system's value (Gallagher, 1974). In this study we examine the following DSS success variables: usefulness, user satisfaction, system contribution to functional area and company success, own use and colleague use.

Association of management with DSS (i.e., active involvement of management) has long been considered as contributing to, or perhaps even essential to, the success of DSS (Ives and Olson, 1984). In this study, association with DSS is evaluated on the basis of the students' familiarity with their company's system and their participation in defining it.

The first hypothesis relates to both individual and company level:

Hypothesis 1: The measures of success and active involvement present high and significant correlation between them.

The second hypothesis in this study relates DSS effectiveness variables to company performance:

Hypothesis 2: The measures of DSS success and active involvement are highly correlated with company performance.

As each company functions as a distinct entity in the game, we also examine the dissimilarity between the companies:

Hypothesis 3: Company differentiation in DSS: Variance between the companies is significantly different from the variance within the companies.

3.4 Procedures

At the beginning of the game, a requirement to develop and report on DSS was communicated to the participants. Each group (company) was required to submit a report on its developed DSS to the game administrator by a certain date. The report was to include the following items: (1) a definition of the scope of the system; (2) a decision analysis; (3) system design; and (4) a discussion of the contribution of the system to the game.

It is important to note that unlike in previous BML researches, this task was introduced as an organic part of the game in order to enhance the simulation, as the procurement, processing and communication of data and related support systems for decision making are of utmost importance in competitive business. The participants themselves, without any intervention from the game administration, had to decide who could develop the system and determine its scope. The students had the opportunity to modify their systems during the game, if needed. Nevertheless, none of the companies reported major modifications.

At the end of the semester, after the last set of decisions had been made, each group was required to present its DSS in class and describe its contribution in achieving the group's objectives during the game. At that same meeting, each of the students was asked to complete a short questionnaire on the DSS assignment. It was pointed out that the DSS presentation and the fulfillment of the questionnaire would have no effect on companies or individual grades; students were encouraged to respond fully and accurately (see the appendix for the text of the questionnaire).

4. NOTIONS AND FINDINGS

4.1 Developed Systems

The 18 companies developed different DSS, mainly Microsoft's Excel spreadsheet-based. The major characteristics of the systems developed are exhibited in Table 1.

For this study, the most important aspect of Table 1 is the extent to which the companies differed on the dimensions relevant to research on MIS. Different companies approached different application areas with models including various statistical analyses, spreadsheets, and even linear regressions. Only one company employed a package ("Easy Plan"). Eight companies developed complicated data analysis tools (mostly statistical or engineering analyses) for their systems. Of the 18 systems developed, ten were interactive and eight were batch. Only four companies developed graphic outputs, while the remaining fourteen did not. Finally, the sophistication and complexity of the models employed varied enormously from simple spreadsheet analyses (companies 5 and 7) to a complex linear model (company 4). While it cannot be claimed that the distribution of attributes of systems exactly measures that in the real world, the degree of diversity of systems developed, based on existing tools, does appear to be very real.

Figures 1 and 2 present a sample of such systems. Figure 1 demonstrates the market analysis conducted by company 1 in the 6th played period. In Part I of Figure 1 a market analysis of the US area is presented. Company 1 mainly operated in the US market and therefore, a full analysis of prices, models, market share and ending inventory was entailed. Part II of Figure 1 is making a detailed analysis of the company's units in the US market: opening inventory, sales during the period, new production units and ending inventory. In Part III of Figure 1 an aggregated analysis of all companies' activities in all areas is exhibited (sold quantities, world market share and ending inventory world-wide).

Figure 2 illustrates a DSS use made by company 15. It shows the total sales (in units) in all three markets: the US, the EU and Brazil. Company 15 also affixed a linear trend line to each market, which is highly correlated with each market total sales ($R^2 \cong 0.92$). These graphs helped Company 15 in making predictions of future sales in each market.

4.2 Analysis

In order to enhance the validity of results of this study, they were compared to previous findings reported by Ein-Dor and Segev (1984). As MIS and DSS variables can be measured either objectively or subjectively, in this study the compared data is participants' subjective assessments.

The analysis of the data related both to individuals and to companies. Company's data in this study aggregate the individual data of the company's members, and is conducted in order to determine whether the participants in the game coalesce into distinguishable companies. The criterion for differentiated companies was the degree to which the behavior of individuals within companies was more consistent than that for randomly chosen individuals. This will be elaborated in Section 4.5.

First, the customary variable in DSS studies, degree of success, is analyzed. Next, association with DSS is explored. Then, company performance is analyzed with regard to the developed DSS. Finally, we discuss company differentiation. Companies are represented in this study by average responses of members to the questions. Questions are based on the Likert scale (Likert, 1932) from 1 to 7. The internal consistency among the items, Cronbach's alpha (Cronbach, 1951), is 0.8165 at the individual level and 0.8274 at the company level. Cronbach's alpha for the measures of success was 0.8452 at the individual level and 0.8561 at the company level. Finally, Cronbach's alpha for the measures of active involvement was 0.8794 at the individual level and 0.8903 at the company level. Means and variance of responses to the first 10 questions are exhibited in Table 2.

When discussing behavioral aspects of information systems, it is common to distinguish between two major roles – users and implementers (Ein-Dor and Segev, 1984). Users are those managers for whom the systems are designed, constructed and operated. Implementers are the managerial and technical workforce who provides those systems.

Given the nature of this game, it did not seem feasible to distinguish between those two groups. All students were potential users of the DSS and most students participated, one way or another, in defining or constructing them. Therefore, results should be treated with caution, as the students were asked to analyze and evaluate the systems they developed themselves.

4.3 Success of DSS

In this section we examine the following six DSS success variables:

1. Usefulness of the system as evaluated by participants (question 2).
2. Own use by respondents (question 3).
3. Use by colleagues (question 6).
4. The system's contribution to the company's performance in respondents' functional areas (question 4).

Co.	System Area	Nature of System	Data Analysis	Interactive	Graphics
1	Production, Finance, Market Analysis	Electronic Sheet	Yes	No	No
2	R&D, Production, Finance, Marketing	Electronic Sheet	No	Yes	Yes
3	Production, Finance, Market Analysis	Electronic Sheet	Yes	Yes	No
4	R&D, Production, Finance, Marketing, Market Analysis	Electronic Sheet, Regressions	Yes	Yes	No
5	Production, Finance	Electronic Sheet	No	No	No
6	R&D, Production, Finance, Marketing, Market Analysis	Electronic Sheet	Yes	Yes	No
7	Production, Finance	Electronic Sheet	No	No	No
8	R&D, Production, Finance, Marketing, Market Analysis	Electronic Sheet	Yes	Yes	No
9	Production, Finance	Electronic Sheet	No	Yes	No
10	Production, Finance, Marketing	Electronic Sheet	No	Yes	No
11	R&D, Production, Finance, Marketing	Electronic Sheet	No	Yes	No
12	R&D, Production, Finance, Market Analysis	Electronic Sheet, Regressions	Yes	No	No
13	R&D, Production, Finance	Electronic Sheet	No	No	Yes
14	Marketing, Market Analysis	Electronic Sheet, Regressions	Yes	Yes	No
15	Finance, Marketing, Market Analysis	Electronic Sheet	Yes	No	Yes
16	Production, Marketing	Electronic Sheet	Yes	No	Yes
17	Production, Finance	Easy Plan, Electronic Sheet	No	No	No
18	Finance, Marketing	Electronic Sheet	No	Yes	No

Table 1. Characteristics of Systems Developed by Companies.

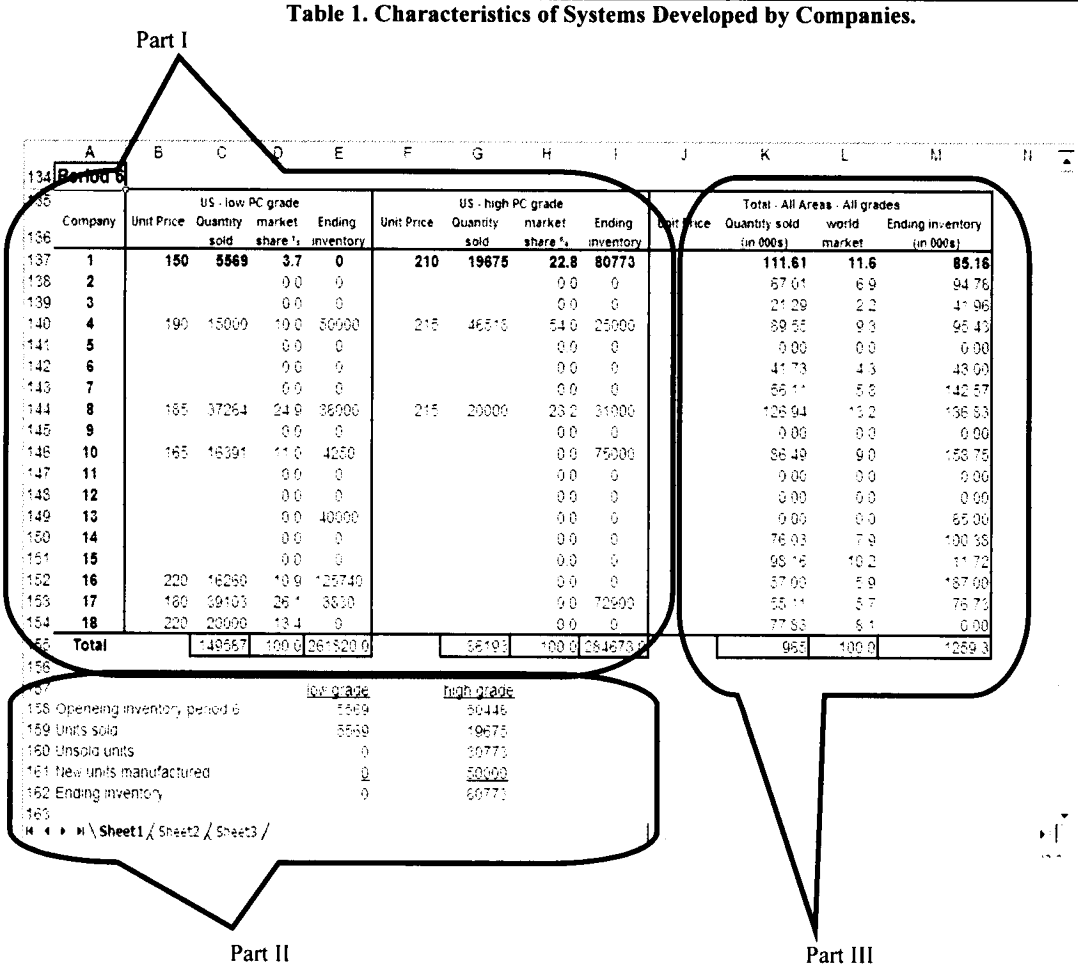

Figure 1. A Sample of DSS developed by Company 1.

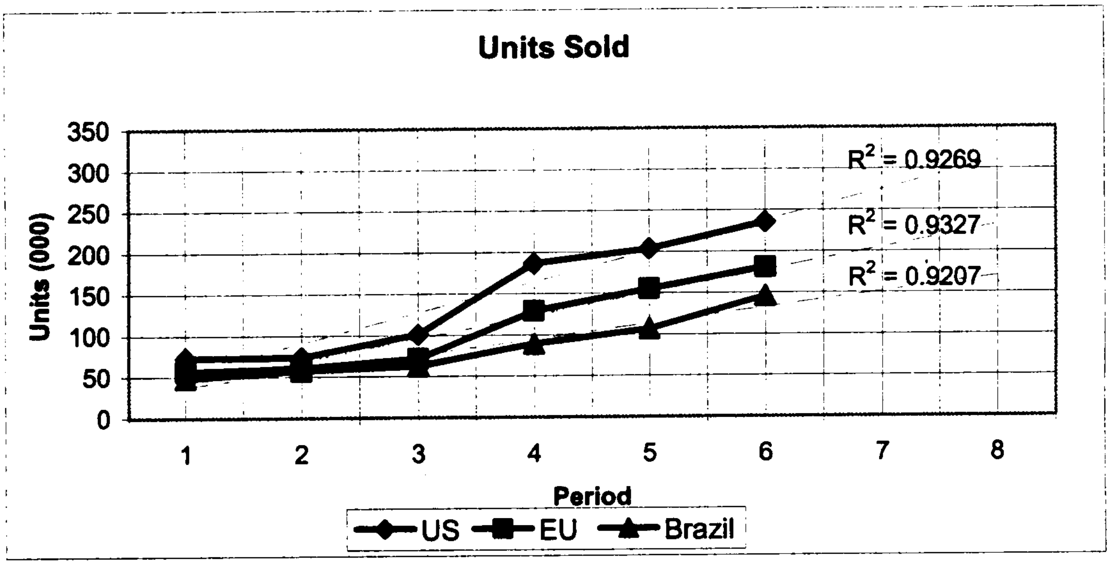

Figure 2. A Sample of Graphical Market Analysis made by Company 15

Variable	Individuals (n=90)		Companies (n=18)	
	Mean	S.D.	Mean	S.D.
Familiarity	5.53	1.29	5.48	0.76
Usefulness	5.46	1.10	5.32	0.87
Own use	5.12	1.47	5.04	0.90
Contribution to functional area	5.17	1.46	4.98	1.07
User satisfaction	5.05	1.37	4.83	1.10
Use by colleagues	5.00	1.11	4.96	0.61
Contribution to company success	5.12	1.30	4.99	1.07
Participation	4.64	1.93	4.67	1.02
Disturbance	2.93	1.95	2.91	0.76
Met expectations	4.71	1.60	4.48	1.36

Table 2. Means and Standard Deviations of Responses for Individual and Companies

	Use		Contribution		User satisfaction
	Own Use	Use by Colleagues	Functional area	Company success	
Usefulness	0.408	0.439	0.64	0.661	0.717
	p=0.001	p<0.001	p<0.001	p<0.001	p<0.001
Own use		0.033	0.656	0.369	0.283
		p=0.403	p<0.001	p=0.002	p=0.015
Colleague use			0.271	0.418	0.385
			p=0.019	p<0.001	p=0.001
Contribution to functional area				0.603	0.564
				p<0.001	p<0.001
Contribution to company success					0.691
					p<0.001

Table 3. Relationships between Criteria of DSS Success for Individual Respondents.
Table entries: Spearman's rho correlation coefficient
Significance level

5. The system's contribution to the company's overall success (question 7).
6. User satisfaction (question 5).

In this study we adopt the approach taken by Ein-Dor and Segev (1984), which regards all success criteria as being co-determined and does not assume cause-and-effect relationships between them. The data obtained from this business game is compared to their findings based on this approach.

Table 3 exhibits all correlations between the success criteria for individual respondents in this study, as defined above, and reveals strong and highly significant relationships between all of them, except for the correlation between own use and colleague use. The strong correlations found would seem to indicate that the criteria are indeed all related and presumably all measure some aspect of success. The lack of mathematical correlation between the own use and the colleague use variables does not imply that those two variables are not correlated. A detailed analysis revealed that participants were divided into two major categories, by companies: companies where all members had a relatively high use of the systems developed (a highly positive correlation between own use and use by colleagues) and companies where only one or two members used the system (a highly negative correlation between own use and use by colleagues). This caused the average correlation between the two variables to become small.Table 4 demonstrates all correlations between the success criteria at the company level. It appears that there are very strong correlations between the measures of success at the level of companies. Note that the grouping procedure by companies largely increased the correlation between own use and use by colleagues. The finding that the correlations are not always highly significant can be attributed to the relatively small number of companies in this study. Even so, an examination of the relevant data indicates that in most cases the relationships are significant. Thus, the data in the study strengthen the hypothesis concerning the nature of success and failure of DSS and replicates previous empirical findings.

4.4 Association with DSS

In this section, we examine the following two associations with DSS variables:

1. Familiarity with the company's system (question 1).
2. Participation in defining the system (question 8).

In studying general association with MIS, Swanson (1974) found that appreciation and involvement with MIS are co-produced so that managers who are involved will be appreciated and those who are uninvolved will be unappreciated. He regarded understanding as an intervening variable through which involvement is transformed into appreciation. In this study, there is a high correlation of 0.829 (significance<0.001) between familiarity and participation; familiarity is the equivalent of Swanson's understanding, and involvement, or participation, is strongly associated with it. Thus, familiarity and participation are jointly used as measures of association. At the company level, the correlation between familiarity and participation is 0.864 (significance<0.001). These correlations are even higher than the correlations found in the previous business games study by Ein-Dor and Segev (1984), who reported of correlations of 0.68 and 0.45, respectively.

Previous studies also found that DSS are more successful where top management is more involved (e.g., Baroudi et al., 1986; Willoughby and Pye, 1977). The relationships between the measures of association and the success of DSS at both the individual and company level are exhibited in Table 5.

The table indicates that at both individual and company level there is a fairly significant relationship between the measure of own use and association with DSS. However, other measures of success present more tenuous relationship with association with DSS. Moreover, familiarity is significantly more related to the measures of success than participation. Thus, the results of this study only partially conform to previous reported findings.

4.5 Company Performance Analysis

This section examines company performance versus all DSS measured variables. In this game, a company's performance was measured by its accumulated retained earnings. By the

	Use		Contribution		User satisfaction
	Own Use	Use by Colleagues	Functional area	Company success	
Usefulness	0.402	0.628	0.7	0.73	0.802
	p=0.052	p=0.003	p=0.001	p<0.001	p<0.001
Own use		0.287	0.56	0.318	0.267
		p=0.124	p=0.008	p=0.099	p=0.142
Colleague use			0.409	0.449	0.457
			p=0.046	p=0.031	p=0.028
Contribution to functional area				0.583	0.631
				p=0.006	p=0.002
Contribution to company success					0.792
					p<0.001

Table 4. Relationships between Criteria of DSS Success for Companies

Table entries: Spearman's rho correlation coefficient
Significance level

end of the game, all companies made nominal profit, but not all made real profit. According to the game results, company 14 won the game while company 18 came in last. Table 6 exhibits the correlations between company performance and all DSS measured variables of this study. Correlation was made for the company level.

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The results indicate that five variables are strongly related to the company's performance: system's usefulness, user satisfaction, contribution of the DSS to the diverse functional areas and the entire company success and whether the DSS met its expectations. It seems that the greater the satisfaction from the developed system in meeting its intended aim as set by the users, the better the company's performance in the game.

Nevertheless, the two variables related to the participation of users in defining the DSS present negative correlation with the company's performance. It seems that added involvement in developing the DSS impairs performance.

Furthermore, we measured a correlation of 0.29 between the number of functions the DSS cover (e.g., production, finance, market analysis) and the companies' performance. Moreover, there is a correlation of 0.29, 0.15 and 0.01 between the companies' performance and their DSS use of data analysis tools, interactivity and graphics, respectively.

To summarize, it can be claimed that a successful DSS in the eyes of the users is related to a better company performance in the game. However, investing a lot of human resources in developing a complicated system, that makes use of several features, does not necessarily guarantee an enhanced company performance.

Criterion of Success	Individuals (n=90)		Companies (n=18)	
	Familiarity	Participation	Familiarity	Participation
Usefulness	0.326	0.219	0.13	0.15
	p=0.012	p=0.293	p=0.604	p=0.604
Own Use	0.772	0.686	0.75	0.626
	p<0.001	p<0.001	p<0.001	p<0.001
Use by colleagues	0.111	0.217	0.051	0.18
	p=0.403	p=0.098	p=0.841	p=0.475
Contribution to functional area	0.477	0.349	0.37	0.13
	p<0.001	p=0.007	p=0.129	p=0.618
Contribution to company success	0.173	0.16	0.134	0.11
	p=0.189	p=0.225	p=0.294	p=0.350
User satisfaction	0.167	0.114	0.10	0.091
	p=0.296	p=0.428	p=0.478	p=0.514

Table 5. Relationships between Measures of Association with DSS and Criteria of DSS Success for Individuals and Companies

Table entries: Spearman's rho correlation coefficient
Significance level

Variable	Correlation
Familiarity	0.01
Usefulness	0.59
Own use	0.18
Contribution to functional area	0.59
User satisfaction	0.85
Use by colleagues	0.37
Contribution to company success	0.74
Participation	-0.21
Disturbance	-0.03
Met expectations	0.69

Table 6. Correlation between Company Performance and All Measured Variables

4.6 Company Differentiation

Ein-Dor and Segev (1978) indicated that the organizational and external environments of information systems are recognized as one of the factors impacting the success and failure of information systems. Environments factors also present some of the major obstacles to DSS research since they are uncontrollable for all practical purposes. Furthermore, companies' environments are so complex that a full description is infeasible. As a result, these factors invariably cloud the meaning of data collected in trans-organizational comparisons of DSS.

One of greatest advantages of the business game is the common and controlled external environment it provides for all participating companies. In spite of the identity of initial situations significant differences in DSS emerged by the end of the game. The data on differences of content between systems are contained in Table 1. Table 7 exhibits the analysis of variance, by companies, for each variable in the questionnaire. The data indicate that, for 5 of the 10 variables, the variance between companies is significantly different (at the .05 level) from the variance within companies.

Variable	F value	Sig. of F
Familiarity	0.995	0.482
Usefulness	2.029	0.033
Own use	1.261	0.265
Contribution to functional area	2.034	0.032
User satisfaction	3.534	0.000
Use by colleagues	0.859	0.621
Contribution to company success	3.483	0.001
Participation	0.918	0.559
Disturbance	0.354	0.988
Met expectations	3.757	0.000

Table 7. Analysis of Variance of All Variables by Companies

There is a degree of consensus within companies as to their success. For two measures of success, the level of performance and the user satisfaction, results exhibit highly significant F values, indicating that the variance of responses within companies are appreciably smaller than those between companies. The third measure of success, the system's use, does not exhibit low variance of responses within companies. This can be attributed to the fact that some companies introduced a relatively high use of the systems developed by all members, while other companies performed with only one or two members using the system.

To summarize, it can be claimed that differentiated companies emerged from the game. The differences cannot be artifacts of the environment, which is common to all. Thus, the business game permits the analysis of differences in DSS in organizational contexts unhindered by uncontrollable external environmental influences.

5. DISCUSSION AND CONCLUSIONS

Simulated companies were formed in this study. Although the general environment was mutual to all participants, the companies became differentiated. Each assumed considerably different strategy, different operating decisions, and a different approach to DSS. Leaving to the companies the decision on areas of DSS development resulted in a variety of applications, utilizing an array of models, programs, and modes of operation. It appears that these companies reflect most real life business approaches to DSS.

In addition to the creation of simulated companies with differentiated approach to DSS, this study also tested three hypotheses. All three hypotheses were mostly confirmed, replicating a number of previous findings. Overall, results at both the individual participant and the company levels underscore the validity of conclusions derived from the simulation to real businesses, notwithstanding the relatively small sample size. Hence, the business game may be used as a vehicle for implementation of MIS and DSS.

Moreover, the game provides an environment of decision-making under uncertainty using the aid of DSS. As it continuously provides feedback from task performance, the game allows students experience the need of relevant information to improve on performance. The game also encourages students to use theoretical concepts learnt through formal lessons and applying them to support their problem solving activities. In addition, the game can help students achieve not only technical capability, but also a managerial perspective of problems. As more and more businesses install enterprise resource planning (ERP) systems, those who are able to create applications that interface with these systems and analyze the data they provide will become increasingly valuable (Ragsdale, 2001). The ultimate result will be more successful MIS and DSS systems in the real world.

Furthermore, DSS is sometimes viewed as strictly an information system subject. Many business schools have reduced their DSS course offerings in recent years in favor of more "hotter" issues, such as e-commerce. Traditionally, one of the greatest challenges of teaching DSS has been the lack of readily-available and integrated DSS creation tools, making it difficult to move from theoretical discussions about DSS to more practical aspects of building a DSS (Ragsdale, 2001). Nowadays, even the frequently used spreadsheets are sufficient tools to create extremely powerful and useful DSS. Employing the business game method provides a strategic opportunity to switch the studying of DSS from theoretical concepts to more practical and relevant contexts and consequently, enhance its applicability in real life applications, not restricted only to the information systems field.

In the examined game, most of the companies developed a spreadsheet-based DSS. Although some may regard those spreadsheets as too simplified DSS, our study showed that complicated systems do not guarantee better company performance. Moreover, spreadsheets offer some substantial pedagogical advantages: Many students today are familiar with spreadsheets tools so they can quickly employ them for the development of a DSS. Spreadsheets also allow students a dynamic data updating and an easy development of data visualization. Also, spreadsheets today hold some powerful data analysis tools (e.g., Analysis ToolPak in Excel). Out of the 18 teams, 9 incorporated data analysis tools into their DSS.

Teaching DSS with business games has a major advantage over both the case and lecture methods: the students are more excited, motivated and become actively involved in the decision-making process in the game and in the development of MIS and DSS of their choice. It also provides additional practicality and illustration of the interrelationships between the decision-making process, the designed information system and the outcomes of its use. Moreover, it exemplifies how decision-making is more successful using DSS.

The findings of this study shed light on the question: "*Why should business games be used as educational tools in teaching DSS?*" The answer has several aspects: (a) Business games give students a chance to practice the art of decision making in a laboratory setting, with little corporate and personal risk involved. The students experience their first actual DSS development training rather than being provided with sanitized descriptions. The game offers the students the experience of DSS that is otherwise unattainable away from the real world. It provides an integrative view of some of the tasks and practical uses of DSS. In essence, business games are to management students what cadavers are to medical students, the opportunity to practice on the real thing harmlessly. (b) The simulation forces the students to think for themselves and generate their own learning. The students are actually engaged in a process of learning how to learn. (c) Students can experience the strong relationship between the usage of DSS, its usefulness and its contribution to the company's performance. Moreover, they can explore the diversity of developed systems, employing different application models, in a mutual competitive environment. (d) Managers seldom have access to all the information pertinent to decisions. Likewise, the developed DSS seldom contain all the information the students would like to have. Thus, they are forced to make decisions with the available information, thereby helping them tolerate incompleteness of information and ambiguity.

However, although feedback from students is favourable, and the game is sufficiently complex to provide challenges and a realistic simulation of decision making, no business game can seize all aspects of information systems. As the game decisions are more simplistic than those of the "real-world", the DSS required to support the decisions are less complicated than those in reality. In general, however, our overall conclusion is that the proposed method of teaching information systems is better than the case or the lecture approach. Yet, there is a need to determine how business games can be applied in studying various aspects of the DSS domain: use and performance can be easily measured and evaluated, but the cost/benefit or return of investment of a specific information system is as vague in the game as it is in real life.

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APPENDIX

Questionnaire – Decision Support Systems Report

The following questions relate to the Decision Support System, which was developed in your company. Please indicate your answers:

		Not at all	To a very small degree	To a small degree	To a degree	To a large degree	To a very large degree	Maximally
1.	I am familiar with the DSS developed in the company	1	2	3	4	5	6	7
2.	The system is useful for decision making	1	2	3	4	5	6	7
3.	I personally used the system for making decisions in my role in the company	1	2	3	4	5	6	7
4.	The system contributed to the company's performance in my functional area	1	2	3	4	5	6	7
5.	I am satisfied with the system	1	2	3	4	5	6	7
6.	My colleagues in the company used the system for decision making	1	2	3	4	5	6	7
7.	The system contributed to the company's success	1	2	3	4	5	6	7
8.	I participated in defining the system	1	2	3	4	5	6	7
9.	Developing the system interfered with my functional role in the company	1	2	3	4	5	6	7
10.	The system's benefits met my expectations	1	2	3	4	5	6	7

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