Developments in Business Simulation and Experiential Learning, Volume 32, 2005

VALIDATING BUSINESS SIMULATIONS: DOES HIGH PRODUCT QUALITY LEAD TO HIGH PROFITABILITY?

A. J. Faria
University of Windsor
Ad9@uwindsor.ca

William J. Wellington
University of Windsor
R87@uwindsor.ca

ABSTRACT

Among the nine major strategic influences on profitability reported as part of the ongoing stream of PIMS research is that a business firm's product quality has a strong positive impact on all measures of financial performance. This finding is based on an examination of the performance history of over 3,800 companies contributing data on a yearly basis to the Strategic Planning Institute. A major concern of simulation users through the years is how realistic are business simulation games. Numerous validation studies on business simulations have examined game validity. The product quality and profitability levels of 451 product-based SBUs from 152 different simulation companies competing in 33 industries within a business simulation game were examined. It was found that product quality and profitability levels as measured by ROI were significantly and strongly positively correlated (.576) as suggested by the PIMS findings.

INTRODUCTION

It has now been nearly 50 years since the first use of a business simulation game in a university class in 1957 (Watson 1981). Since that time, the number of business simulation games and their use in university classes has grown enormously. Presently, in the U.S. alone, over 200 business games are in use at over 1,700 universities and community colleges by approximately 11,000 business teachers (Faria 1998). In an e-mail survey to 14,497 business faculty members at American Assembly of Collegiate Schools of Business institutions, it was reported that 47.7 percent of all respondents are currently using or had used a business simulation game during their teaching careers (Faria and Wellington 2004). Empirical research in the area has been extensive. Comprehensive reviews can be found in Greenlaw and Wyman (1973), Keys (1976), Wolfe (1985), Miles, Biggs and Shubert (1986) and Randel, Morris, Wetzel and Whitehill (1992).

Despite the widespread use of business games, an ongoing issue of concern is whether or not participation in a simulation game is a meaningful experience. This paper introduces another measure that might be used for assessing the relative merit of business game participation that relates to the outcomes reported over the past forty years from the ongoing PIMS project as now administered by the Strategic Planning Institute. Specifically, this study examines the outcomes from two different simulation games to determine, as reported by PIMS, if product quality is positively related to high profitability.

PAST RESEARCH

Meaningfulness, as applied to the business simulation gaming experience, has taken on a number of interpretations as reflected in past research including: (1) the learning, or skills training, aspects of business games; (2) the relative merit of business games versus other teaching approaches; (3) the external validity of business simulation games; and (4) the internal validity of business games.

Research into the skills training or learning aspects of business simulations dates back to the first uses of business games in university classes. The reported types of learning brought about by the use of business games include goal setting and information processing; organizational behavior and personal interaction skills; sales forecasting; entrepreneurial skills; financial analysis; basic economic concepts; inventory management; mathematical modeling; personnel skills such as hiring, training, leading and motivating; creative skills; communication skills; data analysis; formal planning and report preparation; and much more. Faria (2001) provides a history and complete list of references covering research on skills training through the use of business simulation games.

The merit of simulation games versus other teaching approaches has been investigated by a number of researchers (Greenlaw and Wyman 1973; Keys 1976; Snow 1976; Waggener 1979; Wolfe 1985; Miles, Biggs and Schubert 1986; Hall 1987; Spect and Sandline 1991; Washbush and Gosenpud 1991; Randle, Morris, Wetzel and

Whitehill 1992; Wolfe 1997). Several comprehensive reviews, as cited earlier, have summarized the bulk of these comparative studies. Across all of the reported studies, simulation games were found to be more effective teaching tools, as measured by performance on course final exams, than conventional instructional methods (generally cases and lectures) in 75 of the research comparisons, conventional methods of instruction were found to be superior in 27 of the comparisons, while no differences were reported in 58 of the comparisons.

The external validity of a business simulation game has generally been viewed as a measure of how well the business game models

the real-world industry in which the simulation takes place (Carvalho 1991). In a classroom setting, two approaches have been used to examine the external validity of business games. The first approach has focused on the correlation between a business executive's simulation game performance and his/her real-world performance. If the simulation game is externally valid, a successful business executive should also be successful when participating in the simulation competition. A number of studies of this nature have supported the external validity of business games. The best of these studies can be found in Wolfe and Roberts (1986).

The second approach to measuring external validity employs a longitudinal research design. In this approach, a student's business game performance is compared to some measure of subsequent business career success (e.g., number of promotions, salary level, etc.). Using this approach, two comprehensive studies have reported such a correlation (Wolfe and Roberts 1986; Wolfe and Roberts 1993).

The internal validity of business simulations has also been measured in two ways. The first approach basically states that if a simulation exercise is to be considered internally valid, better students should outperform poorer students. Several studies have supported this view of the internal validity of business games (see Wolfe 1987 for one of the better studies and an overview of other research on the internal validity of business games). A second, and possibly more reasonable view of internal validity, examines whether participant decisions in a simulation competition, over time, conform to the environment of the simulation. While the dynamics of the simulation and the actions of competing companies will influence participants' decisions, the simulated environment must be considered and, *ceteris paribus*, participant decisions should adapt to the simulation environment. If this type of adaptive decision-making takes place, the simulation exercise may be considered internally valid. Past research of this type has been only moderately supportive of the internal validity of business games. The most thorough study of this nature, which contains an overview of all past research on internal validity, can be found in Wellington and Faria (2001).

PRODUCT QUALITY AND PROFITABILITY

The PIMS (Profit Impact of Marketing Strategies) project was initiated in the 1960s within the General Electric Company. In order to expand the program, the project was moved to the Harvard Business School in 1972 and, to facilitate the further expansion of the program, the Strategic Planning Institute was formed in 1975 to administer the project.

The PIMS program is a multi-company research project designed to gather marketing and financial information on a number of different business firms for analysis purposes. Each member company of the PIMS project submits information about its business conditions to the Strategic Planning Institute each year. The PIMS' staff members analyze the data to search for general laws that seem to govern the business environment (Henderson 1980). Currently, there are over 3,800 businesses contributing data to the Strategic Planning Institute each year.

Based on many years of research, and through hundreds of publications on their findings, the Strategic Planning Institute has put forth nine basic findings on business strategy. The one that we are concerned with in this paper is, "In the long run, the most important single factor affecting a business unit's performance is the quality of its products and services, relative to those of competitors" (Buzzel and Gale 1987, p. 7). Buzzel and Gale (1987) go on to state that, "There is no doubt that relative perceived quality and profitability are strongly related. Whether the profit measure is return on sales or return on investment, businesses with a superior product/service offering clearly outperform those with inferior quality" (p. 107).

In the most common format of classroom simulation gaming, participants are grouped into companies, and companies are grouped into industries. Companies within a given industry compete against one another for a share of the served market and the resulting profitability. Given this situation, within any business simulation game in which competing companies are able to improve product quality, it would be easy to examine the product quality/profitability relationship that occurs in the simulated competition and to check whether the outcomes conform to the PIMS findings. If they do, the simulation exercise can be deemed to be meaningful and realistic with respect to real world business findings.

In a similar type of study to the present one, Green and Faria (1995) examined the results from a simulation competition with regard to another PIMS principle. Among other conclusions reported as part of the many studies published by the Strategic Planning Institute, a central principle states that business strategies are successful if their fundamentals are good, unsuccessful if they are not. The implication from this is that strategies that are successful in one marketplace/economic environment will continue to be successful in a similar environment even if the firm's competitors are changed (Buzzel and Gale 1987).

To test this principle in a simulation environment, Green and Faria (1995) removed the winning companies (highest earning companies) in 25 separate, five team, simulation industries, after the completion of a three year (twelve period) competition, and moved them to a different industry which still contained the remaining four companies. All twelve (three years) of simulation decisions were then re-run. In 18 of the 25 (72%) of the re-runs, the original winning team and, hence, unchanged winning decisions/strategy, once again emerged as the winner. And the winning team once again emerged as the winner even with four new competitors who were, presumably, following different strategies. In another three industries within the Green and Faria (1995) study, the original winning team came in second. These results strongly supported the view, within the simulated competition utilized, that a fundamentally sound strategy remains a fundamentally sound strategy in a similar environment even if competitors are changed as suggested by the PIMS findings.

Yet another PIMS principle reported states that "Market share and profitability are strongly related" (Buzzel and Gale 1987, p. 8). To test this principle in a business simulation environment, Faria and Wellington (2004) examined the performance results of 440 simulation companies, divided into 96 industries, playing two separate simulation games. The market shares of all 440 competing companies and their end of game profitability were examined. The results reported by Faria and Wellington (2004) showed that market share, whether measured as unit market share, dollar market share, or relative market share, was strongly correlated (at the .00 level) to profitability. Thus market share and profitability were found to be highly correlated to profitability in the two simulation games used in the Faria and Wellington (2004) research. This, again, conforms to the real world findings from the PIMS project.

While not the purpose of their research, House and Taylor (1991) reported a number of findings from a review of student performance in two different simulation games. Among the conclusions stated by House and Taylor (1991, p. 137) were that, "It was found that market share and plant expansion were important determinants of profitability in the executive game….In the business game environment, market share has a negative, short term impact on profitability…." This suggests one example of conformity to the PIMS findings and one example of nonconformity across two separate simulation game environments. The bulk of past research, though, tends to support the external validity of the business simulation games that have been studied. The current study will add to this body of knowledge.

HYPOTHESIS

Based on the research cited above, the following general hypothesis is put forth for testing.

H1: Product quality and company ROI will be strongly and positively correlated (Pearson's r > .5) in a simulation game competition.

Past simulation research has suggested that business simulation games possess external and internal validity. The little available research to date, suggests that selected business simulation games conform to several of the major PIMS findings. Given these findings, and the findings reported from the ongoing PIMS project, it would seem, then, that product quality for companies in a simulated business environment would be strongly correlated with company ROI.

The selection of Pearson's r > .5 is based on the assertion by Buzzel and Gale (1987, p. 7) that product quality and ROI are strongly correlated and on Cohen and Cohen (1983, p. 61) who state that Pearson's r values of .50 or more are considered "strong effect sizes", while r values between .30 and .50 are considered "medium effect sizes", and r values between .10 and .30 are considered "small effect sizes".

DATA COLLECTION AND ANALYSIS

Data were collected on 451 product based SBU's from 152 simulation companies competing in 33 industries that participated in an advanced marketing simulation game titled ***COMPETE: A Dynamic Marketing Simulation*** (Faria, Nulsen and Roussos 1994).

The data from the ***COMPETE*** competition were collected from companies that were involved in seven separate classroom competitions administered by three different instructors spanning the time period from September 2003 through April 2004. Each participating ***COMPETE*** company is divided into three SBUs. One product line SBU of each company sells large screen televisions (TSTs), a second SBU produces and sells computerized video editors (CVE)s, while the third SBU produces and sells a laser game line of products (SSLs). Given 152 student simulation companies there were 456 potential SBUs available for analysis. However, five of the companies elected not to market the SSL line meaning that data for only 451 SBUs was available for analysis. The data available to assess the profitability by product line included: unit and dollar sales by region, product prices by region, unit production expenses by region including overtime, research and development expenditures, inventory carrying costs by region, advertising expenditures by region and product quality. Companies could improve the quality of their products through successful R&D efforts. Additionally, common sales force expenses for the whole company were available and these were allocated to each product line by sales volume. Using this data, a profit margin by product line-SBU was calculated for each firm in each industry. Finally, each ***COMPETE*** firm begins with an equal level of plant and equipment (valued at $50 million on each firm's beginning balance sheet) and this was designated as each firm's total investment and was equally

divided among the three product lines to represent capital investment of $16.67 million in each SBU. ROI was calculated as the SBU profit margin divided by the investment in the SBU.

The data were analyzed using the correlations program from SPSS P.C. Version 10. Correlation coefficients were computed to compare the relative product quality of all 451 SBUs with the computed ROI of the SBU. In addition, the correlation between ROI and product quality for SBUs marketing the same product type was also computed to examine the relationship of product quality and profitability within product line SBUs.

FINDINGS

The findings from the data analysis are reported in Table 1. The results shown in Table 1 indicate that three of the four correlations between the SBU's relative product quality and ROI were significant and that the power to detect the resultant correlations with a .01 level of significance was .93 or better in all four cases (Cohen and Cohen 1983, p. 528). The findings indicate that for the ***COMPETE*** simulation game, the relationship between relative product quality and ROI for the 451 SBUs was strong (r value of .576). As such, the hypothesis that product quality and ROI are strongly related within this simulation exercise would be accepted. The performance outcome in the simulation game utilized in this study demonstrates a "strong" relationship between product quality and ROI which conforms to the findings as reported from the PIMS project.

While the relationship between product quality and ROI was strong overall across all companies and SBUs, when examining outcomes within SBUs the findings vary. While the correlation between relative product quality and ROI is highly significant within the TST and SSL SBUs, it is only moderately significant within the CVE SBU. This may not be surprising, nor is this finding contrary to those reported by PIMS. PIMS does not report findings within similar industries but reports findings across all companies regardless of products sold or markets served. In other words, what PIMS is reporting is similar to the All SBU results reported in Table 1 and this relationship is highly significant as would be expected from the PIMS findings.

DISCUSSION AND CONCLUSIONS

Based on the findings from this study, the performance outcomes of the participant teams comprising the 451 SBUs examined provide evidence of a "strong" relationship between relative product quality and ROI. This finding supports the acceptance of the study hypothesis and conforms to the findings reported by PIMS. When the product line SBUs were analyzed separately, the findings were less significant.

The explanation for the variance in these findings is believed to have arisen from two measurement issues. Firstly, the variation in product quality across different firms within a product line might be expected to be less than variations in product quality across different firms and different product lines. Secondly, the major notion behind PIMS is that there are universal laws in the market place. A comparison among different SBUs in different industries would be expected to uncover these "universal" laws.

In conclusion, the performance outcome with regard to relative product quality and ROI within the simulation game examined in this study did fit the PIMS findings of a "strong" and statistically significant relationship between product quality and ROI. As such, the ***COMPETE*** simulation, and likely many others used within our business classes, conform to yet another of the PIMS standards. This once again provides further validation of the use of business simulation games for teaching purposes.

REFERENCES

Buzzel, R.D. & Gale, B. T. (1987). *The PIMS Principles: Linking Strategy to Performance*. New York: The Free Press.

Carvalho, T. A. (1991). Evaluating Computerized Business Simulators for Objective Learning Validity. *Simulation & Gaming*, 22, (2), 328-347.

Cohen, J. & Cohen, P (1983). *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*, Hillsdale, New Jersey: Erlbaum Press, 25-78.

Faria, A. J. (1998). Business Simulation Games: Current Usage Levels. *Simulation & Gaming*, 29, (3), 295-308.

Table 1: Pearson's r Correlations Between Product Quality Index and ROI by SBU

SBU Type	N	Pearson's R	Significance
All SBUs	451	.576	.000
TST SBU	152	.470	.000
CVE SBU	152	.119	.144
SSL SBU	147	.230	.005

Faria, A. J. (2001). The Changing Nature of Business Simulation/Gaming Research: A Brief History. S*imulation & Gaming*. 32, (1), 97-110.

Faria, A. J., Nulson, R. O. and Roussos, D. S. (1994). *COMPETE: A Dynamic Marketing Simulation*, Fourth Edition, Boston, Richard D. Irwin, Inc.

Faria, A. J. & Wellington, William (2004). A Survey of Simulation Game Users, Former-Users, and Never-Users. *Simulation & Gaming*. 35, (2), 178-207.

Faria, A. J. & Wellington, William (2004). Validating Business Simulations: Does High Market Share Lead to High Profitability? *Developments in Business Simulation & Experiential Learning*, Association for Business Simulation and Experiential Learning, 332-336.

Green, D. & Faria, A. J. (1995). Are Good Strategies Consistently Good? *Developments in Business Simulation & Experiential Learning,* Association for Business Simulation and Experiential Learning, 31-37

Greenlaw, P.S. and Wyman, F. P. (1973). The Teaching Effectiveness of Games in Collegiate Business Courses. *Simulation & Games*, 4, (2), 259-294.

Hall, D. R. (1987). Developing Various Student Learning Abilities via Writing, the Stock Market Game, and Modified Marketplace Game. *Developments in Business Simulation and Experiential Learning*, Lane Kelley and Pat Sanders (eds.), Association for Business Simulation and Experiential Learning, 84-87.

Henderson, Bruce (1980). *The PIMS Program*. Cambridge, MA: The Strategic Planning Institute.

House, W. C. & Taylor, L. A. (1991). Critical Success Ratios: A Comparison of Two Business Simulations in a Multi-Year Environment. *Developments in Business Simulation & Experiential Exercises*, Association for Business Simulation and Experiential Learning, 137.

Keys, B. (1976). A Review of Learning Research in Business Gaming. *Developments in Business Simulation and Experiential Learning*, C. E. Neilsen (ed.), Association for Business Simulation and Experiential Learning, 76-83.

Miles, W.G., Biggs, W. D. & Schubert, J. N. (1986). Student Perceptions of Skill Acquisition Through Cases and a General Management Simulation. *Simulation & Games*, 10, (1), 75-86.

Randel, Josephine, Morris, B.A., Wetzel, C. D. & Whitehill, B. V. (1992). The Effectiveness of Games for Educational Purposes: A Review of Recent Research. *Simulation & Gaming*, 23, (3), 261-276.

Snow, C. C. (1976). A Comment on Business Policy Teaching Research. *Academy of Management Review*, 1, (2), 133-135.

Spect, L. B. & Sandlin, P. K. (1991). The Differential Effects of Experiential Learning Activities and Traditional Lecture Classes in Accounting. *Simulation & Gaming*, 22, (1), 196-211.

Waggener, H. A. (1979). Simulation vs. Case vs. Text: An Analysis of Student Opinion. *Developments in Business Simulation and Experiential Exercises*. Bernard Keys (ed.), Association for Business Simulation and Experiential Learning, 113-118.

Washbush, J. B. & Gosenpud, J. J. (1991). Student Attitudes About Policy Course Simulations. *Developments in Business Simulation and Experiential Learning*, Walt Wheatley and J. Gosenpud (eds.), Association for Business Simulation and Experiential Learning, 105-110.

Watson, H. J. (1981). *Computer Simulation in Business*, New York: John Wiley & Sons.

Wellington, W. & Faria, A. J. (2001). An Investigation of the Environmental Awareness Attained in a Simple Business Simulation Game. *Developments in Business Simulation and Experiential Learning*, Association for Business Simulation and Experiential Learning, 239-249.

Wolfe, J. (1997). The Effectiveness of Business Games in Strategic Management Course Work. *Simulation & Gaming*, 28, (4), 360-376.

Wolfe, J. (1987). The Effects of Game Complexity on the Acquisition of Business Policy Knowledge. *Decision Sciences*, 9, (1), 143-155.

Wolfe, J. (1985). The Teaching Effectiveness of Games in Collegiate Business Courses: A 1973-1983 Update. *Simulation & Games*, 17, (3), 251-288.

Wolfe, J. & Roberts, C. R. (1986). The External Validity of a Business Management Game. *Simulation & Games*, 17, (3), 45-59.

Wolfe, J. & Roberts, C. R. (1993). A Further Study of the External Validity of Business Games: Five Year Peer Group Indicators. *Simulation & Gaming*, 24, (1), 21-34.