



Development of BASE Manufacturing Business Board Game

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Abstract. The authors developed a board business game of manufacturing called BASE Manufacturing Game (BMG) to provide an opportunity to learn business for engineers. The purpose of development includes management, accounting, and to increase learner's motivation for further studies. By using Questionnaires, the authors proved incredible teaching effectiveness. BMG is a standard for following BASE business games and authors have been continuing board development in Japan and Thailand.

Keywords: Business game · Board game · Manufacture
Engineering education · Active learning · BASE

1 Introduction

Growing up high-quality engineers is an important requirement for higher education. In many universities, there are established curriculums to teach engineering. However, it is often biased on technological surfaces, often ignores social impacts. Engineers must have united knowledge across many topics, including a sense of Technology, Society, and Business.

To serve this purpose, the authors developed the business game which describes the most important ideas of manufacturing and business on tangible board in 2008. This game, BASE manufacturing game (BMG), was mostly used in Japanese and Thai universities and showed amazing performance to increase understandings and motivations of attendees. BMG became a standard and an origin of following BASE business games, and become famous in many conferences, workshops, and lectures.

2 Literature Review

Business Game and simulation has a long history. About the type of business games, Lean et al. [1] had a similar questionnaire based research and reported 35.9% of current users are using Role Play, 20.5% for non-computerized game, and 25.7% for

computer-based simulations. Since there are quite a lot of business games, Greco et al. [2] tried to create a taxonomy of business games. However, this idea seems too complicated for most of the game developers who are not professional.

Let us examine how business simulation games are used in engineering education. Chapman and Martin [3] claimed that engineers should improve some other skills, not only technology. They tried “CRAC business game” for this purpose. Foss and Eikaas [4], based on strong reliance that students have good talent in computer games, created a computer-based learning system called “PIDstop.” Hauge and Riedel [5] recognized the recent complexity of business and behavioral factors, and created two games, called “COSIGA” and “Beware”. Kumar and Labib [6] explained the framework of “Next-Generation Manufacturing Simulation Game”. There are few other references or popular business simulation board game which explicitly focuses on general manufacturing, to contribute engineering education. The Authors need more idea and experience of business games to grow up engineers.

3 Outlook of BASE Manufacture Business Board Game

3.1 Educational Policy

Before developing BMG, we defined the following educational policy. To say in briefly, BMG is a standard set of an easy business game with great fun for engineers.

- (1) The target audience is students of engineering in a higher grade.
- (2) Purpose: Learners will be able to do the followings with a relaxed environment with joy.
 - (a) Understand basic of company management
 - (b) Understand basic of accounting
 - (c) Increase the further motivation to study business
- (3) Avoid adding complicated rules or an exception to the rule.

3.2 BMG as Wooden, Tangible Board Game

BMG is the combination of wooden frame company board and market board, and cards. Figure 1 is the photograph of the whole set of BMG. There are four companies called (Red, Green, Blue, and Yellow) around the table. All companies are operated by two or three student groups. The company is designed as a combination of factory and office. Machines, Materials, Men and some optional pins are set on the board. Each company has a paper, pencil, eraser and calculator to manage operation and accounting. Toward the center of the table, there are five Markets (Town A to E). Companies will make a bidding in each market. There is a timer to control bidding. At the center, there are sets of “Action Card” turned inside out.



Fig. 1. Image of the whole set of TMG (Color figure online)

4 Flow of the BMG

4.1 Initiation

Two to three students form teams and manage a company. Each team must choose a CEO (Chief Executive Officer) and CFO (Chief Financial Officer). They receive a small share of capital (300,000 USD) and establish their company, which produces commodity products. The CFO records share capital as income. From the second year, there are no additional capital stocks. However, they can borrow money from the bank, based on their business strategy. Companies whose last year's result was a surplus, have to pay tax in this period.

4.2 Monthly Role

Students must make a decision on one manufacturing action, and one management action except for a happening card appears.



Fig. 2. Samples of action cards (surface, standard, and happening (20%)).

1. The CEO draws an action card (Fig. 2). It includes 20% happening card to learn risk management.
2. The CEO makes a decision from the followings.
 - (1) To buy new materials.
 - (2) To compile existing materials to the products.
3. The CEO decides management action.
 - (1) To hire new engineers or salesperson (Full time/ Part time with a six-month contract is selectable)
 - (2) To buy a new machine
 - (3) Other Options (Insurance, Loan, Advertisement, R&D etc.)
4. The CFO calculates all expenses and withdraws total cost from the cash at the end of last month.

4.3 Manufacturing

Players have a company board (See Fig. 3). From the players, on the left side, there are raw materials. In the middle, there are machines. On their right, they can see stockyard. They can see, touch, and move the items, in case they need, they can roll back to reconfirm whether their activity is correct. This is the great merit of the tangible game. The manufacturing process consists of two steps (One month for Input, another one month for Output, these processes are possible to complete at once). Throughout this rule, students learn the idea of lead time.

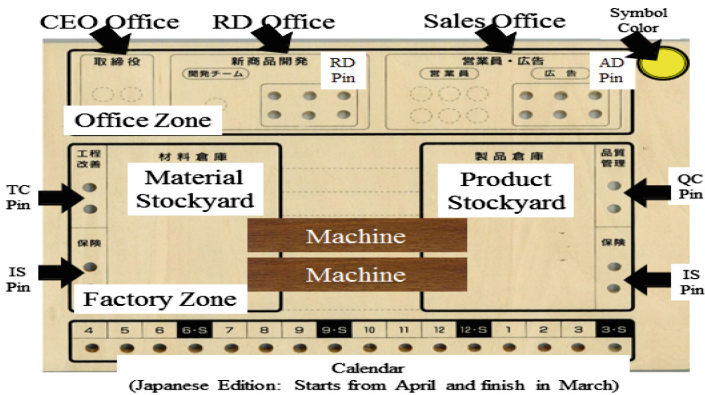


Fig. 3. Company board

4.4 Bidding

After the completion of manufacturing, Bidding is held on every three months.

- (1) Students came up with the market with salesperson and items which they want to sell. They are allowed to bid, slide, or withdraw for two minutes.
- (2) When the time is up, the dealer will start the judgment process.

- (a) If the number of application is less than market capacity, all of them can sell at its maximum price.
- (b) If the number of applications is more than market capacity, all of them must fight a price bidding.
- (3) In a case of bidding, each participant must decide one price for their all products, type a price of the calculator, and following dealer's order, all teams open the price on the front.
- (4) R&D and Advertisement have some advantage in bidding.
- (5) Dealer declares the winner until the market will be full. Remained products must be brought back to their company.
- (6) CFO will record the sales revenue and check the cash balance.

4.5 Closing Role, Accounting

At the end of the year, the CFO must finish workflow.

- (1) Reconfirms all revenues.
- (2) Recalculates all expenses and checks the cash flow integrity.
- (3) Compiles other sheets (P/L, B/S).

Students must check their cash balance at any time, and at the end of the year, they create Profit and Loss Statement, and Balance Sheet. All process are required to complete by handwriting. Human being often makes errors, and the authors let students know this fact throughout their experiences. BMG has five different sheets, and they are proceeded by students, by handwriting, by following orders.

- (1) Cash Flow Management Sheets (Table A)
- (2) Product cost Calculation sheet (Table B)
- (3) Depreciation cost Calculation Sheet (Table C)
- (4) Profit and Loss Statement (Table D)
- (5) Balance Sheet (Table E).

Table A represents a daily operation and horizontal and vertical proof ensures its integrity. Student gets a correct number and prices at the end of the year. In Table B, they calculate accurate product cost, to adjust raw material costs by adding carry-over from the previous year, deducting the loss and carry-over as assets to next year. Table C is the simple depreciation that fixed asset (machine) loses its value 10% per year. By getting those numbers, students complete Table D and E. Throughout this process, they can learn principles of accounting.

5 Teaching Effectiveness

BMG is used in Japan and Thailand. To verify the effectiveness of BMG, we conducted some surveys.

5.1 Survey on Understandings of Business Ideas

In June 2012, 20 students of Tohoku University joined a two-day program. The quiz was held on before and after the session, consists of 20 general business ideas and business ideas which the authors included in BMG. The Authors use five-point scale test (1 = Don't understand at all to 5 = Strongly Understand). They are from various faculties and are all freshmen. The Authors can regard there is no significant difference on their previous knowledge. 18 students answered both, so the authors compared these 18 students.

Table 1 shows its principal questions. In all 20 questions, after is higher than before and its average was 1.64. The Authors can point out three points as an evidence of its teaching effectiveness.

Table 1. Understanding survey in Tohoku University (2012)

No	Content of questions	Before	After	B/A
1	What is the management of company	2.59	3.94	1.52
2	What is the difficulty of company management	2.53	4.76	1.88
3	How to reduce fix cost ratio	1.29	4.53	3.50
4	Good company sometimes suddenly bankrupt	1.53	4.41	2.88
5	Effect of cash shortage	2.29	4.76	2.08
6	Outsourcing can reduce labor cost	2.29	4.53	1.97
7	Depreciation reduces benefits, but not reduce cash	1.82	3.59	1.97
8	Too hard price competition is harmful	2.06	3.94	1.91
9	Large Sales don't mean large surplus	3.82	3.88	1.02
10	Deflation suffers company	3.06	3.12	1.02
11	Education is necessary despite it takes a cost	3.41	4.35	1.28
12	Factors to obtain new job other than money	2.47	3.94	1.60

- (1) To understand management and difficulty as a real experience (Q1, Q2)
- (2) To learn importance of cash management and accounting (Q4, Q5, Q6)
- (3) To acquire new knowledge on accounting (Q3, Q7).

On the other hands, the authors have to mind BMG has not strong to increase understandings for commonly known ideas (Q9, Q10). However, it worked to improve understandings on general business ideas although it doesn't appear in BMG (Q11, Q12). Therefore, the authors can conclude BMG's teaching effectiveness is widely approved for beginners.

5.2 Satisfaction

The Authors conducted a survey of satisfaction and their motivation at after questionnaire. It is five-point scale questionnaire (1 = Very Negative to 5 = Very Positive). 19 students responded. Table 2 summarizes its result shows very high satisfaction of participants.

Table 2. Satisfaction survey in Tohoku University (2011)

No	Content of questions	Average	SD	Mode
1	Satisfaction of this program	4.67	0.58	5
2	Can you recommend this program to others?	4.47	0.94	5
3	If there is an advanced course, do you want to participate again?	4.21	0.95	4

6 Conclusion

Herein, the authors introduced our board game, BMG, to simulate traditional management. As a conclusion, the authors confirmed our work has enough teaching effectiveness and possible to provide opportunities to increase student's motivation.

6.1 Reconsidering Potential of Board Games

From the experience of creating BMG, the authors confirmed the potential educational power of board games. To adapt to physical limits and time limitations, the authors have to waive many important ideas bravely. Nevertheless, the authors were thereby able to create a very familiar game to beginners. Return to the origin of "Why we create a game?" is required.

6.2 BMG Afterwards

As we reported, the authors have been continuing development of tangible board game. SKG (Software Kaihatsu Game, Hamada et al. [7]), and SCC (Supply Chain Collaboration Game, Kaneko et al. [8]) are typical examples of the extension of BMG. Now the authors have seven categories, 17 games in BASE business game series and is expected to grow up in Japan and Thailand.

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