

26 Apr 1972

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Recommended Citation

Ding, G. Day and Warner, Jack R., "Goal 26: A Game for Housing Education" (1972). *International Symposia on Low Cost Housing Problems*. 59.

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GOAL 26: A GAME FOR HOUSING EDUCATION

by

G. Day Ding* and Jack R. Warner**

INTRODUCTION

It is prevalent for the study of housing to be organized into subject matter courses dealing separately with specific aspects of housing hardware (eg. building techniques) or housing software (eg. various public and private housing programs). As a consequence of this separation, the vital role of the homebuilding industry is either ignored or given only superficial consideration. It is suggested, however, that this neglect is not always accidental, since competence and confidence in presenting a well integrated course focusing on the total housing delivery system is not normally found among teaching faculties.

It is now accepted that the "real-world" of producing and delivering housing is still handicapped by many professionals (architects, engineers, planners alike) who, because of their educational background, still cannot distinguish suboptimization from a global viewpoint. That this has hindered severely the development of viable delivery systems for housing in this country is painfully apparent today.

Thus, a greater systems-orientation must be a pre-condition for better performance towards achieving the goal of a decent home for every American, and that there is no better beginning than when concerned graduates from related fields (architecture, engineering, psychology, economics, etc.) come together for interdisciplinary investigations of the built environment. Such is the case of the graduate program in Environmental Systems Studies offered at Virginia Polytechnic Institute and State University since 1968. (1)

This paper presents the developmental background of a computer-assisted game (2) constructed as a vehicle for a better understanding of the housing delivery system. It is used as a stimulant in the introductory graduate course on Building Systems Technology. However, the catalytic potential should be stressed since the game is intended primarily as a means of pin-pointing the interactive aspects of the various subsystems of the housing industry.

THE NEED FOR HOUSING IN THE UNITED STATES

Prior to Operation Breakthrough, HUD's effort to promote industrialized building on a mass scale, the debate raged over conventional vs. industrialized building and the ability of each segment to provide housing for America. It now appears that both these sectors, as well as the mobile homes manufacturers and others, are needed if we are to achieve the goal of 26 million houses during the decade.

At VPI, we took the often asked question of under what conditions could an industrialized housing industry develop, to create a multi-term student project: that of developing a game to simulate the various production sectors of the homebuilding industry.

GOAL 26: BACKGROUND

To initiate GOAL 26 as a student problem, we asked that teams of students develop a manual board game that would allow players to see, through play of the game, how the production sectors of the homebuilding industry functioned and reacted to various constraints and incentives.

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A Monopoly-like version developed as a result of this round of student development. This is discussed in detail later in the paper.

A few rounds of play on the manual version of GOAL 26 quickly revealed the shortcomings of the game. The players quickly discovered how to beat the system, since there was a finite number of chance action play cards and finite number of playing strategies. However, the players were committed to the game and being students required to develop the game further, they soon tried to complicate the process to give realism to the game and defeat their fellow students. This interest served two purposes. First, in order to complicate the constraints and incentives affecting the homebuilding industry, the students had to find out how to get the proper statistical information. This in itself was no small task as anyone reading the Kaiser and Douglas Reports will attest. So, one of the pedagogical objectives of the game was achieved; that of making the students aware of the real factors affecting building and where to obtain real data on these factors.

Computer usage in architecture is encouraged at VPI and this served as the basis for the more sophisticated computerized version of GOAL 26. Once the proper statistics were obtained these were incorporated into the game within a random chance range of occurrence, so that the players cannot outguess the computerized chance cards.

DEVELOPMENT OF THE GAME

It is the intent of this paper to cover the development of GOAL 26 so that others might more efficiently develop similar games on their own, profiting from our experience. We will not go into the computer soft work in this paper. Those interested in that aspect can contact the authors for detailed information.

The original version of GOAL 26 is summarized here. The four principal developers of housing were selected as roles for the players. These are:

1. General Contractor (27%) - builds on land owned by others, usually according to the owner's plans.
 2. Merchant Builder (41%) - builds housing, usually of their own design, on their own land, for sale or rental to others.
 3. Housing Manufacturer (11%) - uses assembly line techniques to produce sectionalized units or packages of materials for rapid assembly on site.
 4. Mobile Home Manufacturer (12%) - produces movable, completely finished and furnished units in the factory.
 5. Owner Built Homes (9%) - not included as a player.
- The numbers in parentheses represent the percentage of housing that the player currently produces.

The Game Board

The game board, shown in Figure 1, was developed primarily as a time keeping mechanism. Time keeping was accomplished by dividing the perimeter of the board into 28 sections, 12 of which represent the months of the year. The four corners were designated "build squares", where the players would realize the results of their assignments of money, manpower, and material.

The two rows are for "construction" and "planning". The three columns labeled "land", "labor", and "material", are used to hold the commitment of each of these resources made by a player. Each of the players has a specified ratio of each of the three resources which must be committed to build a given number of housing units. These ratios are as shown in Figure 2.

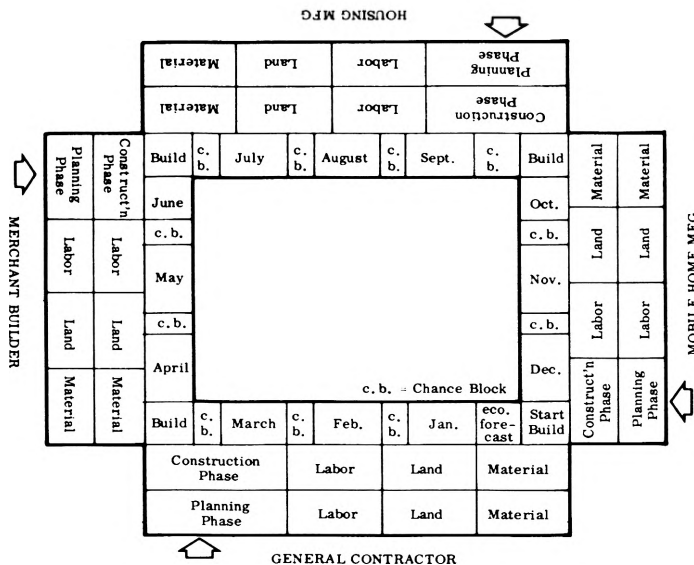


Fig. 1. The Manual Game Board

RATIOS REQUIRED TO PRODUCE 1 HOUSING UNIT

PLAYERS	MEN	MONEY	MATERIALS
1. General Contractor	3	3	2
2. Merchant Builder	3	2	2
3. Housing Manufacturer	1	3	2
4. Mobile Home Manufacturer	2	2	2

These were chosen based on advantages apparently enjoyed by each of these sectors

Fig. 2. Commitment Ratios

Chance Cards

These cards represent the factors which can affect the housing industry during a year. As the players pass over a chance block between two months, a card is chosen at random from a pile of cards keyed to that block. An example of such a card is shown in Figure 3.

Separating each of the month blocks are chance blocks representing some of the possible variables which affect the housing industry throughout the year. These are:

1. Weather
2. Governmental Financial Policy
3. Taxes
4. Government Administrative Policy
5. Labor
6. Technology
7. Materials
8. Suppliers

There is, in addition, an economic forecast block between the start of the game and the January block.

The Commitment Grids

Four grids are located around the outside of the board, one on each side, for one of the four players. As can be seen, this card contained a grid showing the penalties or dividends which were paid to or collected from each player, according to the event described on the card.

Play of the Game

Each player is originally given a predetermined number of land, labor, and material chips and also a specified amount of money or capital. (He can use the money to buy any additional

A recent labor settlement resulted in higher labor prices: for this round the following labor ratios apply.

1. General Contractor *4
2. Merchant Builder 5
3. Housing Manufacturer 2
4. Mobile Home Manufacturer 2

*(or trade 1 material unit to Merchant Builder for 2 free labor units--your option)

Fig. 3. Chance Card

units of land, labor, or materials.) The game is started by reading the economic forecast for the coming year to all of the players. The time piece is then moved to the January "month block" by a referee. At this time each player is allowed to make a commitment of as many units as he desires of either land, labor, or material to the planning stage. He is, however, restricted to the commitment of only one additional unit of resource during each month. After each player has made his commitment, the time piece is moved to the "chance block" separating January and February. A card is selected from the cards representing that particular chance block and read to the players. Each player then pays or collects the appropriate amount of capital or units of men, material, or land as directed by the card. This process is repeated until the first "build block" is reached. At this time the player has the option to move as much of his resources from the "planning" phase to the "construction" phase. The amounts moved to "construction" must be in multiples of resources to build units as illustrated in Figure 2.

The same process is repeated until the end of six months of play when the second build block is reached. At this time, the construction is ended, the housing units are sold, and the resources plus a profit are returned to each of the players. After this, the resources committed to "planning" are moved up to "construction", as described before. This same cycle is repeated until the year has been completed.

After a year has been played, the economic forecast is again read and the cycle is repeated until 10 years or 10 cycles of play have been completed. At this time, the game is over and a winner--the player who has the most money--is declared.

DEVELOPMENT AND ADAPTATION OF GOAL 26

Realizing the potential and limitations of the game as it existed after the initial stage of development, the question then became, how can the game be restructured to better achieve its objectives. The second stage of development was to examine the shortcomings of the game and provide a realistic solution that better represented the complexities of the real world model and the objectives of the game.

The most obvious problem was the correlation of the annual forecast to the chance events of the simulated year. A perfect correlation never exists, but in the original game the relationship was intuitive and haphazard and in this sense self-defeating as a teaching mechanism. First, the idea of operating on one annual forecast would frighten most business men, so the decision was made to use a quarterly report. The information content of the original report was little more than an indication of the economy moving up or down, hardly an indication of what could be happening in many of the supporting areas of the residential housing business. After exhaustive research and discussion, the following variables were selected to be in the quarterly forecast:

1. Prime Interest Rate
2. Money Supply
3. Unemployment Rate
4. Building Industry
5. Building Cost Index
6. Skilled Labor Wage Index
7. Common Labor Wage Index
8. Material Price Index
9. Land Price Index
10. Political Forecast

With the exception of the land price index most figures can be obtained from such sources as U.S. Departments of Labor and Commerce, Engineering News Record, and other government statistics. The initial feeling of the students was that such a quantity of information would be unfamiliar and unusable by most players.

The problems then existed how to use this data in developing a forecast. The information was readily available as a yearly series so a linear regression procedure was adopted to come up with a quarterly forecast. During the quarter any changes are recorded and actual end of the quarter values are computed in the simulator and used in the next quarter's forecast. The idea was to weight this game-developed figure slightly heavier by not using all the available historical data. The reason here was to make the game more volatile and expose players to a greater variety of experiences in a shorter period of time.

The second problem area of the original game revolved around the money transactions. These transactions were so time consuming that the continuity of the game was lost. Obviously, money transactions are essential to the game, but it was agreed that a computer could handle the transactions much more effectively (perhaps a push into the cashless society?).

The third problem was the timing of the chance events. Because of the limitations of a board game each event category was scheduled at the end of a specified month. It is unrealistic to assume this world of chance could be modeled in such a rigorous scheduled manner. First, the schedule was removed for the events making it possible for any events to occur during any quarter in virtually any combinations. With this scheduling restriction removed, the old limit of possible events was removed, making the chance occurrence of those events more realistic. The following categories of events were agreed upon:

1. Government Administrative Policy
2. Government Financial Policy
3. Private Financial Policy
4. Taxes
5. Market Demand
6. Land Law and Pricing
7. Labor
8. Material Market
9. Technical Developments
10. Weather

Within each event the probability of occurrence could be varied and the actual event could be better related to the forecast.

The fourth problem was the development of realistic resource combinations. The premiums and penalties had been developed intuitively and more for easy manipulation rather than appropriately related to the classification of the type of players. The concept of computer adaptation of the game removed some of that problem. Realizing that the perfectly predictable or logical premium penalty values are not available still left some intuitive flavor to the values, but the ability to apply penalties and premiums to more of the committed resources helps to make the chance event structure of the game more realistic.

The fifth problem was the need for both more control and more variability. Essentially a fifth player or referee was needed to make certain decisions and control the game. With the sophistication of the computer game much of this control function is placed within the computer.

A sixth problem was determining a realistic quantity of each resource to be allocated to each player. The original game was played with virtually unlimited resources, which is not a good model of the housing industry. With the computer this can be controlled, with additional labor being attracted from outside the building industry during high demand periods and labor being drawn away during low demand periods. This feature adds another more realistic dimension to the resource management objective of the game.

One distinct impression of the original board game was that it could easily become static. Once the novelty of the game was gone, it was easy for the game to settle into a rut because of the intuitive and limited forecasts and the static game parameters. One important element of the game simulation theory is the idea of the dynamic game situation. This is essential when trying to model the housing industry. Obviously, the industry does not operate with fixed cost and proportions of resources over a very long period of time. Here again a computer simulation enables the costs and resource proportions to change in relation to the events of the game, making their effect permanent rather than temporary as they were under the board game penalty system. The computer displays certain information for the players to operate with, while generating other changes internally for the players to discover by interaction with the computer.

Working with these problems revealed other problems that had to be resolved. For example, one major problem was the adaptation of the national housing goal of 26,000,000 units to the game. This made it necessary for players to play as a collective industry rather than the real world model of the highly fragmented housing industry. Actually in the game each of these industry-sectors is motivated by obtaining profit while achieving any national goal. So the game is very realistic because the idea of profit maximization and competition is maintained.

So far, our major difficulty with the computerized version is gaining access to a sufficient number of terminals so that all players can act simultaneously.

However, our initial objective of having students discover how the homebuilding industry functions has been achieved...and in a very enjoyable manner.

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