

Simulation Games and Experiential Learning in Action, Volume 2, 1975
THE MINNESOTA MANPOWER MANAGEMENT SIMULATION GAME
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INTRODUCTION

Managers universally attest to the important influence sound manpower decisions have on organizational effectiveness. However, these managers have typically been trained to view personnel management in terms of discrete decisions such as recruiting, employment, compensation, labor-relations, and training. College programs and personnel management handbooks are similarly organized into discrete functional areas. Subsequently most managers tend to develop personnel policies and make personnel decisions related to discrete functional areas, thus overlooking the essential interrelatedness of these personnel decisions to the firm's profits and other goals. Perhaps the problem can be stated by saying that many managers have been trained to view manpower management decisions in discrete, neat categories and have not been trained to develop a more integrated approach to analyzing and planning manpower resource utilization. Similarly, researchers have approached manpower issues in a piecemeal manner. Researchers typically have studied motivation, training, and development, selection collective bargaining or some other selected aspect of manpower management. Few have tried to study and understand either the interrelatedness and interaction of personnel decisions or the implications for cost and efficiency goals.

An overall model of the manpower system that interrelates policies and decisions in one manpower function with those from another functional area is lacking. Most work has been directed toward analyzing many two-variable relationships: the relationship between wages and turnover, or incentive wages and performance, or training programs and changing skill levels have been studied. But the interactions among training program, wage programs and changing skill levels, and motivation and performance have been ignored. However, it is precisely these more complex interactions and their relationship to organizational goals that manpower managers face. Each manpower manager, trying to anticipate and solve problems and make decisions must develop his own such model, whether he does it implicitly or makes it explicit. Consequently, there is a need for more systematic approaches for analyzing, planning, implementing, and evaluating alternative manpower policies and programs.

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We set to work to develop a systems model in incorporating the best evidence available concerning the two-variable relationships of manpower components and their relationships to organizational objectives.

The training objectives for the Minnesota Manpower Management Simulation are to allow managers and students to gain insights into the interrelationships among man power decisions and organizational effectiveness, and to allow them to sharpen their decision-making skills and gain experience in the use of various manpower forecasting analysis, planning and modeling techniques.

THE RULES OF THE GAME

The model is based upon a hypothetical casualty insurance firm called Minnesota Home Group (MHG) and each player assumes the role of the manpower manager. The basic concept of the game is that MHG's performance is determined by the effectiveness of the manpower decisions the player makes over time. MHG's profits for example are determined by deducting the costs of policy holders claims, and certain fixed costs, the costs of the various players manpower decisions from the firm's total revenue. Competition in the industry is such that all firms have comparable prices for insurance policies and uniformly change prices as warranted by economic forces such as demand and inflation.

Manpower is the only resource in MHG; all firms initially face the same basic demand for insurance policies and have the same technology; whether or not this policy demand is realized depends solely upon how effectively the player analyzes the situation and how effectively he makes his manpower decisions. The player goes through a process in which major manpower decisions are faced sequentially. Each player must determine the optimal number of employees for each job category in MHG. MHG has four occupational families, agency, claims, administrative, clerical each with four job categories, resulting in sixteen different yet related jobs. Once a desired manpower level and distribution is determined and compared to the current internal workforce, then the appropriate manpower strategies must be determined to achieve the desired manpower position. The desired number and distribution of employees is generated by players analyzing overtime hours, anticipated turnover, measures of productivity and labor costs and product demand data. Since recruiting and/or training employees takes time, players learn to plan beyond a single

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quarter in determining actions for each quarter. The player can recruit, promote, demote, hire and lay off employees. Manpower shortages and inefficient staffing are reflected in overtime and labor cost data and eventually in profits.

Each player also must set up and maintain a wage structure to attract, retain and motivate employees. Wages are a major element affecting the success of MHG actions to build and maintain an effective staff; wages also relate to labor costs and profits. Any number of wage policy options are available to the players, such as across the board adjustments to meet inflations, linking wages to changes in market wages and revisions of the wage structure through selective wage increases. Players may purchase wage survey data, and other market information during the simulation.

Finally, various manpower programs are available to the player. These programs have an impact on employee effectiveness and manpower costs. The effort devoted to each program, indicated by the player's allocation of his manpower program budget, can be varied at will each quarter or maintained at some level throughout the year. The player can decide to implement three types of training programs: skill, induction and/or supervisory training. Each of these programs relates differently to manpower effectiveness and their effects diminish over time. Recruiting activities include agency fees, advertising, and interviewing. Players must decide the degree of recruiting expenditure required based upon the number and quality of new employees required plus the length of time the job vacancies can be tolerated. Selection research involves developing and applying improved predictors of performance of recruits and enhances MHG's ability to identify competent recruits from the labor pool which in turn enhances the quality of MHG's labor force.

Job design and performance appraisal programs also are available to the player. These programs affect the motivation and effectiveness of the workforce. Most of the manpower programs require the player to make some minimum initial expenditure in order to be effective and continued expenditure to be maintained.

After the quarterly decisions are made they are processed by the computer. The computer simulates the company's operations based upon the player's manpower decisions and prints out three reports for each team. The reports provide players with a summary of their decisions, the resulting performance of MHG, and various indices that the players can

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use to analyze and monitor the impact of their decisions. Key indices included in the reports include labor costs per unit, profits, percent of potential demand realized, productivity, etc. Players also use this feedback to develop and subsequently revise their manpower plans and policies as well as to guide their next quarter's decisions. Players find they must deal with excessive over time, production bottlenecks, high turnover, inability to attract sufficient manpower, high labor costs and an assortment of problems that face any manpower manager.

A manpower program budget has been determined by the company president for the first year of play (4 quarterly decisions); the player is required to plan and submit a budget for subsequent years. The budgets granted to the players for the following year's play are determined by company performance, which, in turn is determined by the soundness of the player's manpower decisions. The man power budget has fixed and variable expense items. Fixed items include supplies, overhead, etc. and are not under the player's control. The variable expense portion of the budget, with some exceptions, is used to finance the various manpower programs the player decides to institute. Each player allocates the variable portion of the manpower budget according to his manpower policies and plans.

DESCRIPTION OF THE MODEL

A simplified general version of the simulation model including the key variables and relationships is discussed below. In the following list, the variables are defined, the numbers of the equation in which a variable appears are listed in parenthesis following the variable name. Variables of the current time period have no subscript; tagged variables have subscripts -t. There are i occupations and j jobs within each occupation. In this model: $K = 4$, $j = 4$.

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LIST OF VARIABLE

Endogenous Variable

Pf	profits
R	total revenues
E	total expense
W	total wage bill
B	total manpower program expenses
C	cost of insurance policy holders claim settlements
K	fixed expenses
h _{ij}	manhours straight times worked on job ij; $i = 1, \dots, m; j = 1, \dots, m$.
h _{oij}	manhours overtime worked on job ij; $i = 1, \dots, m; j = 1, \dots, m$.
l _{ij}	the average labor force employed on job ij; $i = 1, \dots, m; j = 1, \dots, m$.
W _{ij}	wage rate paid on job ij; $i = 1, \dots, m; j = 1, \dots, m$.
R _c	total expenditure on recruiting activities; R _{cij} , expenditure on recruiting activities on job ij; $i = 1, \dots, m; j = 1, \dots, m$.
I	total expenditures on job enlargement and job design programs; J _j , expenditures on job design activities on occupation i; $i = 1, \dots, m$.
A	total expenditures on performance appraisal programs; A _i , expenditure on performance appraisal programs for occupation i; $i = 1, \dots, m$.
Sp	total expenditures on supervisory training programs; Sp _i , expenditure on supervisory training programs for occupation i; $i = 1, \dots, m$.

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LIST OF VARIABLE (cont'd.)

Sk	total expenditures on skills training program; Sk_{ij} ; expenditures on skills training for job ij ; $i = 1, \dots, m$; $j = 1, \dots, m$.
I	total expenditures on induction training programs I_{ij} ; expenditures on induction training for job ij ; $i = 1, \dots, m$; $j = 1, \dots, m$.
Sr	total expenditures on selection research programs for programs for occupation i ; $i = 1, \dots, m$.
In	total expenditures on information purchase options including wage surveys and unemployment data.
Tr	total expenses for manpower allocation such as promotion, demotion and layoffs.
M_{ij}	the volume of insurance policies that any job ij can process; $I = 1, \dots, m$; $j = 1, \dots, m$.
M_x	the minimum volume of insurance policies processed by any job ij ; $i = 1, \dots, m$; $j = 1, \dots, m$.
P_{ij}	the straight time employees productivity on any job ij ; $i = 1, \dots, m$; $j = 1, \dots, m$.
Po_{ij}	the employees overtime productivity on any job ij ; $I = 1, \dots, m$; $j = 1, \dots, m$.
S_{ij}	the employees skill level on any job ij ; $I = 1, \dots, m$; $j = 1, \dots, m$.
Os_{ij}	the skill level of the employees remaining on job ij from the previous quarter; $i = 1, \dots, m$; $j = 1, \dots, m$.
NS_{ij}	the skill level of the employees promoted and/or demoted with job ij ; $I = 1, \dots, m$; $j = 1, \dots, m$.
IS_{ij}	the skill level of the employees hired into job ij in the quarter; $i = 1, \dots, m$; $j = 1, \dots, m$.
At_{ij}	the average tenure of the employee in job ij .

Exogenous Variables

D	the demand for insurance policies facing MHG each quarter. $D = f(D_{-t}, M_x_{-t})$
U_j	the unemployment rate for occupation j . $U_j = f(a, U_{jt-4})$ where a is a trend factor and unemployment is assured to be seasonal.
Mkt_{ij}	the labor market wage rate for job ij . $Mkt_{ij} = f(a, U_{j-t}, If)$ where a is a trend factor and U is unemployment, in occupation j and IF is an inflation factor.

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LIST OF VARIABLE (cont'd.)

- If the rate of inflation which is set by the controller.
P the price of the insurance policies issued by MHG. $P = f(P_{t=0}, If)$ where price is a function of the price set at quarter 0 by the controller and the inflation factor.

THE GENERAL FUNCTIONS

The general procedure is to compile profits for any quarter by simply subtracting total expenses from total revenues.

Quarterly profit, then is:

$$Pf = R - E \quad (1)$$

Total expenses is the sum of four variables; the cost of the claims settlements of policy holders, the total direct and Indirect wage bill, the total expenses related to the manpower programs and transactions and fixed costs.

Total Expense Functions

Total expense is:

$$E = W + B + C + K \quad (2)$$

where:

$$W = \sum_{ij} [1.3h_{ij} \cdot 1_{ij} \cdot w_{ij} + ho_{ij} \cdot 1_{ij} \cdot 1.5w_{ij}] \quad (3)$$

which is the sum over each occupation and job of the direct wages paid, the overtime wages paid, if any and the fringe benefit expenses which are assumed to be .3 of the direct wage expense. Wage rates, internal wage structure and interval wage rates relative to external market rates are essential decisions that the player has direct control over. Overtime hours worked in each job is indirectly under the control of the player through how effectively he has staffed and allocated his work force and how effectively he has analyzed the situation and decided upon the appropriate manpower programs and actions. The total manpower program and allocation transactions related expenses are:

$$B = Rc + J + A + Sp + Sk + I + Sr + In + Tr \quad (4)$$

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All these variables are under the direct control of the player; these manpower programs and actions are a primary means through which he implements his manpower policies to achieve his organizations goals. To illustrate, a player may decide based upon his analysis and manpower forecasts that he wishes to recruit a certain proportion of manpower needs for job (ij) and to promote to fill the remainder of job (ij) manpower needs. The player faces several decisions in this situation. He must, for example, decide the level of recruiting expenditure, whether or not to institute select research activities and at what level, and the levels of skills, Induction and supervisory training expenditures that may be required. He must also, for example, decide if he needs to purchase one of the optional wage surveys to analyze whether or not his wage rates are appropriate to insure his firms ability to recruit manpower. The sum of all the expenses for the manpower programs, information purchases and transactions cost for promotions and demotions and layoffs, are represented in this function.

The cost of claims settlements (C) is a random proportion within a fixed limit of total revenue. The fixed costs (K) Include such factors as supplies, wages for the manpower manager and his staff, etc. are a constant proportion of the players total budget. These proportions were identified for us by insurance finance experts.

The Revenue and Productivity Functions

The production process of MHG resembles a “weakest link” process; the volume of policies processed and issued is limited to the volume processed by the least effective job (M_{ij}). The general procedures for calculating total revenue per quarter for MHG is to apply the model to each job (j) sequentially, then to search for the least effective jobs (j). Total revenue, then, is:

$$R = M_x \cdot P \quad (5)$$

Where M_x is the minimum M_{ij}

and

if $M_x > D$; then $R = D \cdot P$

if $M_x < D$; then $R = M \cdot P$

where

$$D = f(a, D_{-t} M_{x-t})$$

The demand for policies facing the firm in any period is a function of economic forces (a) the past demand experienced by the firm and the past effectiveness of the firm in meeting that demand. The insurance policy price is exogenous and is adjusted periodically in relation to inflationary and other economic factors.

The effectiveness of the manpower in any job is:

$$M_{..} = (l;h;p)_{ij} + (h-o.p.o.1)_{ij} \quad (6)$$

if $M_{..} > D$; then $h_{o..} = 0$

if $M_{ij} < D$; then $h_{o..} = f(1, p_o)_{ij, -t}$

where: h_o is subj: to $\lim = 70$.

$$p_{oij} = f(p, h_{o-t})$$

The effectiveness of any job (j), Is based upon the average manpower level in (j), the manpower productivity on (j), the hours worked plus the effective overtime hours worked. Overtime hours are worked when the effective manhours needed on the job to produce to demand (D) are greater than the effective manhours available on the job. The overtime hours tend to be less effective based upon level of overtime required in the past and productivity of the workforce in j. The maximum overtime allowed seventy hours per man per quarter.

The average labor force (1) in any job during a quarter is partially controlled by the player through his manpower allocations decisions and partially through other organizational and market forces. For example, the player regulates the rate of layoffs and demotions should he decide to reduce his work force and the production rate should this analysis and policies suggest them. The rate of voluntary turnover and the inflow of recounts, however, are also a function of such variables as the unemployment rate, MHG's wage rates relative to the external labor market, the level of recruiting expenditures and the rate of promotions and job opportunities within MHG, etc.

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The productivity of the labor force in any job is:

$$P_{ij} = f(S_{ij}, E_{ij}) \quad (7)$$

A function of the skills of the work force related to the job requirements and the motivation of the workforce on that job.

The skills of the work force in any job is given by the following equation:

$$S_{ij} = (OS_{ij}, NS_{ij}, IS_{ij}) \quad (8)$$

where: $OS_{ij} = f(AT_{ij}, Sk_{ij}, S_{ij-t})$

$$NS_{ij} = f(S_{ij-t}, Sk_{ij}, I_{ij})$$

$$IS_{ij} = f(R_{ij}, W/Mkt_{ij}, Sr_{ij}, I_{ij})$$

The manpower skills on any job is a combination of the skills of employees remaining on that job from the previous quarter (OS_{ij}), the skills of employees whom the player has promoted or demoted into the job (NS_{ij}) and the skills of the employees successfully recruited into the job from the labor market (IS_{ij}). Productivity of the work force is a key variable that manpower decisions can influence in the simulation and the player has several manpower decisions that effect the workforces skills on job; therefore, the firms productivity and total revenues. To illustrate, a player can influence the skills of the workforce on job ij -- by expending a portion of his manpower budget on skills training (Sk_{ij}) which will effect the skills of the workforce remaining on the job from the previous quarter (OS_{ij}), the employees promoted and demoted into the job (NS_{ij}) and new recruits (IS_{ij}). The model possesses some of the complex interaction among manpower variables found in reality. To illustrate, a player can decide, based upon his manpower forecasts and the policies he is trying to implement, to recruit manpower to fill all his manpower requirements instead of reallocating his workforce. The player can impact the skill of those employees recruited by adjusting the level of his expenditures on recruiting activities (R_{ij}), by insuring that his wage rate for job ij is competitive with market rates for that job (W/Mkt_{ij}), by adjusting the level of expenditures on selection research activities (Sr_{ij}) and by instituting some induction and skills training for the recruits hired (Sk_{ij}). However, a player who expends a relatively high among on recruiting activities, but neglects to maintain a competitive wage structure or a selection research program which helps insure appropriate recruits are selected, will find the effects of his recruiting expenditure on the skills levels of recruits diminished.

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The motivation of the workforce on any job is given by the following equation:

$$E_{ij} = f(W_{ij}/W_{ij-t}, A_{ij-t}, J_{ij-t}, Sp_{j-t}) \quad (9)$$

The elements influences employee motivation include the wages paid relative to wages paid in previous quarters, the expenditures on performance appraisal programs, job design programs and supervisory training. Similar to the S_1 function, the effects on motivation of expenditures on some of these manpower programs are lagged and diminish over time. To illustrate, expenditure on supervisory training activities will take a quarter to effect motivation due to the lag time needed for the training to take place and the training effect will diminish over time unless the program is maintained over time.

EXPERIENCE WITH THE GAME

Since 1972, we have used the game as a training device in manpower analysis, planning and control seminars. Seminars have been conducted for managers, both for mixed groups of participants and within individual firms as a part of management development efforts. We also have used it as part of a manpower analysis course in the Universities of Minnesota and Cornell Industrial Relations Graduate Program.

Reactions to the simulation exercise and the related seminar materials have been positive from both students and professional managers. Students find that techniques for analysis can have relevance for “practical” manpower management; staff managers find that manpower decisions can be related to profit and productivity and develop an appreciation for the relevance of manpower modelling. Both students and managers develop skills in the generation and development of models for decision making.

CONCLUSIONS

An integrated-analytical approach is at the heart of sound manpower management. Manpower educators, decision makers and researchers, often backgrounded in social and behavioral sciences, have generally lacked an appreciation for the development and application of modelling skills and systems analysis or the application of more quantitative and analytical approaches to decision making.

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We have found the Minnesota Manpower Management Simulation a useful tool for students and managers to develop skills in modeling and to increase their understanding and experience with the various analytical approaches to man power decisions.