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MATCHING A STRATEGY SIMULATION TO THE BUSINESS POLICY LITERATURE: A BLACK BOX APPROACH TO SIMULATION DEVELOPMENT

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ABSTRACT

Business policy and strategy classes that use a simulation experience select from one of several alternatives in experiential exercises designed to aid in the application of management, marketing, and economic theory. The benefits of each pedagogy have been the subject of numerous articles. An underlying assumption of both methods is that the student will he able to apply the textbook, periodical literature, or lecture material. Thus, the case or materiel selected should conform to theoretically-derived models of industry structure (Porter, 1980 for example) and strategy (e.g. Buzzell, Gale and Sultan, 1975; Hatten and flatten, 1977). This paper will describe the development of an industry specific strategy game in which the algorithm was developed using a black-box method to generate outputs that conform to the generally accepted principals of business policy as represented in most textbooks that use a content approach to strategic management (Examples: Hatten and Fatten, 1986; Thompson and Strickland, 1987; Pearce and Robinson, 1985).

BACKGROUND

The algorithm models used in most simulation games are subject to the general simulation process that includes a definition of the system, selection of a distribution of inputs, development of an initial steady-state, manipulation of the input variables, and development of a final steady state. They differ from closed-system simulations in that the range of inputs selected are not generated from an independent and identically distributed (IID) number generator but are selected by student players who select inputs by educational background, intuition and good guesswork. Most models are multiple input-single output models that spear to permit the development of packages or gestalts of inputs that lead to greater or poorer demand generation (in number of units demanded by the marketplace). As in closed system M/M/M (queuing theory based) simulations, non-optimal supply-side conditions will result in lost sales.

Previous articles by game developers (Goosen, 1986, 1981; Pray and Gold, 1983) have evaluated various methods of providing stable and predictable models for simulation games using smoothing techniques, and multiplicative or additive models based on one or two key variables (e.g. price and marketing expenses). The significance of these approaches is that they control volatility of the simulation and control the expansion and contraction of the industry demand by avoiding kinked demand curve problems and insure that the firm elasticities are greater than the industry elasticities.

The supply-side of these simulations use traditional production functions. Although the interface of the simulation controls the range of inputs, the economic behavior of the competitors can create levels of demand that are game-specific rather than derived from “real-world” empirically-derived relationships.

The simulations developed by these methods have usually been generic games that emulated mature industrial or consumer products in a non-specified or instructor-specified industry. Students are able to fine-tune their decisions by experimenting to find the optimizations in the mathematical relationships. A weakness in this approach is that decisions can be made without regard to good business practice.

An alternative approach to model development is to observe marketplace inputs and outputs and develop a black-box model that reflects an I/O interface that can be empirically observed. Such a model is derived in an open system and although the algorithm may he less elegant, it can be made to conform to relationships that are marketplace observable or theory driven. The simulation development process is altered so that the desirable inputs and steady- states are externally-derived and the model is developed to emulate these relationships in a non-generalizeable fashion.

Since real-world relationships van among industries (e.g. emphasis on research and development or capital intensiveness), the model needs to be industry specific and can be developed by reviewing the strategic group literature for the general form of the relationships and studying the specific behavior of the industry. The disadvantage of this approach is in the difficulties of algorithm development. The advantages of this approach are pedagogical: players can follow text and lecturer prescriptions for strategic planning including an industry analysis and strategy formulation with some predictable performance outcomes. Jo a black-box model the production function is assumed away and the players concentrate on the stability of the environment and the development of a firm that has the synergies to gain a sustainable competitive advantage.

USING THE STRATEGIC GROUP LITERATURE

The concept of strategic groups has been popular since the late 1960’s when General Electric and the Boston Consulting Group fashioned matrices to evaluate the performance of SBI’ (business unit) products in the context of the industry structure. The development of the PINS data base in the 1970’s increased the popularity of the strategic groups concept because decision-makers were able to analyze their firms and develop strategies using empirically-derived prescriptions. Although this body of literature has been subject to criticism (Anderson and Paine, 1978; Prescott, Kohli, and Venkatraman, 1986) the basic tenets reviewed below are widely-accepted and are Included in the portfolio chapters of most strategy and policy texts. Some of variables are discussed in this literature are market share, capacity utilization, capital intensiveness, marketing expenditures, and R&D expenditures.

The Profit Optimization Models (PROM) were developed under contract from General Electric to explain the firm’s successes and failures by using general laws of the marketplace. This was the first model to suggest the market share-return on investment (ROI) connection and utilized data from diverse markets and industries. The underlying assumptions were based on cost strategies: as volume of production increased, the unit cost of production decreased. Thus, the successful strategy consisted of lowering price to induce market penetration that was supported by high volume production. The strategy-performance link that was supported by this model assisted executives in reviewing and implementing strategies. The GE matrix appears in most policy books as a tool for placing products along the dimensions of industry attractiveness and business strength.

Profits Impact in Marketing Strategies (PIMS) refined some of the earlier relationships for forecasting profits by using a multiple regression model consisting of 37 variables that explained 80% of the variability in ROT (Schoeffler, Buzzell, and Heany, 1974; Buzzell, Gale and Sultan, 1975). Their conclusions were similar to those in the General Electric studies as well as similar studies conducted by the Boston Consulting Group: increased market share leads to Increased POT. These models generated the following observations;

> The pretax profit margins on sales were law in low market share businesses and high in high market share businesses. This was attributed to lower purchase-to-sales ratios that may have been due to the vertical integration of the firms participating in the program.
>
> As market share increased, there was a tendency for marketing expenses as a percent of sales to decline. This has been attributed to economies of scale as well as a marketplace bandwagon effect.
>
> Market share leaders are able to compete better and therefore are able to charge higher prices for their high quality products.

The tenets of strategy outlined above were derived from industry pooled data; however, the conclusions have generally held up over time and are part of the body of knowledge communicated in the business policy classroom when students are ‘instructed to develop market share strategies such as holding, harvesting or divesting.

Some of the relationships established by PIMS are industry or market specific. In this perspective. marker share is more important for infrequently purchased goods ad in industries where customers are fragmented. Hatten, Schendel, and Cooper (1978) used an alternate approach to analyze the strategies leading to market share. They used a within Industry mode] (beer brewers) that led them to conclude that the strategy-performance connection varies by within industry groups pointing to the differences between national firms, regional firms and semi-national/ financially weak firms. From this study, students are counseled to make sure that their analyses account for within-industry differences.

Tubatkin and Pitts (1983) confirm that there are no universal truths in the marketplace. across time periods, and among different sizes of business. In their surrogate model of PINS, they conclude that an industry specific model is superior in its ability to explain performance and that universal truths apply in industry leaders. Thus, a simulation can be developed that emulates the relationships provided by strategic group literature, particularly if that simulation mode]s a specific industry. Table I below provides a complete summary of these relationships as developed in the policy literature.

TABLE 1
AN INVENTORY OF STRATEGIC GROUP RESEARCH
(adapted from Ramanujam and Venkatraman, 1984, p. 141-142)

Authors	Major Findings
Schoeffler et al(1974)	Market share, investment intensity and company factors key determinants of ROI
Buzzell et al(1975)	Further confirmation of market share-ROI. Doesn't pay to advertise a poor quality product.
Gale(1980)	Increased investment intensity reduces profitability except under certain conditions
Gale&Branch(1981)	Growth, inflation, new product introduction, investment intensity drain cash; high mkt share builds cash
Craig & Douglas(1982)	Product related variables (R&D, quality) biggest impact on market share and ROI.
Rumelt & Wensley(1980)	Stochastic process (luck or chance) causes market share.
Buzzell & Farris(1977)	Marketing expenses negatively related to profitability
Anderson & Paine(1978)	Market share-ROI most likely to apply to mature industrial product.
Farris & Reibstein(1979)	Heavy advertising assoc. w/premium prices especially late in PLC.
Buzzell & Wiersma(1981)	Productivity and product quality influence market share; industry differences re:competition
Burnett(1980)	PLC and strategies confirmed; some variance by industries.
Pembrick & Schechter	Efficiency measures major avenues for profits in mature industrial products.
Biggadike(1979)	New ventures need 8 years to reach profitability. Large scale entry recommended.
Buzzell(1983)	Negatives outweigh positives of vertical integration.
Galbraith & Schendel (1982)	6 Strategic types for consumer goods and 4 for industrial products. Competitive position moderates relationship
Porter(1980)	Industry gestalts described with recommended strategy focus.
Prescott(1983)	Fit between competitive environment (industry specific) and competitive strategy led to ROI.

The general trend of the literature has been a movement from generic strategic conditions to industry-specific recommendations. This trend suggests that:

1 Industry-specific models will have differences in their basic strategic relationships.
2. The simulation that is industry derived will provide an element of predictability to the student who understands the environment.
3. Student players can apply classroom derived knowledge.
4. Students can conduct an industry study to learn about strategic behaviors that will provide a niche in the simulation.

BUILDING A BLACK-POX SIMULATION FOR A HIGH TECH INDUSTRY

The black-box approach being reported here is the development of a strategic management portfolio game modeled on the information systems industry. The industry was selected because it is popular with students, there is abundant information available, and the industry is evolving so that the game can be played with a variety of scenarios. Although there is abundant data for this industry, a regression model that might be built would have central tendency problems that inhibit building scenarios suggested by an industry study. . In addition, the industry has service as well as manufacturing components making a production function difficult to determine (Golden and Smith, 1986).

The industry presents several phenomena that present additional simulation difficulties. The first of these is that the manufactured components need to he bundled with service elements (e.g. a computer comes with some software, and some service). Thus it is simultaneously capital and labor intensive. Second, there is no one industry leader whose strategic behavior can provide a norm for pricing, marketing, and research and development expenses. Third, it is an industrial product but it is not mature Finally, manufactured components vary (by company) between job shop (unit batch) and process techno logy. These four factors remove the possibility of using well-developed additive and multiplicative models with elasticity parameters for demand and standard production functions for supply. The alternative, then, is a heuristic that emulates industry behavior developed around a set of scenario packages or gestalts.

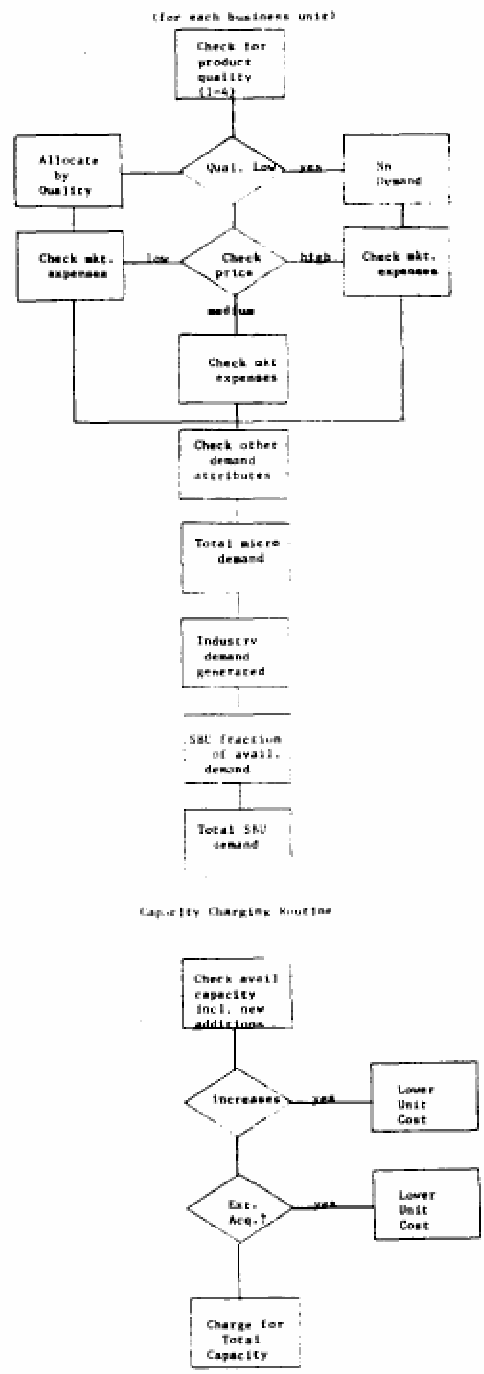
The simulation opens with four business units: a computer manufacturer, a software company, a network company, and a turnkey company. In addition, each corporation may choose to enter a new venture as a fifth business. Teams make decisions regarding price, marketing, basic R&D, product improvement R&D, human resource development, additional sales and service staff and capacity for each business unit. In addition, the team makes a set of corporate decisions regarding capital structure and portfolio composition (the business units can he bought and sold throughout the industry), The simulation is designed to have each player operate one business unit and have the entire team make the corporate decisions.

There are several successful gestalts that can be implemented: a business unit ran niche in the high priced market successfully by implementing a consistent R&D program and an extensive marketing program. A business unit can grow by the addition of capacity or through the purchase of similar business units; in this case, the unit cost of delivering the product or service is reduced somewhat reflecting scale economies. The larger supplier may implement a price reduction strategy to implement pricing strategies. Some R&D expense is desirable; if prices are lowered, marketing expenses may be reduced somewhat. Focus strategies are implemented by bundling a mainstream or high-priced product/service with increased sales and service staff. Thus, three distinct strategies emerge: differentiation into a premium product, focus differentiation with a heavy sales/service component, and a cost strategy.

The strategic types that lead to successful play were derived by interviews with industry executives, a review of industry literature and a review of the strategic group literature, in this simulation, a low quality product strategy cannot he Implemented successfully. Quality is a function of ongoing investment in both R&D categories and a poor quality product cannot be offset by other strategies (Buzzell et al, 1975). It is a stable, fragmented industry (as the game opens) with an industrial product: thus the market share-POT relationship ought to hold as long as the industry structure does not change (Prescott et al) This framework led to the development of a heuristic that does several things (see Figure 1 below): checks for the coexistence of conditions before allocating tentative demand (using a controlled additive model): checks for the behavior of the industry before making a final demand allocation; and provides automatic scale economies if a corporation engages in horizontal diversification.

All demand is subject to a stockout routine based on available capacity Other aspects of production are assumed away (a strategic management simulations does not necessarily need to specify a production function). Costs of production including capital, labor, and raw materials are charged based on total units of capacity and it is assumed that all capacity is available and units are produced using job shop or kanban inventory techniques to produce whatever is demanded as long as capacity permits. The report generator indicates lost sales and excess capacity situations.

FIGURE 1
DEMAND GENERATOR



CONCLUSIONS

Mack box simulation and heuristic algorithms are not easily subjected to the mathematical analysis that the more elegant supply and demand functions provide. They permit a focus on the outside of the simulation: a mathematical peek at the functioning of the model would reveal a combination of discrete (pricing) and continuous functions (other demand variables) and a totally discrete production function. The model functions much like the bound-and-branch algorithms used in solve integer programming problems arid for similar reasons: if a strategic gestalt cannot he totally implemented, it is a failing strategy and is figuratively discarded from the successful branches of the model. The difficulties in controlling such a model are vastly outweighed (in the authors' experiences) by the student satisfaction with the play of the simulation

REFERENCES

Buzzell, R.D., Gale, B.T., and Sultan, R.G.M. "Market Share-A Key to Profitability" Harvard Business Review, Januarv-Februarv, 1975, pp. 97-106

Gold. S.C. and Pray, T.F. "Simulation Market and Firm Level Demand: A Robust Demand System," Developments In Business Simulation and Experiential Learning 1O(1983) p. 101ff

Golden, P. and Smith, J. "Demand Generation in a Service Industry Simulation: An Algorithmic Paradox," Developments in Business Simulation and Experiential Learning 14(1987) p. 67ff

Goosen, K. "An Interpolation Approach to Developing Mathematical Functions for Business Simulations," Developments in Business Simulation and Experiential Learning 13(1986), p. 248ff

________ "A Generalized Algorithm for resigning and Developing Business Simulation," Developments in Business Simulation and Experiential Learning 8(1981)

Hatten, K., Schendel, D. and Cooper, A. C. "A Strategic Model of the U.S. Brewing Industry: 1952-1971" Academy of Management Journal, 210978) pp. 5 9 2-6 10

Lubatkin, M. and Pitts, M "PIMS: Fact or Folklore?" Journal of Business Strategy (1983) pp. 38-431

Porter, Michael Competitive Strategy New York: The Free Press. 1980

Prescott, J.E., Kohli, A.K. and Venkatraman, N. "The Market Share-Profitability Relationship: An Empirical Assessment of Major Assertions and Contradictions" Strategic Management Journal, 7(1986), pp. 377-394

Ramanujam, V. and Venkatraman, N. "An Inventory and Critique of Strategy Research Using the PIMS Database" Academy of Management Review, 9(1984) pp. 138-151

Schoeffler, S., Buzzell .B.D., and Heany, D.F. "Impact of Strategic Planning on Profit Performance' Harvard Business Review, March-April, 1974, pp. 137-145