ARE THE BUSINESS SIMULATIONS WE PLAY TOO COMPLEX?

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"***Things should be made as simple as possible, but not any simpler***" (Einstein)

ABSTRACT

U. S. Business games were born as small, experiential exercises in the 1940s and 50s, but with the advent of electronic computers and the birth of the American Management Association's GENERAL MANAGEMENT BUSINESS SIMULATION (THE MOSE COMPANY) in 1957, these games became computerized and evolved very large and large and complex. That is, the simulations were designed modeling oligopolies with only a few identical competing firms that required making many decisions regarding the finance, marketing, production, and managing of a firm selling a product or set of products over a few (6 to 12) rounds of play. The players (managers) were to make decisions and establish a set of overall corporate strategies to guide their decision making for the relatively few rounds that were to be completed. When the decisions and strategies included many of the functional areas of a firm, the games were deemed: "Total Enterprise Simulations." As mainframe computers became more sophisticated and faster, the business simulations were saddled with more and more decisions, but the teams still made decisions using the same number of rounds of play.

While there were a few gamers who saw the limitations of large business simulations, in general this concept was little noticed until the advent of the microcomputer with its limited memory and speed of calculations. However, one particular professor, Dr. Ronald Frazer, presented a number of papers at ABSEL supporting the concept of small business simulations. He thought that students would learn more by participating in several, limited purpose games, each of which would only require from one to a few days of effort to play, than when they played a total enterprise simulation that requires an entire semester of effort.

This paper re-explores the logic of Professor Frazer's premise in the light of still newer technologies, the current reliance on very large and complex total enterprise business simulations and recent research findings regarding the relative outcome evaluations of teams that play these oligopoly type total enterprise simulations.

INTRODUCTION

The first business game to be used in a university class took place at the University of Washington in 1957 (Watson 1981); over the period between 1957 and 1961, collegiate business simulations proliferated. Wolfe (1993, referencing Kibbee, Craft and Nanus, 1961) reported that, "*By 1961, however, over 100 business games had been created…" (*Quote from page 452). Zuckerman and Horn (1973) described 26 computerized total enterprise games, 15 "man-only" total enterprise games and 42 business specific games. They listed 197 business oriented games but did not describe them in any way; they did however, explain why these specific games were not included in the described set of games.

The computerized games in general, were quite complex. In order for a business simulation to have face validity, it has seemingly been the goals of business game designers to have their games take on as many features of firms in the practitioner world as possible, thus reproducing realism. As computers have grown in capacity, games have become more and more complex in their attempt to replicate realism.

The issue of realism and complexity has been a longstanding research topic. As early as 1961, Kibbee addressed this issue by writing that the object of business simulation used for education and training was not to exactly replicate a business problem, but to provide some general principles that could be used in solving the problems shown by the simulations. Kibbee explained, "*What is far more important in most management games is verisimilitude: the degree to which the players feel the simulated situation is rea*l," (Quote from page 9.) Thus, according to Kibbee, the issue is or should be, face validity; not factual validity.

Computerized business games became very complex early in their development. Zuckerman and Horn (1973) described the American Management Association's GENERAL MANAGEMENT BUSINESS SIMULATION, copyrighted in 1957, which required 12 to 15 hours of participant preparation time and, depending on the number of rounds played, from 3 to 20 hours of playing time. They described the CARNEGIE TECH MANAGEMENT GAME copyrighted in 1964 as requiring 50 to 100 hours of preparation time and 12 months of classroom playing time

as a minimum. The DECISION MAKING EXERCISE copyrighted in 1970 was described as requiring 15 to 20 hours of preparation time and 75 to 150 hours in playing time. All the computerized total enterprise simulations described in Zuckerman and Horn's 1973 book, except for one, were for the college level or above students or executives. Two additional compendiums of simulations and games were written: Horn, (1977), *The guide to simulation/games for education and training*, (3rd Edition) and Horn and Cleaves (1980), *The Guide to Simulations/Games for Education and Training*, (4th Edition).

Zuckerman and Horn also described 15 man-only or non-computerized total enterprise simulations; all but 4 were for college level or above students. The college student and executive level games, while the stated objectives and the decisions were described in the same terms as the computerized games, consumed much less time. The authors of this paper would suggest that this indicates that the simulations were much less complex that their computerized brethren. Zuckerman and Horn described the WASHINGTON UNIVERSITY BUSINESS GAME by Niland and Towie, copyrighted in 1969 as requiring no player preparation time and 4 to 10 hours of playing time divided into 25 to 30 minute periods. The EXECUTIVE SIMULATION GAME by Heier, (no copyright date) was described as requiring 1 to 2 hours of preparation time and 4 hours of playing time in 15 minute periods. The MANAGEMENT DECISION SIMULATION by Vance, copyrighted in 1960 required 3 hours of preparation time and 10 playing periods of 30 minutes per week.

Clarkson College was an early pioneer in using business simulation games in the curriculum of its business school. It constructed a laboratory for simulation gaming in 1960. Professor J. Ronald Frazer utilized this laboratory during his career at Clarkson (Frazer 1981). The college's first games were hand scored, but by the 1970s, the college began to use time sharing techniques to put their business simulation games "on-line."

COMPLEXITY AND REALISM MAY NOT BE AN ADVANTAGE

Springer et al (1965) wrote that "*The power of a model in solving a problem comes precisely from its not corresponding to reality except in those details pertinent to the problem at hand.*" (Quote from page 178). This overly realistic issue may be seen in a very simple example. A traveler needs to review a road map. This traveler has two maps available to him/her; a map with a scale ratio of 100:1 and a map with a scale ratio of 250,000:1. Obviously the 100:1 map is far more "realistic." But, which map will the traveler select? I do not think the 100:1 map would be selected. The 100:1 map would show the location of every tree, sign-post and fence post. This simple example demonstrates that overly realistic models may not be the best way to solve a problem, even very complex problems. Norris (1986) suggested that when using a business simulation in an educational or a training environment, the primary objective is learning.

The underlying problem of complex games may lie in the limitations of the human mind. Miller (1956) reported on his research about the fundamental abilities of humans to process information. He noted that seven simultaneous concepts (plus or minus 2) were the general limit for human comprehension. Compare this "magical" number seven to the number of decisions and interactions in large, complex total enterprise simulations being used in classrooms and training sessions. These authors would support the theory that such complex games are beyond participants' scope of learning.

There seems to be a commonly held view that complexity is "*a good thing*." Yet, one benefit of using models to represent the real world is that, through *abstraction* and *simplification* of reality, it is possible to focus on a *specific* problem.

As early as 1973, evidence was being assembled that learning experiences gained from the use of complex business games might not be as effective as was once assumed. Greenlaw and Wyman's (1973) research concluded that there was little evidence that the use of business games was superior or even adequate when compared to other forms of instruction. Maybe the games selected for this study were too complex for the students and they did not comprehend the causes and effects of their business decisions. The complexity aspect was not considered in Greenlaw and Wyman's research, and the above comment is these authors' conjecture.

Wolfe (1978) conducted a study to investigate the link between game complexity and the acquisition of business policy knowledge. Wolfe reported, "*The simple game increased knowledge in two of the emphasis areas - the need for reappraisal and flexibility, and the effects of individual and group factors in a policy and decision making situation. The IG* [intermediate complexity game] *improved only one area, while the CG* [complex game] *improved a player's knowledge in all five areas*" (Quote from page 149).

The problem with Wolfe's study is that all three games were played for the duration of the studied university course. The advantage of simple games is that they can be played quickly. Therefore many different games may be experienced a single, one term course of a university's curriculum. Wolfe's conclusions are likely correct when only **one** simple game is played, but it is likely wrong if **multiple** small games are played and compared to a single complex game played encompassing the same time period.

In several ABSEL meetings in the 1990s and early 2000s, Patz (1990, 1992, 1995, 1999, 2000, 2001, 2002, 2003, 2004, 2005 and 2006) noted problems when evaluating participants in several total enterprise simulations. The participant evaluations were biased by a phenomenon he called "Dominance," which occurs when teams whose firms have the best performance early in the game seem to obtain a great deal of market power and go on to maintain or dominate the industry in terms of performance. Professor Patz's results were based upon

composite measures of firm performance which often have as many as 10 identifiable measures.

Teach and Patel (2007) studied the dominance factor in over 40 competitions using the total enterprise simulation CAPSTONE. They used firm profits as the measure of success and noted the same phenomenon as Patz. In addition, Teach and Patel did a stepwise regression of the 10 variable composite performance measure used by CAPSTONE as a performance measure. They found that over 60 percent of the variance in this measure was accounted for by the variance in the simulated firms reported profits. The second greatest contributor to the total performance score was the amount of working capital and that attribute accounted for less than 15 percent of the variance. The studies reported by Patz and Teach & Patel strongly suggest that great care needs to be taken when measuring the level of learning and knowledge gained by participants in large business simulations. Assuming that firm performance is an effective measure of the level of learning and knowledge gained may lead to serious misconceptions.

THE CLARKSON EXPERIENCE

Frazer (1977) wrote, *"…playing many different games in a course with students on different teams for each game is now a viable alternative to the traditional management simulation…played over a prolonged period."* (Quote from page 3).

Frazer (1980) presented a paper at ABSEL where he provided a set of tenets on game design. These were:

- Don't worry too much about "*realism*"
- Design an on-line game so students can have immediate feedback and reinforcement
- Play more than one game in a class during the semester
- Since there are dominant variables in most real life situations, games should also have dominant variables
- There should be one simple, clear-cut goal in each game
- While a certain amount of debriefing is necessary, don't overdo it

With the advent of the Internet, the second tenet is now essentially *a fait accompli'*.

Frazer (1985) contrasted student experiences in a simulation course in which many short games were played over the course with students' experiences a course in which one complex game was played over an extended period of time. In this paper, Frazer described three types of these "small" games: 1) *management science games* which were noncompetitive, but required the participants to perform analytical skills; 2) *interdependent games* which were competitive games; and 3) *negotiation games* which required "deals" to be made between competitive teams. His general thesis was that the discipline of management was characterized by the "*necessity for combining analytical and behavior concepts.*" The playing of a variety of business games allowed these two important but different skills, - analytical methods and the application of behavioral concepts - to be honed by the playing of a variety of games. The combination of these two skills was seen as particularly valuable to aspiring managers.

In addition, Frazer (1983 quote from page 98) claimed that, "*Another advantage of the small games is that its relatively few decisions make it possible to make these decisions in a relative short time."* Professor Frazer went on pointing out that larger games with their complex relationships often resulted in poor analysis and, in addition, masked the effects of bad decisions.

Frazer (1986) was also concerned with the indoctrination effects of using a single game in a course. Every game has a series of learning objectives and the bias of its game designer built in to it. The participants may be easily persuaded that the biases of the designer and the learning points apply to *every* situation. Playing multiple games provides a much better balance to the participants' business game experiences.

FURTHER EVIDENCE

Research on very simple games developed using programmable calculators and was reported by Goosen (1977) in which he found: "*simulations can be processed in the classroom on programmable calculators*" and "*simulations processed on programmable calculators can result in significant learning experiences."*

Wolfe and Jackson (1989) reported on a study that tested the ability of students playing a complex game to detect a significant error in the advertising – demand algorithm. They found that the undergraduate players of this game never noticed the error. This finding must be a very disturbing result for proponents of complex games. It clearly indicates that when outcomes of the participants' decisions in a complex game do not follow the laws of economics, the players cannot comprehend the errors. If the game has it wrong, the participants learn the wrong lessons.

In testing business game performance to final examination scores, Whitely and Faria (1989) reported no significance differences in the student's grades on their final examinations between those who played a complex business game and the students who did not play any game at all. They did, however, report a difference of grades in the exam questions that required quantitative skills, but the score differences on the quantitative questions was insufficient to result in a statistically significant difference in the entire examination grades.

Hall and Cox (1994) challenged the assumption that complexity was necessary for educationally effective business simulations. These authors described two aspects of realism. The first assertion was that realism was "*a key determinant of educational effectiveness and that realism was produced through complexity."* And the second aspect was that "*the amount of cognitive processing performed by participants relates to the simulation's complexity. In turn, the simulation's duration relative to cognitive processing produces cognitive pressure that may lead to role overload.*" This roll overload was negatively related to the

level of adult learning (Quotes from page 30). The risk of *role overload* (French and Caplan 1972) is very great in large scale simulations. This problem was identified as *analysis paralysis* by Teach (1990).

In a survey of teaching faculty who were users, former users or never users of business games, Faria and Wellington (2004) reported that *realism* was cited as an advantage for the student only 13.6 percent of the time and former-users cited *realism* only 15.1 percent of the time. Thus, substantially less than one in five users considered realism as an advantage.

WHY NOT USE SMALL OR SIMPLE BUSINESS GAMES ?

Small business oriented simulation games were referred to as "*microsimulations*" by Burns and Sherrell (1982). They considered "*a microsimulation to be a scaled down version of the usual mainframe business game, designed to illustrate a specific decision area.*" (Quote from page 269) They considered the learning objectives of these small business games to be minimal but non-trivial. However in their conclusions, the authors claimed that the students' simulation encounters in "*microsimulations*" were independent, highly involving, and that this learning environment provided an effective learning experience.

THE PROBLEM

Wellington, Faria and Hutchinson (2007) reported:

"*Several factors may explain good performance in a simulation competition. For example, it is possible that good students will consistently outperform poor students. To test this, a number of studies have examined the relationship between grade point average (GPA) and simulation performance. While some studies have reported a positive relationship to exist (Hsu 1989; Wolfe and Chanin 1993; and Wolfe and Keys 1990), many others have found no such relationship (Faria 1986; Glomnes 2004; Gosenpud 1987; Gosenpud and Washbush 1991; Norris and Niebuhr 1980 and Wellington and Faria 1994).*"

"*Learning is another obvious factor that might lead to good simulation performance and several studies have examined this relationship. Learning is generally measured by performance on end of course examinations. While two studies have reported a relationship between simulation performance and performance on mathematical problems (Faria and Whiteley 1990; and Whiteley and Faria 1989), many other studies report no relationship between superior simulation game performance and performance on the course final examinations (Anderson and Lawton 1992; Washbush and Gosenpud 1993; Wellington and Faria 1991; and Whiteley 1993).*" (Quote from pages 24 and 25).

Anderson and Lawton (2007) used "*a moderately complex total enterprise simulation requiring students to make approximately 40 decisions involving elements of the marketing mix (e.g., price, quality, promotion), operations (e.g., hire and fire workers, order raw materials, set production levels), and finance (manage cash flow, borrow long-term funds) for each period of play.*" (Quote from page 44) They tried to find "*a relationship between the students' success on a simulation exercise and their perceptions of its value as a PBL* (Problem Based Learning) *problem. This study found no significant relationship between financial performance on a simulation and student perceptions of its ability to achieve the benefits derived from a good PBL problem.*" (Quote from page 43).

LET'S INVESTIGATE SIMPLE GAMES AGAIN

A very small, one decision variable, spreadsheet, marketing game was used at Penn State and the results of students playing this game was reported by Edman (2006 quote from page 340). The conclusions of Edman's study were:

1) "Compared to competition in real markets, the game model is too simple with only price as a decision variable"
2) "Students learn to make price decisions based on information from the game model in which they compete"
3) "The simplicity of the game seems to be suitable for the learning objectives."

The WEE game was presented by Teach and Murff at ABSEL (2007) a two variable marketing game that could be played by individuals or by a team. It was designed to help the students transition from a text book comprehension to a practicing decision maker in understanding a price-quantity demand function (sloping downward and to the right) and a promotion-quantity demanded function (asymptotic, upward sloping to the right). A parameter in the game can be used to reflect when there is a relationship between price and promotion that affects demand.

This simple game has a second mode which introduces the player to the oligopoly nature of competition by using three computer modeled competitors and has the capability of requiring the player to forecast or anticipate the results from whatever decision he or she makes during the rounds of the game. The WEE game is designed to be played in its entirety within a classroom setting of 75 minutes.

A PROPOSAL

This paper suggests a hypothesis that needs to be tested: *The use of a series of small business simulations is better at conveying knowledge than using a single, large scale business game when teaching any set of concepts, theories, or practices when used in a university or college level course.*

Testing this hypothesis would require a common testing instrument to be administered to participants in a class that has been divided into two or more sections at the same institution and who have played either a series of small business simulations in one section or played a single large-scale simulation in another section. This is very similar to the 1978 Wolfe study protocol. It could also be tested again using a common testing instrument with different but comparable institutions, when each institution uses a single game type. Caution must be taken because one may also be measuring differences in the effectiveness of the instructors as well as the difference in the student bodies when the test is done across multiple educational institutions. However, the effects of student body differences and the differences in instructor efficacy could be minimized by proper experimental design. These authors would recommend an essay style exam as this would provide the students with ample means of expression and explanation. The evaluation of the testing instrument should be made by all the instructors involved in the research effort, not just the one.\

Ending, as we began, with a quote from Einstein, "*Any intelligent fool can make things bigger, more complex, and more violent. It takes a touch of genius -- and a lot of courage -- to move in the opposite direction."*

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