## Development of BASE Mass Manufacturing Production

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**Abstract** This article details the development of a business board game replicating Mass Production called "BASE Mass Production Game"(MPG). It was adopted from the original game called "BASE manufacturing game" (MG) that we already developed. Improvements were made to the game to make it easier to understand and to provide a different view of business and management. The purpose of making this game was to provide a simulated experience for engineering managers reflecting the cost of production, Mass Production, economic uncertainty, market demand, capacity, and accounting. The results of the participants' performance and satisfaction were compared before and after playing through the use of questionnaires. The teaching objectives were reached and figured out by the statistical numbers reflected in the participants' end of game results.

Keywords: Business Game, Board Game, Manufacturing Game, Mass Production, BASE

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## Introduction

Thailand is one of the most famous countries that is a free social environment for Entrepreneurs. According to Report of the Global Entrepreneurship Monitor 2016/2017 (2017), Thailand is ranked in 5th in Media's attention for Entrepreneurs, 3rd in acceptance ratio of "Fear of failure." Many students in Thailand dream of opening their own business. However, few universities provide an opportunity to learn business management skills or any business related experience. Thus, it has become an imperative issue to teach business management, and entrepreneurial skills in many universities, especially for engineering students.

Student authors (Chairungroj, Ruenpak, Pitkhae, and Piromkij) were fourth-year students of Engineering Management or Management Technology course at Sirindhorn International Institute of Technology (SIIT), Thammasat University, have been studied business theory for three and half years. However, this knowledge was separated and fragmented, and tend to forget after the examinations.

Meanwhile, Teacher authors (Hamada, Kaneko, Hiji) was struggling to provide a learning opportunity to explore business theory horizontally, to unite fragmented expertise with real business by using five senses. Such activities matched Student Author's demands. Student authors felt interested in their activities, and joined their project (BASE) in August 2016 as senior project students, with ten other members, and started to develop a new game.

## **Literature Review**

The BASE project has two surfaces. One is to play a game to train engineering students. The other one is to develop business board game with engineering students. As Wolfe and Gold (2004) mentioned the ultimate goal of business education is to develop a good business game, student authors obtained a lot of optimized business idea later.

As Hamada et al. (2014), Kaneko et al. (2016) stated, BASE project has developed various kinds of physical board business games. BASE was created by Hamada and his associates in 2007. It

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has been commonly known at ISAGA together with its related associations. This most famous game is BASE Manufacture Game (MG), a typical small manufacturer business model and focuses on price competition to increase profit margins. In 2016, his group developed a Thai version of the BASE MG; refreshing its design (Hamada et al., 2016).

## Characteristics of MPG, Teaching Policy and Purpose

MG's idea belongs to Small Business, no consideration on a large company then. For example, MG treats only one kind of product, and customer's number was limited, up to 28.

We planned to improve MG. The new game should be sufficient for teaching future engineers who would be working in large firms upon graduation. Therefore, the author decided to increase the variety of decision making options while keeping good aspects of MG. The name "BASE Mass Production Game" (MPG) was given to this new game. The development of MPG is in comparison to other business simulation games which focus on the mass production itself but also to contribute to the field of engineering education more practically.

#### Tangible Board Game

MPG is a very attractive business education board game to understand basic of manufacturing that also provides competition, motivation, and fun. The board game comes with equipment that offers friendly atmospheres for the players to enjoy while they are learning. Most of all it helps players understand business principles within the flow of the game. This game is best suited for business students, or anyone is interested in the mass production business. In sum, board game contains many elements and factors simulating real-life factors that encourage business learning. The tradition of BASE, "to study by using five senses" is quite fresh for students in digital age and increase their interests.

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#### **Teaching Purposes**

We decided the teaching purposes of MPG as follows. They are mostly similar to MG.

- 1) Understanding cost control.
- 2) Understanding how to set a fair price.
- 3) Understanding fear of price competition and bankruptcy.
- 4) Understanding importance of business strategy.
- 5) Understanding product control.
- 6) Understanding inventory control.
- 7) Understanding how to manage risk and uncertainty.

#### Difference between BASE Manufacture Game and MPG

As mentioned above, MG tried to imitate small company's management to be able to understand for engineers who have never studied business. For example, most teams make just one product per month by only one machine. To solve this problem, the authors increased a lot of choices for players. We described a difference between MG and MPG in Table 1.

Main Focus	MG (Original) Price Competition	MPG General Management of Mid-class Company
Cash at the beginning	3,000	5,000
Raw Material	One type, 20/each	Various, Depend on
		Material Card
Lead time for raw	None	1 Month
materials delivery Delivery Cost	None	Charged
Number of Machines	1-2	Over 4 Lines
Capacity of Machine	1 per month	3per month
Events affect	None	Depend on Chance Card
all participants.		+ Situation Card
Capacity of Market	24	280 + Customer's Order
Defeated Products on	Return to Company	Stays in the target
bidding		market and cause Value
		reduction
Duration of Game	3-4 years	One year

#### Table 1. Differences between MG and MPG

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### Cutting-Off

Reality and Easiness are in a trade-off relationship. To seek a real management, the game will be complicated. It takes time to learn the rule and causes a delay. Hamada, Hiji, and Kaneko (2015) argued "Cutting-Off" is necessary to create a good game.

On the way of developing MPG, we met same problems. The elaborate game takes a long time to learn, makes many mistakes, takes a long time to operate, and less satisfaction. To solve this problem, we cut out some ideas. It was required to consider how to keep students understand the complex rules, not to cause delay, not to decrease the performance of MPG. We took the methods as follows.

1) Considering rules that are more difficult than MG, we decided to shorten the game period as only one year.

2) Provide enough share capital and loan to avoid bankruptcy during the game.

3) Using cards that affect all members of the same table to save the time and individual questions.

4) Increasing the capacity of markets to avoid bidding which takes a long time.

5) Lead students to sell Customer-Demand Deal to refrain bidding throughout their experiences.

6) A well-prepared sample of accounting sheets and slides to explain the rule briefly.

As a result, the duration of the game was just 80 minutes, most of the teams have finished its accounting within three hours lecture, and we could reserve enough time for debriefing.

## Flow of Mass Production Manufacturing Game

### Initiation

Two or three students form a team acting as the CEOs and executives of a company. The minimum number of teams needed to begin this game is three. However, four or five teams are recommended. Every team starts with 2000 in capital and 3000 as a loan.

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#### **Objectives**

The game has definite objectives throughout the year. The goals to be reached at the end of one year are:

- 1) All loans (3000) must be settled.
- 2) Improve company performance and strategy.

#### Timetable

One year is separated into 16 periods. As shown in Table 1, in some months, Procurement of raw materials (P) and regular selling opportunity (S) is limited. Players draw various types of cards. By "Situation Card," economic condition might be changed and affects all members of the same table. "Chance Card" provides players a benefit. Sometimes, they meet "Customer Demands cards" reflects the demands of foreign customers that is separated from regular sales by bidding (Sales-on Demand.) Manufacturing and sales-on-demand are always possible.

#### Table 2. Flow of one-year activities

ST	CH	1	2	3	4	5	ST	CH	7	8	9	10	11	12	ST	13	CH	14	15	16
		Р			Р	SL						SL				Р				SL

Note: ST = Situation Card, CH = Chance Card, P = Raw material procurement, SL = Regular Sales period

#### **Procurement and Manufacturing**

After drawing one "Situation card," each team starts choosing their "Chance." Chance relates to the economic condition applied to all participants on the table. Next, each team draws a "Material card" for each supplier to set prices. Then teams start their manufacturing process. Each team makes products from the raw materials they bought. However, the raw materials cannot be put on the production line immediately because it takes one month to arrive at each team's factory. Once the manufacturing process begins, it will take one month of production before it becomes a final product ready for shipment.

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Additional "Situation cards" are drawn every six months, and the Chance can change at that this time also. In this stage, companies should consider their production power and current economic conditions to determine how many materials they should buy and what Chances are most effective.



Figure 1. Example of a situation card (1, 2) and material card (3, 4)



Figure 2. Example of Chance card

#### Selling and Bidding

After each team's company has finished their final production, they must sell their products. There are two possible ways to sell the products in this game. First, is through "regular sales." It is done in three regular markets (Eco, Standard, and Premium - see Figure 3). Each company must pay for shipping costs to access the marketplace. This rule brings into the risk and competition with other game players. Another choice for each team is to sell their products to correspond with "purchases orders" that will have fixed prices, and pop up in the game randomly (See Figure 4). The purchase order requests are usually in large amounts.

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Therefore, at times companies may have to cooperate with other teams to fill the demands of the purchase orders. Bidding will become necessary when companies sell their products on the market, and the number of products exceeds the market's capacity. When bidding is required, every team will have to determine their selling price and show their prices at the same time with the other teams on the board. The lowest priced products are first out. The remaining that exceeded capacity stays on the market. Failed products get a 30% reduction in value. If they fail to sell after three times, the price will become 10% of the original price.



Figure 3. All Markets Examples

(The number in the first block is the indicated maximum selling price per item. The other one shows the market capacity.)



Figure 4. Example of order cards

#### Accounting and checking

As same as other BASE business board games, at the end of every year, companies must complete their accounting sheets. This will indicate the company's stability and performance. Each team must also double check with their accounting information from the preceding year. They are mostly same as MG, but least improvement has been added.

### **Teaching Effectiveness**

MPG is used for students studying in the SIIT faculty of Thammasat University in Thailand. Questionnaires were conducted to verify the effectiveness of MPG.

#### Survey on understanding of Business Ideas

On March 6, 2017, 45 students of the SIIT faculty joined a two-day program of playing MPG. The students were Engineering Management (EM) students, Civil Engineering (CE) students, and Mechanical Engineering (ME) students. Students were divided into two groups: EM students and CE&ME students. Because EM students have basic knowledge of business, management, and accounting. However, CE and ME students, they lack any business or management knowledge. The questionnaire was divided into before and after game playing sessions consisting of nine general business idea questions. The evaluation scale was as follows: "Don't Understand" = 1 to "Strongly Understand" = 4.

Table 3 shows the main questions provided for EM students. The results of the answers to all nine questions showed a higher understanding after playing the game than before playing. The average was 1.10. We can point out three points as an evidence of its teaching effectiveness.

Table 4 shows the main questions provided for CE/ME students. The answers to all nine questions showed improved understanding after playing the game than before playing it. Its average was 1.42. We can point out three points as an evidence of its teaching effectiveness.

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No	<b>Content of Questions</b>	Before	After	B/A
1	Do you understand the importance of cost?	3.00	3.30	1.10
2	Do you understand breakeven?	3.17	3.30	1.04
3	Do you fear of bankruptcy?	3.11	3.40	1.09
4	Do you worry price competition?	3.00	3.40	1.13
5	Importance of business strategy of company	3.11	3.50	1.13
6	Importance of risk management	3.06	3.45	1.13
7	Importance of production planning	3.11	3.35	1.08
8	Concept of inventory control	3.06	3.35	1.09
9	Impact of company uncertainty	3.00	3.40	1.13

#### Table 3. Understanding Survey of EM students (n=29)

#### Table 4. Understanding the Survey of CE&ME students (n=16)

No	Content of Questions	Before	After	B/A
1	Do you understand the importance of cost?	2.46	3.08	1.52
2	Do you understand breakeven?	1.69	2.77	1.64
3	Do you fear of bankruptcy?	1.92	3.23	1.68
4	Do you worry price competition?	2.23	3.31	1.48
5	Importance of business strategy of	2.69	3.31	1.23
	company			
6	Importance of risk management	2.62	3.23	1.23
7	Importance of production planning	2.53	3.23	1.28
8	Concept of inventory control	2.23	3.08	1.38
9	Impact of company uncertainty	2.23	3.08	1.38

The authors can conclude that the EM students came out higher than the CE&ME students because they had prior knowledge of general business ideas. The after questionnaires also showed that the EM students were even higher than the questionnaire results of the CE&ME students. This fact shows previous knowledge effects on the outcome. Nevertheless, the average of Before-after ratio of CE/ME students is higher than EM students. It was considered that CE&ME students had become more knowledgeable and understanding of business principles as a result of playing MPG without enough previous knowledge. Therefore, the authors think that MPG is still familiar with beginners, even it uses vast numbers and complicated rules in the short term than MG.

#### Achievement of Teaching Purposes

Table 5 shows the total result of improvement. For Teaching Purposes, points represent all objectives were raised. Therefore, we can consider MPG has achieved our Teaching Purposes by MPG.

No	Content of Questions	Related Teaching Purpose	Before	After	B/A
1	Do you understand the importance of cost?	1	2.69	3.18	1.18
2	Do you understand breakeven?	2	2.47	3.06	1.24
3	Do you fear of bankruptcy?	2, 3	2.53	3.31	1.31
4	Do you worry price competition?	3	2.59	3.34	1.29
5	Importance of business strategy of company	4	2.84	3.40	1.20
6	Importance of risk management	7	2.78	3.34	1.20
7	Importance of production planning	5	2.78	3.28	1.18
8	Concept of inventory control	6	2.63	3.21	1.22
9	Impact of company uncertainty	7	2.59	3.25	1.25

**Table 5.** Understanding Survey of all students (n=45)

*Note: see teaching purposes in the topic "teaching purposes" above* 

#### Achievement of Teaching Purposes

A survey about satisfaction with the game was conducted in an after-game questionnaire. The scale used was: "Don't Understand" = 1 to "Strongly Understand" = 4. Thirty-three students responded to both groups. Table 6 and Table 7 summarize the results. These tables show the satisfaction level for EM students and the reasonable satisfaction for CE&ME students.

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No	<b>Content of Questions</b>	AVG	SD	Mode
1	Does your company satisfy performance?	3.00	0.73	3
2	Do you think you get new knowledge after playing this game?	3.15	0.67	3
3	Did you mistake in your calculation?	3.00	0.79	3
4	Do you like the idea and element of this game?	3.00	0.79	3
5	Is this game interesting?	3.10	0.72	3
6	Is this game containing some confusion?	2.80	0.7	3
7	Do you understand this game very well?	2.90	0.55	3

#### **Table 6**. Satisfaction Survey of EM students (n=29)

**Table 7**. Satisfaction Survey of CE&ME Students (n=16)

No	Content of Questions	AVG	SD	Mode
1	Does your company satisfy performance?	2.62	0.96	3
2	Do you think you get new knowledge after playing this game?	3.08	0.64	3
3	Did you mistake in your calculation?	2.77	0.93	3
4	Do you like the idea and element of this game?	2.77	0.83	3
5	Is this game interesting?	3.08	1.04	4
6	Is this game containing some confusion?	2.92	0.64	3
7	Do you understand this game very well?	2.92	0.86	2

The conclusion of the satisfaction survey shows that the average of EM students was higher than the CE&ME students. Thus, it can be concluded that the EM students had a higher level of satisfaction with the MPG game after they played it. Our objective, to develop a physical business game suitable for those students who have experiences to learn business has been succeeded.

### Feedback from Students

Two students in SIIT tried out this BASE manufacture game to investigate the possibility of its use in university classes:

#### 1) Ms. S. S., SIIT, EM student

First, after I listened to the game's introduction, I had no idea how the game could teach us about business. I was confused about how to play this game, but after I had played the game with a few mistakes, I started to understand the game. Then I noticed that it was also enjoyable to keep planning the strategy to earn revenue and get more profit. It not only helped me understand more about business strategies, but it was also fun learning through the game.

2) Mr. K. H., SIIT, ME student

In my opinion, Mass production game helps understanding about production business more management. Before playing the game, I thought it would be straightforward. The set of rules looked simple, and the equipment was distinct. During the game, I found the game conditions became more complicated; including selling strategies, production management, and bidding prices. *After playing the game, I became more aware of the effect of* external factors, which were hidden in the game. These secreted factors had a great deal of influence on the action of an individual player; even more so in the actual business world.

Positive feedback was given by our test panel. Before students tried, they seemed to have no idea of "game" as a kind of business activity and didn't understand the concept that games are a standard tool for learning. After they tried out the game in short exercises, it was concluded that MPG would be an excellent tool for training. It is also a training tool for midsize firms.

## Conclusion

#### Current problems

To develop a game to manage middle-class company management to correspond students' demands who have already studied business previously has been succeeding. Not only MPG has the power to extend the learning opportunity to those students but has a potential to be used commonly in real industry, within a short time.

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It was our first trial to conduct MPG and remained many difficulties to let students understand the basic idea of this game, especially for the students who have less experience of learning business. We need concrete manuals and exercise session for next opportunity. This game can firmly provide a sense of business as well as fun. MPG includes many circumstances that are vital to understanding business planning and strategy, as well as, cost control and risk. Knowledge of primary manufacturing process and accounting principle can be built up throughout the game by repeating improvements.

#### Future Works

More work is required to improve the actual game board and game materials. The explanation techniques of the game also need to be developed more. It is necessary to gather feedback about the game to keep growing it and to understand the benefits that this game can offer students. At this point, the MPG contains enough business elements such as cost control, business strategy, and economic uncertainty. However, improvements are needed in simplifying the game so that participants can obtain more benefits adequately and efficiently from playing it. It would also be desirable to try to shorten the time it takes to play this simulation game. Development MPG completed in May of 2017, but the authors aim not only to use for teaching at the university level but also to use as a teaching tool in mid-class firms, by the next generation team.

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