

Developments in Business Simulation & Experiential Exercises, Volume 10, 1983

A COMPUTERIZED MODEL OF HUMAN BEHAVIOR IN A TOTAL-FIRM MANAGEMENT SIMULATION

James E. Estes, University of South Carolina

ABSTRACT

This paper presents a model of human behavior for a computerized total-firm simulation. This model incorporates some of the commonly recognized behavioral factors as they react to managerial decisions made by participants in general-management roles in a total-firm simulation. The volume of output scheduled by management, the scrap rate, sales and labor turnover are adjusted within the computerized program to reflect the level of morale of production workers, their supervisor and the salesmen resulting from decisions made by the simulation participants. The effects of overtime and new-worker learning curves are also incorporated into the model.

INTRODUCTION

Computerized simulations of companies in many different industries--manufacturing, banking, distribution, insurance, etc.--have been used by colleges and industry for many years to train managers to be more effective. But one of the most vital elements, the human element, generally recognized as being crucial to effective management of any business, is represented in only certain areas in some simulations and is completely absent in others. This paper presents a model of human behavior for a computerized total-firm simulation. This model incorporates some of the commonly recognized behavioral factors as they react to managerial decisions made by participants in general-management roles in total-firm simulation,

CURRENT KNOWLEDGE OF HUMAN BEHAVIOR

Human behavior in the work environment is an extremely complex phenomenon which has been extensively researched using a wide variety of methodologies. For example, since 1910 over 1,000 separate published studies of employee turnover from work organizations can be identified [1]; and turnover, the ultimate decision to leave an organization, is merely one facet of the broader concept of total employee attitudes and their resulting behavior. [5] Some of what takes place in the work environment is understandable and explainable; much more is not. Although some facets of human behavior can be predicted, specific human actions can not be predicted with any real degree of consistency. [12] Wolf and Connolly [21] and Dillard [4] illustrate some of the problems. There is not even agreement as to how to conduct the research by which to learn more. [1; 14; 17; 18] Organ puts it nicely when he observes, "At times we resemble not so much a discipline as a balkanized confederation of uncomfortable and unwilling factions," [12]

Although it is not yet possible to develop a model which will consistently predict specific individual behavior (and it may never be), we have learned enough to make a start at crude models which attempt to interrelate some of the known factors affecting human behavior at work. This has been done by March and Simon 1958 [9], Vroom 1964 [20], Price 1977 [13], Mobley, et al 1979 [10], and Steers and Mowday 1981 [16]. All of these models face the same problems of

trying to recognize all of the indigenous and exogenous variables that are operative in a specific situation and the specific relative influence each is exerting on a specific individual at a specific time and his specific perception of and sensitivity to each of them at that time, his perception of alternative courses of action and their consequences, and his personal preferences at that specific time. Because of the large number of facets to be considered and their subjective and fluctuating natures, it is highly unlikely that a successful quantitative model will be developed in the near future.

SIMULATION OF HUMAN BEHAVIOR IN COMPUTERIZED MODELS OF BUSINESS

No simulation is an exact replica of a real business. Many facets that are considered relatively less important are deliberately eliminated or simplified to keep the simulation "manageable" so that it does not overwhelm the participants. Some other elements are simply overlooked while still others are omitted because developers consider it impossible to model them effectively in a computerized simulation.

In many simulations management changes product lines, increases or reduces production, expands or closes departments or entire plants, shifts marketing territories, and makes other decisions having drastic impacts on the workforce. Yet no mechanism is included to reflect worker reaction to changing conditions. Instead, workers are assumed to be inanimate. Is this what we should be teaching the participants?

Some simulations provide ways in which the administrator can arbitrarily insert numbers that increase or reduce productivity in production, distribution, etc., cause workers to quit, declare strikes, etc. [3;6] This is an improvement, but these subjective judgments are made by the administrator, none are internally represented in the simulation logic. Other simulations incorporate rudimentary elements in the computer program itself, such as salesmen quitting if their income falls a certain percentage below the industry average, less productivity when workers are working overtime. [2;6]

Collective Bargaining Models

Attempts to develop models of human behavior have resulted in at least three simulations of collective bargaining in which the participants represent management, and the union's reactions are modeled in the simulation. Stanton and Greer [15], Veglahn, Frazer and Bommer [19] and Heintz and Schreier [8] have developed such models.

Personnel Management Model

Norris and Fin [11] have developed a computerized simulation dealing much more with day-to-day human behavior within the organization itself, but limited to personnel-management functions. A manufacturing company is the simulated environment, but the participants do not determine the volume of production, nor concern themselves with machinery or materials.

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They do not make decisions on pricing, marketing, company wide budgets nor financing. "PERMASIM simulates the decision-making role of personnel managers charged with the responsibility of recruiting, selecting, and maintaining a productive work force to meet production requirements." [11, p. 232] Participants compete directly to recruit and maintain workers. Turnover, absenteeism and productivity are incorporated into the model by comparing the participants' decisions against preset indices of real-world behavior as they relate to the types of decisions a personnel manager would normally make.

A COMPUTERIZED MODEL OF HUMAN BEHAVIOR IN A TOTAL-FIRM MANAGEMENT SIMULATION, MANAGING A DYNAMIC BUSINESS

A search of the simulation gaming literature, as well as correspondence and personal discussions with simulation gaining authorities have failed to disclose any instance in which any complex behavioral model has been incorporated into a computerized whole-firm simulation. It is easier to develop a quantitative model of human behavior for a computerized company than for a real company because problems presented by varying value systems, interpersonal relationships and individual specific responses do not exist because the employees do not really exist. For simulation purposes, it can be assumed that the characteristics of the work force and the work environment are those of a typical company, and that individual reactions average out and can be simulated in terms of aggregate group reactions.

The author's attempts to develop a model of human behavior suitable for a computerized whole-firm simulation are based on two premises: (1) the managerial decisions of the simulation participants are indicative of their general philosophies of management which would be reflected in their day- to-day managerial activities if they were really managing an actual company; and (2) the individual and group dynamics of the employees would reflect their perception of and reaction to such managerial actions, and such reactions can be simulated with an acceptable degree of realism. Naturally, this attempt to develop a fairly comprehensive model of human behavior for a computerized simulation is going to have many areas which need to be improved upon; but it will provide a starting point for additional factors, more realistic weightings, and various other improvements. The factors in the model are, of course, limited to those that are explicit or implicit in the simulation for which it was developed, MANAGING A DYNAMIC BUSINESS. [7]

The Simulated Company

MANAGING A DYNAMIC BUSINESS is a simulation of a small manufacturing company that produces Product A, an unspecified product used in the construction of homes, businesses, etc. A second product, Product B, can be introduced by the administrator whenever he so desires. Product B can be either an improved version of Product A which eventually replaces it in the market; or Product B can be a completely different product made from the same materials on the same machines, but with a different market and different seasonality, price elasticity, and sales volume potential. Participants develop the company's marketing strategy with decisions on price, number of salesmen, compensation package and advertising and expense-account levels. In production they decide the number and condition of equipment, whether to purchase for cash or to finance,

hours to be worked per week and number of shifts. Materials must be purchased, and consideration must be given to price reductions available for long-term contracts and larger volumes, relative to the rate of usage and cash flow. Additional cash is available only through bank loans for periods not exceeding one year.

Deliberate Unreality in the Model

One important factor in the model is intentionally different from reality. Real people are significantly different in learning and performance abilities, and in real life companies might be lucky or unlucky in the employees they get even if they have excellent labor relations. This could be easily simulated in the model by a table of random numbers. It is not done in MANAGING A DYNAMIC BUSINESS because the students' grades are determined in part by the performance of their company relative to companies run by other students in direct competition. The author feels that it is not fair to students to have any facet of that performance influenced by luck. Differing levels of worker learning curves and effectiveness have been incorporated in the simulation to reflect decisions which impact on the company's reputation as being a good or bad place to work. It is believed that the company's reputation affects the quality of workers that apply there and that this reputation is a result of the management's decisions, not luck,

THE MODEL

The appendix presents a schematic representation of the behavioral model. It attempts to integrate employee reactions to managerial decisions affecting the workers as they would be reflected by changes in the level of output of acceptable units, changes in the quality of work as reflected in the scrap rate, and changes in the rate at which workers leave the company through resignations and terminations for cause. The company has a basic scrap rate of approximately four per cent and an annual labor turnover rate of approximately 20 per cent, both of which are fairly realistic for an average manufacturing company in normal economic times.

In the model any action that management takes to reduce production by reducing the number of hours worked per week would reduce the workers' income, and that has a negative effect on the workers' morale. The magnitude of impact the reduced income has on the workers' morale is a combination of both absolute and relative factors. The workers' reactions incorporated in the model are based on a combination of research findings, conventional wisdom, common sense and, in some cases, supposition. Based on this foundation, worker reactions to certain situations are incorporated in the simulation as follows:

New Employees

If production has recently been expanded by hiring additional workers, regular workers tend to feel that management should continue full paychecks to the workers and build up inventory if a sales slump is only temporary. They also tend to feel that the company should lay off the new workers if they have now found out that they do not need them after all. If there are alternative job opportunities available (the economy in general is not in a bad recession), the new employees normally would tend to resent being put on reduced workweeks by a company

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that had just recently hired them with at least the implicit understanding of a full-time job.

Severity of Reduction

Another factor that affects the amount of impact the reduced income would have on the workers' is the severity of the reduction. Although the workers would not like even a small reduction in their income, their resentment would increase as their income is further reduced.

Length of Time

Workers' morale is also affected by the length of time they have to suffer through a loss of income. Having it happen only in the current quarter is not as bad as having suffered through it for three, six or nine months already, or at one or more times during that period. The degree of impact in the past normally would be proportionate to the length of time past (the longer into the past it happened, the less impact it has now) The model incorporates this feature by assigning smaller weighted values to reductions in the more distant past.

Overtime

Overtime has both positive and negative effects on morale. Since it pays more money per hour (time- and-a-half in the simulation), a little overtime raises morale. However, with today's labor force, for whom leisure time has a very high utility, extensive overtime would probably have a net negative effect on morale. Regardless of the level of morale, it is often found that workers are less productive when working extended hours. In the simulation, the workers are slightly less productive during overtime work, and their productivity declines at an increasing rate as the amount of overtime increases. Research has also demonstrated that once workers get accustomed to the additional income from overtime, they object to having all overtime eliminated. This effect is also incorporated into the model as reduced productivity in the quarter in which overtime is eliminated after having been in effect for at least the two preceding quarters.

Production Worker Level of Morale

Management's actions have a two-fold influence on the level of the workers' morale. One facet is the absolute amount of financial loss suffered by the workers. Of equal importance in the long run is what it tells the workers about management's philosophy and attitude toward them. If their standard of living suffers so that the company can increase profits, there is little that management can say that will disguise its motivation.

Quantity of Production

Actions of the previous management have established a level of productivity among the workforce. The model adjusts to reflect changes in the level of morale of the workers that result in changes in absenteeism, lateness, working speed, etc., which results in corresponding changes in productivity.

Quality of Production

Although Zero Defects is a goal of some companies and seems to be assumed by some simulations, in real life

workers do make mistakes, resulting in scrap. MANAGING A DYNAMIC BUSINESS has a basic scrap rate of approximately four per cent, and the model adjusts that figure to reflect changes in the level of morale as worker satisfaction or dissatisfaction causes them to be more or less careful in their work.

Labor Turnover

Under normal conditions workers exercise a natural selection process by not accepting jobs they know they will not like. However, once they start work employees often find that the job is not what they expected it to be, and if other jobs are available, they quit. This often happens within the first three months of employment, although it may take longer. Other employees are fired by the company because they are unsatisfactory. This also, usually happens during the first three months although it, too, may take longer. Other workers who liked a job originally may decide to quit for various reasons. These elements are represented in the model by a normal turnover rate of twenty per cent, which becomes higher when there is an expansion of the workforce or when management's actions in reducing the workweek become severe enough in degree, duration, or some combination of these.

New Workers Learning Curve

In the simulation it takes three workers to run each machine, and it is assumed that each new worker is put into a group with two experienced workers. Even with this arrangement there would be some decline in production as the new worker adjusts to his new job. It is assumed that under good management each new worker becomes fully adjusted by the end of his first three months. The model adjusts for this by reducing the production output and increasing the scrap rate in accordance with the number of new workers each quarter. As a company establishes a history of poor labor relations, it becomes more difficult to attract good workers. Poorer quality workers tend to take longer to learn and to be less productive, and this is incorporated into the model.

Level of Supervisory Morale

The level of morale of the first-level supervisor can have an effect on output. In the simulation the workers automatically get a wage increase every year under their union contract. There is no such provision for their supervisor. Management's failure to increase the supervisor's salary might not cause the workers to produce less, but a management decision to increase the supervisor's salary at the same time would improve his morale and could possibly motivate him to cause the workers to produce a little more. This is incorporated into the model by causing a small increase in output that is related to the size of any increase in the supervisor's pay.

Salesmen's Compensation

All salesmen are "outside" salesmen calling on customers at their places of business. These salesmen's primary motivation that can be affected by management is their compensation package of salary and commissions and the amount of expense-account money they have allocated to them. In the model morale is raised or lowered by increases or reductions

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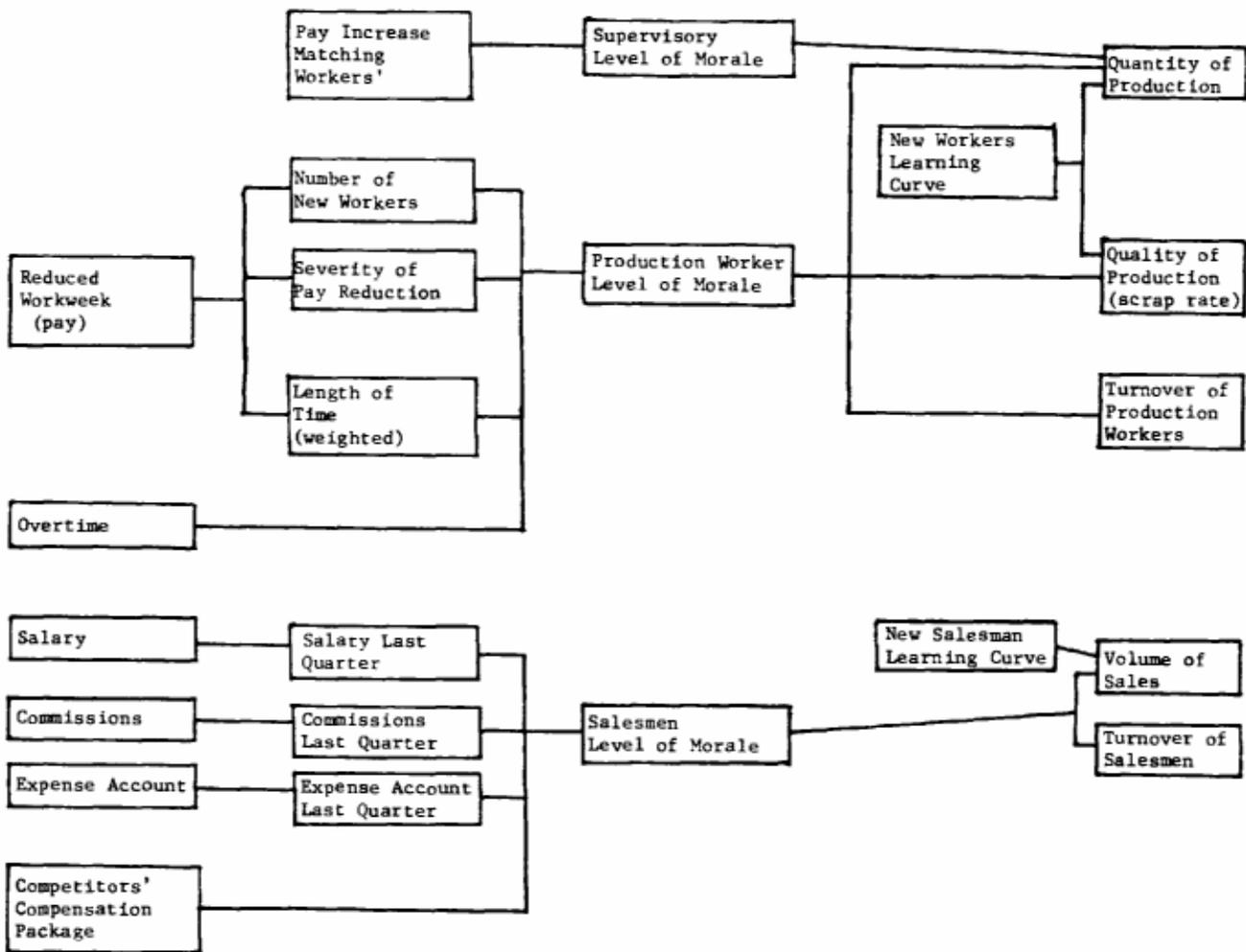
in these factors from the previous quarter. How their compensation package compares with what is being paid by the other companies in the industry is also an important morale factor. The salesmen's level of morale affects the amount they sell and determines their decision to stay with the company or to leave it. The model incorporates a learning curve for inexperienced new salesmen.

CONCLUSION

The development of the current model of human behavior in MANAGING A DYNAMIC BUSINESS has been an evolutionary process covering many years. The current model was introduced in the 1980 revision, and has been experienced by over 800 participants. Feedback from the participants indicate that the current version of the model makes the simulation even more realistic and a more valuable learning experience than a simulation in which the human element is missing.

APPENDIX

A COMPUTERIZED MODEL OF HUMAN BEHAVIOR IN A TOTAL-FIRM MANAGEMENT SIMULATION,
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REFERENCES

- [1] Cummings, L.L., "State of the Art: Organizational Behavior in the 1980s", Decision Sciences, Vol. 12, No. 3, July 1981, pp. 365-77.
- [2] Dale, A. G., May, F. B., Clark, C.T., Lymberopoulos, P.J., The Small Business Executive Decision Simulation: OPERATING MANUAL, Bureau of Business Research, The University of Texas, Austin, 1963.
- [3] Dickson, E.G., Kinney, P.T., "PS New Generation In Business Simulation", 1982 ABSEL Proceedings, pp. 256-59.
- [4] Dillard, J.F., "So, Where Do We Go From Here?" Decision Sciences, Vol. 12, No. 1, January 1981, pp. 46-50.
- [5] Estes, J.E., "An Analysis of Employees' Attitudes Toward Their Work Environment", Personnel Psychology, Vol. 16, No. 1, Spring, 1963, pp. 55-67.

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- [5] Estes, J.E., "An Analysis of Employees' Attitudes Toward Their Work Environment", Personnel Psychology, Vol. 16, No. 1, Spring, 1963, pp. 55-67.
- [6] Estes, J.E., "What's in it for Me?: Over, Under, and Around Using a Computerized Simulation", Journal of Experiential Learning and Simulation, Vol. 1 No. 1, January 1979, pp. 65-89.
- [7] Estes, J.E., Honess, C.B., Corbett, A.P., Managing a Dynamic Business, Eagle Publishing Company, 1982.
- [8] Heintz, T. and Schreier, J.W., "A Structured Approach to the Simulation of Labor Negotiation", Journal of Experiential Learning and Simulation, Vol. 3, Nos. 3/4, December 1981, pp. 247-59.
- [9] March, J.G. and Simon, H.A., Organizations, John Wiley and Sons, 1958.
- [10] Mobley, W.H., Griffeth, R.W., Hand, N.H., Meglino, B.M., "Review and Conceptual Analysis of the Employee Turnover Process", Psychological Bulletin, Vol. 86, No. 3, 1979 pp. 493-522.
- [11] Norris, D.R. and Finn, R.H., "PERMASIM: A New Personnel Management Simulation", Journal of Experiential Learning and Simulation, Vol. 3, Nos. 3/4, December 1981, pp. 229-38.
- [12] Organ, D.W., "Comments on Professor Cummings's Paper", Decision Sciences, Vol. 12, No. 3, July 1981, pp. 378-79.
- [13] Price, J.L., The Study of Turnover, Iowa State University Press, Ames, Iowa, 1977.
- [14] Rose, G.L., "Organizational Behavior and Decision Making in the 1980s: A Critique", Decision Sciences, Vol. 12, No. 3, July 1981, pp. 380-83.
- [15] Stanton, W.W. and Greer, C.R., "Interactive Simulation of Private Sector Collective Bargaining", 1977 ABSEL Proceedings, pp. 32-39.
- [16] Steers, R.M. and Mowday, R.T., "Employee Turnover and Post-Decision Accommodation Processes", Research in Organizational Behavior, Vol. 3 1981, pp. 235-81.
- [17] Taylor, R.N., "Behavioral Decision Making in the 1980s: Comments on the Cummings Paper", Decision Sciences, Vol. 12, No. 3, July 1981, pp. 384-87.
- [18] Van de Ven, A.H. and Astley, W.G., "A Commentary on Organizational Behavior in the 1980s", Decision Sciences, Vol. 12, No. 3, July 1981, pp. 388-97.
- [19] Veglahn, P.A., Frazer, J.R. and Bommer, M.R.W., "Computer Simulation--Training Tool for Collective Bargaining", Personnel Journal, Vol. 57, No. 11, November 1978, pp. 614-17.
- [20] Vroom, V.H., Work and Motivation, John Wiley and Sons, 1964.
- [21] Wolf, G. and Connolly, T., "Between-subject Designs in Testing Expectancy Theory Models: A Methodological Note", Decision Sciences, Vol. 12, No. 1, January 1981, pp. 39-45