DEALING WITH THE COMPLEXITY PARADOX IN BUSINESS SIMULATION GAMES

Hugh M. Cannon, Wayne State University

ABSTRACT

For all their advantages, business simulation games tend to be overly simple, addressing a relatively small number of decision variables in comparison with those faced by managers in real life.. As more variables are added, the game may become too complex and students may lose the connection between the decisions they make and their performance. This breaks the learning cycle, thus defeating the purpose of the simulation. We refer to this phenomenon as the *complexity paradox.* This paper discusses the paradox, the ways it is addressed in real life, and how these may be adapted to a gaming environment.

INTRODUCTION

One of the on-going dilemmas faced by those who use simulation games as educational tools is what might be called the *complexity paradox.* The paradox is as follows: On one hand, the purpose of a simulation game is to provide a realistic laboratory in which students can learn business decision making, experimenting with various decisions and getting feedback regarding their relative level of success (Gentry 1990). On the other hand, the more faithfully a game portrays the true complexity of an actual situation, the more decisions there are to make and the more phenomena there are to model. This increases the potential for obscuring the linkage between cause and effect, thus defeating the purpose of the simulation (Fritzsche and Cotter 1990).

In this context, *complexity* is seen as a function of number of decisions available to players, the number of functions or subfunctions modeled in the game, and the degree of abstraction possessed by the concepts employed (Burns. Gentry and Wolfe 1990; Wolfe 1990). Each of these increases the amount of knowledge students need in order to properly connect a particular decision to the relative impact it has on company performance. While the actual relationship between complexity and learning is not well established (Wolfe 1990), the phenomenon we are addressing is reflected dramatically in a study by Wolfe and Jackson (1989). A deliberate flaw was introduced into the demand function of a relatively complex business game. The players were not only unable to detect the error, but the flaw had no effect on either their perceptions of the game's reality or the quality of their economic performance." What could be more central to the learning experience than understanding and reacting to the nature of the demand function? If a flaw went totally undetected, we can only assume that some significant learning was circumvented. The fact that the flaw did not affect reality perceptions, nor performance, underscores the *complexity paradox:* Making the game more realistic obscured the ability of students to perceive cause and effect, or in this case the lack of cause and effect.

As it turns out, the complexity paradox appears to occur in reel life as well. We have all observed situations where problems become too complex that people no longer see the relationship between effort and performance. Not only do they cease to learn correct principles from their experience, but they often learn incorrect ones. They become superstitious, ascribing performance to "luck" or to abstract factors that have no direct relationship to success, such as "We work harder" or "We drive tough bargains." Actions cease to be goal-oriented and people resort to arbitrary social and political criteria for making decisions: "That's the way we do it here" or "I think this is what the boss wants us to do."

While we have all observed this kind of behavior in organizations, it is also true that successful organizations do make goal-directed decisions in the real world, and people do learn from their experience. And they do it in a complex environment. One way to approach complexity in a simulation game environment, then, is to ask how people deal with it in real, successful organizations.

The purpose of this paper will be to review the ways organizations deal with complexity and to suggest the design implications this might have for the development and use of simulation games.

HOW SUCCESSFUL ORGANIZATIONS DEAL WITH COMPLEXITY

Recall that *complexity* refers primarily to the number of decisions that need to be made and the number of factors that need to be considered when making these decisions. When we consider this in light of what we know about cognitive psychology and psycholinguistic theory, the problem becomes obvious: People think by rehearsing combinations of ideas in short-term memory. However, this memory can only handle a limited number of ideas (between two and seven) at once. The key to complex decision making, then, is to break down the decision process so that all the relevant decisions and criteria are addressed without violating this human limitation. Within an organizational setting, this is accomplished in four ways: through *strategic chunking, sequential elaboration, organizational specialization and coordination,* and *intermediate measures of performance.*

Strategic "Chunking"

First, people effectively increase the amount of information they can handle by "chunking" it. That is, they group a set of related ideas into a single higher-level, more abstract concept. For instance, in a marketing problem, they might represent a number of related decisions in the form of a general strategy, such as "market growth in the premium quality market."

Consider the application of this strategy to a brand of “gourmet” dog food. The strategic chunk implies a product-related decision aimed at delivering benefits that are common to all products in the category (premium quality "gourmet" dog foods) rather than unique to the company’s brand. For instance, the product itself would feature the highest quality ingredients. Packaging would be expensive and elegant, consistent with the “gourmet” image. The brand name would communicate the same image.

The pricing scheme would follow the same logic. It would address the value of prestige and quality to people who are not currently using the product. Thus, prices would necessarily be higher than those of dog foods that are not part of the gourmet category. Promotion would feature the importance of “treating a special dog to a special kind of food. Distribution would be in a separate category on the store shelves, perhaps even using a separate type of distribution altogether, such as specialty pet stores.

Sequential Elaboration

Note that, in our discussion, we were able to discuss in some detail the specific kinds of decisions implied by a “market growth in the premium product category.” Embedded in the notion of marketing strategy is the idea that it would include at least four subcategorize of decisions: Product, pricing, promotion, and distribution. This is embodied in another chunk, known as the “marketing mix.’ Having decided to consider the strategy, we were then able to elaborate on each element of the marketing mix in sequence.

Of course, in a real marketing situation, the elaboration would go well beyond this. In the end, it would include a host of decisions that would ultimately lead to the full implementation of the strategy. Promotional strategy would include advertising, sales promotion, publicity, and personal selling strategies. Advertising strategy would include message, media, and budget strategies. And so forth (Cannon and Alex 1990).

This leads to the second method of dealing with complexity. The thinking process is spread out over time in a series of thinking episodes, each of which addresses a specific aspect of the problem. An effective chunking scheme links the relevant episodes in a way that effectively decomposes a problem into its component parts, producing a set of related decisions that can be acted upon by the organization. The product formulation would ultimately be translated into the establishment of specific product formulations, the purchase of ingredients, production processes, and so forth. The pricing decision would ultimately lead to customer price quotes and the proper invoicing of shipped merchandise.

This sequence follows the basic notion of hierarchical decisions processes suggested by Colley (1961) in his classic discussion of advertising strategy. A strategic decision at one level of planning provides the objective for the next. Cannon and Alex (1990) formalized this process in their development of a planning model for use in advertising education.

Organizational Specialization and Coordination

In practice, business problems quickly become too complex for a single individual to handle, even through chunking and sequential elaboration. The elaboration process, then, is spread out not only over time, but across people. Organizations succeed through *specialization,* or what Lawrence and Lorsch (1967) call organizational *differentiation,* breaking down large problems into small subproblems which can then be handled by specialized individuals or teams. Product strategy decisions are made by a marketing team at one place and time in an organization, while production planning decisions are made by another team at a different place and time. Similarly, within the marketing department, sales decisions are handled separately from advertising, advertising from distribution, and so forth.

The key to success, of course, is to not only allocate the responsibility for analysis and decision making appropriately to various groups within the organization, but also to ensure that the decisions are coordinated in such as a way that they work together to effectively address the problem. The is called *coordination,* or what Lawrence and Lorsch (1967) call organizational *integration.*

According to *systems theory, coordination* takes place as each specialized function within an organization is linked to the overall purpose of the organization through the specification of desired inputs and outputs (Miller and Rice 1967). For instance, a purchasing function is given a budget and other resources as input and delivers an output of specified materials and components for the production process. The sales function takes product and human resources as input and delivers revenue-producing sales transactions as output.

Intermediate Measures of Performance

This leads to the final way in which complexity is handled effectively within organizations. As we have noted, the complexity of the overall system may obscure the link between specific activities and the overall performance of the firm. After all, what impact does the selection of a particular component have on overall profitability, especially if the relationship is counterintuitive? For instance, a particular component might be both more expensive and inferior in quality to another, but because of its compatibility with other more important components, it may be written into the specifications for a product.

Companies deal with this problem by developing *intermediate measures of performance.* A purchasing agent will be rewarded not for the overall profitability of the firm, but for the quality of the contracts she is able to negotiate with suppliers. Presumably, this quality is defined in terms of the relationship of purchasing inputs and outputs required to improve the overall profitability of the organization. It may be average cost of required materials and components, a ratio of purchasing department expenses to the overall value of purchases, or whatever.

The point is that employees do see a direct relationship between the decisions they make and the performance they achieve. Furthermore, by studying the relationship among the performance measures used by the various functional units within the organization, any given individual should be able to see the relationship between relatively insignificant decisions and overall organizational performance.

This final point is crucial. What often happens in organizations is that high-level managers develop a system of intermediate performance measures to ensure that the organization moves towards its objectives, but front-line employees see no relationship between their performance and the overall performance of the company. Even worse, in some cases they may perceive a negative relationship (as in the case of purchasing the high-priced, inferior part to ensure compatibility with a more important component that is low-priced and high quality).

Here, simulation games can be much easier to manage than real life. Even the most complex game represents an enormous simplification. By distilling organizational processes down into a relatively pure set of relationships, simulation games require less specialization, and hence, fewer people to make the organization work. This makes it easier for game players to share information and to see the relationship between intermediate measures of performance and the overall performance of the organization. On the other hand, they can be made sufficiently complex that both the development of intermediate measure of performance and their rationalization into an optimal system-wide effort is still en issue.

IMPLICATIONS FOR DESIGNING SIMULATION GAMES

Notwithstanding the relative simplicity of business simulation games, the methods of dealing with complexity still apply. In fact, they provide a potentially important key for advancing the gaming discipline. By systematically incorporating the principles of complexity management into games, game developers can potentially expand them into new levels of realism without sacrificing educational impact.

Principle of Strategic Management

The principles of strategic management are perhaps the most commonly used today. Strategy is a major focus of many business administration classes. Even the simplest game lends itself to some level of strategy development. The following constitute methods by which principles of strategic management might be incorporated into simulation games:

- o **Program Strategic planning**. Gamers often require their students to develop initial strategic plans prior to beginning the simulation, articulating the strategies they plan to use. Student plans provide a basis for discussing the strategic planning process in class, the nature of strategy, and how various types of decisions work together to support it. For instance, one might discuss the relationship between price and quality in a “premium” strategy. Students might propose a low-cost, high-quality strategy. But this confronts them with the requirements of such an approach -- some method of maintaining profits, such as an abnormally low cost of production or a promotion/distribution advantage that would yield greater unit sales volume.

- o Strategic debriefing. Many gamers use debriefing as a method of helping students recognize the strategic issues faced during the course of running a simulation. Students describe the strategy they actually used, how it worked, and how it was modified as the game progressed. Debriefing applies not only to computer simulations, but to gaming and experiential learning in general, and the principles by which it should be conducted have been addressed extensively in the literature (see Lederman 1992 for a review)

- o Designing realistic strategic interactions into gams. Many of the strategic patterns in games come naturally. For instance, the logical interplay between price and product quality creates a natural opportunity for strategic analysis: Low prices do not support the higher unit cost that usually accompanies superior products. In other cases, however, special efforts are needed. For example, heavy discounting can erode the premium image created through consistent, long-term advertising. But the long-term strategic effect (as opposed to the tactical effect of increasing short-term sales) of discounting is lost if the game does not include the discounting effects on product image.

Principles of Sequential Elaboration

In order to exploit the principle of sequential elaboration, gamers must develop a structure in which the game unfolds for students in sequential order, thus confronting them with one logical chunk at a time. The following are three methods of incorporating the principle of sequential elaboration into a computer simulation game.

- o Sequential planning procedures. Sequential planning procedures are a set of instructions regarding the process by which students should develop their various levels of strategy. Developing procedures provides a means of incorporating sequential elaboration into a gaming environment without changing the game itself. The process confronts them with a limited number of decisions at time, automatically linking one Bet of decisions to each of the others in the decision system. Cannon and Alex' (1990) hierarchical planning process provides an useful example from advertising planning. Sets of decisions are linked in hierarchical fashion, where the decisions at one level provide the objectives for the next. If category growth within a particular market were adopted as a marketing strategy, the objective for promotional strategy would be to promote usage of the product category (as opposed to emphasizing brand differentiation, for instance). Students would first evaluate the propriety of category growth in a particular segment as a strategy. Then they would evaluate methods of promoting category growth. In the second stage of decision making, however, they would not need to relate their decisions directly to profitability, thus reducing complexity by decreasing the number of factors they must consider when making the decisions. Following the sequential planning process, students will have identified a number of different decisions, which can then be entered into game in the conventional manner.

o **Sequential execution.** Sequential execution is a variant of sequential planning, where the sequence 18 managed by the computer game itself. Instead of asking for all decisions at once, the computer might be programmed to process one set of decisions, and then ask for the next set in light of those already made. For instance, after receiving a set of decisions addressing marketing strategy, students might be prompted with these decisions and asked to make a set of promotional decisions to implement them.

o **Contextual gaming.** Contextual gaming represents a further extension of sequential execution, where a sequence of decision are made in the context of a computer-simulated working environment. For instance, the game might allow a student to enter her office and click on her simulated in-basket. There she would be confronted with ten issues, five of which require urgent attention, three of which require scheduling meetings. In the course of the meetings, he programmed dialog prompts students to make key decisions. In its most sophisticated form, the program would adapt the dialog to address the issues of sequential decision making. A suggestion to lower prices in conjunction with a premium strategy might be confronted by challenge, such as, "How will we pay for our product development and quality control if we get embroiled in a price war?" Other voices in the simulated meeting might offer counter points to challenge the student's judgment, such as, "But no one else would have the guts to cut prices for a premium quality product. That would be our advantage!" And so the drama unfolds. The outcome of the drama is a set of decisions, much as we would find in a conventional simulation, which, in turn, would be fed into a conventional gaming algorithm.

Principles of Organizational Specialization and Coordination

As noted earlier, organizational specialization and coordination builds on the notion of sequential planning. However, instead of presenting an individual (or group) of students with a carefully sequenced set of decisions, it seeks to distribute these decisions across various different individuals or groups. Different strategies may be developed by combining the following patterns of specialization and coordination, as suggested by Table 1:

o Functional specialization. Functional specialization seeks to allocate decisions on functional grounds, or according to the specific type of expertise needed to make the decisions. For instance, product decisions might be allocated to one team and promotional decisions to another. Similarly, a multi-product/multi-market firm might allocate decisions on a product or market basis, creating something analogous to product or marketing management teams, or perhaps product/market management teams. If the products were notebook computers and printers, a product organization might include separate teams for each of the two products. A market organization might combine the two products in one team to address consumer markets and another team to address business customers. A product/market organization assign a separate team to notebook computers sold in the consumer market, notebook computers sold in the business market, and so forth.

TABLE 1
A FRAMEWORK FOR DEVELOPING STRATEGIES OF SPECIALIZATION AND COORDINATION

		Coordination Strategy	
		Vertical Strategies	Lateral Strategies
Specialization Strategies	Functional	Coordinate specialized functional tasks using centralized control through a vertical information system.	Coordinate specialized functional tasks using informal contact among functional managers.
	Hierarchical	Coordinate various levels of management decisions using centralized control through a vertical information system	Coordinate various levels of management decisions using informal contact across levels of management.

o **Hierarchical Specialization** Hierarchical specialization divides student teams by level in the organization. A top management group might be in charge of decisions regarding overall strategic planning and capital budgeting, while a lower level marketing team might be in charge of managing the marketing and advertising strategy required to implement top management's decisions.

Vertical coordination. Vertical coordination seeks to coordinate decisions of various groups through formalized assignments and reporting procedures. The game might include a work allocation system where different groups receive specific assignments from a centralized source directing them to develop strategies that meet certain criteria, such as, "Develop a $2 million integrated marketing communications campaign that positions our slippers the fun footwear for children between the ages of 2 and 8 years of age. Product, price, and distribution specifications are as follows. Additional information will be available upon request from this office" or "Develop a bedroom slipper that will appeal to children between the ages of 2 and 8 years of age and can be produced at a volume of 5 million units per year with a cost of goods of $3 or less per pair." All proposed decisions are reviewed and approved by the central coordinator prior to implementation. Of course, a similar system could be implemented with a conventional game, where assignments are made through procedures that are designed by the instructor prior to beginning the game

Lateral coordination. Lateral coordination seeks to coordinate decisions through direct interaction among the various decision-making groups. Decisions are proposed by specialized groups and approved by consensus. The integrative process can still be incorporated into a computer system. For instance, the computer might provide an email network among the various teams, allowing them to describe strategies and decisions prior to putting them into effect. A variation on this approach would be to develop a coordinating function, where all proposed strategies were reviewed, and potential conflicts or incongruities were flagged for mutual resolution. Of course, either of these strategies could be administered externally to the game, thus making them compatible with conventional computer simulations.

Principles Governing Intermediate Measures of Performance.

A considerable literature has developed around the issue of measuring student performance in experiential learning environments in general (see Burns, Gentry, and Wolfe 1990) and computer simulation games in particular (Wolfe 1990; Anderson and Lawton 1992). Most of the attention has been given to identifying various measures of overall performance in a game. However, Teach (1990) argues that these are inappropriate. Among other reasons, he notes that measuring (comparative) profitability imposes the unrealistic constraint on games that all firms begin in an equal position. This prevents students from learning how to adjust their strategies to different resource and environmental configurations. In the place of profits, he suggests that forecasting accuracy -- the ability of players to anticipate the outcome of actions taken -- would be more appropriate. Anticipating the outcome of decisions is critical to good decision making, and it is not dependent on the nature and amount of resources a company possesses.

Wolfe (1993) argues that intermediate levels of performance are appropriate for specialized functional games, such as those dealing with marketing, but not for total enterprise games, where the purpose is to learn how to manage an entire organization. In this context, he sees forecasting accuracy as a type of intermediate performance measure. Implicit in his discussion is the notion that there may be other types of intermediate measures as well. These might include lower-level, goal-directed activities such as creating product awareness, increasing market share, and so forth.

This discussion involves two separate issues: (1) the equality of resource and market potential across firms, and (2) the objective of the game, whether it is to help students integrate material across disciplines or to address their decision-making ability within a particular functional discipline. These two dimensions are addressed in Table 2, where they provide a framework for designing intermediate measures of performance.

Integrative games with equal company capabilities

Perhaps the most common type of computer-based simulation game is the integrative game with equal company capabilities.

TABLE 2
A FRAMEWORK FOR DESIGNING MEASURES OF PERFORMANCE

		Level of Focus	
		Integrative	Functional
Initial Company Capabilities	Equal	Evaluate performance in terms of overall company achievement.	Evaluate performance in terms of intermediate measures of achievement.
	Unequal	Evaluate performance in terms of overall forecasting accuracy.	Evaluate performance in terms of forecasting accuracy for intermediate decisions.

The game is designed to immerse students in a high-level management position, where the key to performance is the ability to identify and manipulate overall strategy, understanding how lower-level decisions support the broader strategic plan. We often refer to these as "total enterprise games" (Keys 1987). Here, strategic chunking is part of the task required to affect performance in the game, and none of the developmental strategies we have outlined are appropriate. Performance is a function of how well the company achieves according to criteria such as profit, return on investment, return on assets, etc. The more complex the game, the more demanding it is for students, and the more appropriate it is for advanced students

Integrative games with unequal company capabilities
Integrative games with unequal company capabilities *are* similar to those with equal capabilities, except that they are more demanding. Students must not only be able to conceptualize strategy in the midst from a myriad of decisions, but they must be able to adapt their strategy to fit the needs of a specific company. As Teach (1993) indicates, this is much more characteristic of a real business enterprise.

- **Functional games with equal company capabilities**
  In contrast to integrative, or total enterprise, games, functional games address a particular area of decision making, such as Marketing or Personnel Management (Biggs 1987). Follow the logic of our earlier discussion, achievement-based measures are appropriate when all competing companies are on an equal footing. However, instead of measures such as profit, return on investment, return on assets, and so forth, performance is based on intermediate measures of achievement within a given functional area, such as sales, market share, or some lower-level criteria such as advertising effectiveness, product acceptance, or calls per salesperson.

o **Functional games with unequal company capabilities**.
Again, the unequal company situation parallels equal company capabilities, except that achievement is no longer a valid criterion, since unequal companies cannot be evaluated by the same yardstick. The criterion, then, should be students' ability to forecast the level of achievement they will achieve.

Note that these performance criteria can be combined, both with each other and with other strategies listed above. For instance, within a particular game environment, intermediate measures of performance might be used in conjunction with a strategy of organizational specialization and coordination to evaluate the performance of functional specialists, while top-level managers or integrative personnel would be evaluated by global measures. Also note that looking at the ability to forecast the results of decisions is not the only way to address games where companies have unequal capabilities or starting points. For instance, Pray and Gold (1991) suggest a goal-setting algorithm than might be used for this purpose. The principles outlined above provide general guidelines that can be adapted innovatively to address the underlying issues of global versus functional performance, equal or unequal resources.

SUMMARY AND CONCLUSIONS

This paper has argued, largely a priori, that there exists a *complexity paradox* in computer simulation games. That is, computer simulated business games tend to be overly simplistic. Making them more realistic increases complexity, thus making it more difficult for students to associate the decisions they make with the effect they have on performance. The paper presents a number of strategies that might be used to resolve this paradox.

Among other things, the paper suggests that complex games can be used at both an introductory and advanced levels. As students become more sophisticated, more of the strategic "chunking of decisions can be done by the students themselves. For beginning students, the strategies proposed in the paper can be used to reduce the complexity faced by individual students during a given decision episode.

Our discussion is subject to two key limitations. First, we are assuming a theory of learning in which students evaluate their activities in light of the performance feedback they receive. This is consistent with the general theory of experiential learning proposed by Gentry (1990), but there are competing theories as well. For instance, one might reason that students don't really learn anything substantive about the theoretical relationships underlying the games structure, but only that they can identify strategic decision patterns that will enable them to succeed in the game. This is consistent with Wolfe and Jackson's (1989) finding that a major flaw in the demand function of a game did not influence either student's perceptions of realism or student performance. But clearly, further research is indicated.

Second, we are assuming the validity of the *complexity paradox* phenomenon itself -- that students do, in fact, lose the ability to see the effects of decisions when they are embedded in a complex simulation. While the paradox sounds intuitively correct, the theory would suggest an inverse relationship between complexity and student learning. The empirical evidence supporting this relationship is tenuous as best (Wolfe 1990). Again, further research is indicated.

REFERENCES

Anderson, Philip H. and Leigh Lawton (1992) "A Survey of Methods Used for Evaluating Student Performance on Business Simulations," Simulation & Gaming 23:4 (December), 490-498.

Biggs, William D. (1987) "Functional Business Games," Simulation & Games 18:2 (June), 242-267

Burns, Alvin C., James W. Gentry and Joseph Wolfe (1990). "A cornucopia of considerations in evaluating the effectiveness of experiential pedagogues.' In James W. Gentry (ed.), Guide to Business Gaming and Experiential learning. East Brunswick: Nichols/GP Publishing, pp. 253-278.

Cannon, Hugh M. and Theodore C. Alex (1990) "Structuring a live case: A method and example from an introductory advertising class." In James W. Gentry (ed.), Guide to Business Gaming and Experiential Learning. East Brunswick: Nichols/GP Publishing, pp. 21 6-230.

Colley, Russell H. (1961) Defining advertising cioals for measured advertising results. New York: Association of National Advertisers.

Fritzsche, David J. and Richard V. Cotter (1990) “Guidelines for administering business games” In James W. Gentry (ed.), Guide to Business Gaming and Experiential Learning. East Brunswick: Nichols/GP Publishing, pp. 74-89.

Gentry, James W. (1990) What is experiential learning?” In James W. Gentry (ed.), Guide to Business Gaming and Experiential Learning East Brunswick: Nichols/GP Publishing, pp. 9-20 Keys, Bernard (1987) “Total Enterprise Business Games," Simulation & Games 18:2 (June), 225-241.

Lawrence, Paul R. and Jay W. Lorsch (1967) *Organization and Environment* (Irwin: Homewood, IL).

Lederman, Linda Costigan (1992).”Debriefing: Toward a Systematic Assessment of Theory and Practice.” Simulation & Gaming 23:2 (June), 145-160

Miller, E. J. and A. K. Rice (1967) *Systems of Organization: The Control of Task and Sentient Boundaries* (Tavistock: London)

Pray, Thomas F. and Steven Gold (1991). “Goal Setting and Performance Evaluation with Different Starting Positions: The Modeling Dilemma.” Simulation & Gaming 22:4 (December), 476-489.

Teach, Richard (1990). “Profits: The false prophet in business gaming,” Simulation & Gaming 21:1 (March), 12-26.

Teach, Richard (1993). "Forecasting and management ability: A response to Wolfe,” Simulation & Gaming 24:1 (March), pp 63-72.

Wolfe, Joseph, and Ralph Jackson (1989) “An Investigation of the Need for Algorithmic Validity.” Simulation & Games 20:3 (September), 272-291

Wolfe, Joseph (1990) The evaluation of computer-based business games: Methodology, findings, and future needs.” In James W. Gentry (ed.), Guide to Business Gaming and Experiential Learning East Brunswick: Nichols/G P Publishing, pp. 279-300

Wolfe, Joseph (1993) 0n the propriety of forecasting accuracy as a measure of team management ability: A preliminary investigation,” Simulation & Gaming 24:1 (March), pp. 47-63.