# THE DESIGN OF MULTI ROLE WEB BASED SUPPLY CHAIN SIMULATION GAME FOR LEARNING

Armand Omar Moeis[1] , Rama Raditya[2], Akhmad Hidayatno[3]

Department of Industrial Engineering, University of Indonesia, Depok, Indonesia
E-mail : armand.moeis@gmail.com, rama.raditya90@gmail.com, ui.hidayatno@gmail.com

***ABSTRACT***

*This research discus about the design of new simulation game in supply chain field named Enterprise Game. Enterprise Game is multi role and web base simulation game hence It can represent the complexity of supply chain. Enterprise Game is tested on the undergraduate student to evaluate its capability for teaching supply chain concept. Based on evaluation result, Enterprise Game is capable for teaching supply concept.*

***Key words:*** *simulation game, experiential learning, supply chain.*

## 1. INTRODUCTION

Supply chain is system for delivering products or service from raw materials to end customer [1]. According to the supply chain council, supply chain activities are divided by 5 categories, they are: 1) Planning 2) Sourcing 3) Making 4) Delivering 5) Return [2]. Moreover, supply chain function must also interact with another function in company like financial and marketing. There are possible conflicts of interest between function in the company [3]. These enormous number of entities and interaction between entities create dynamic and detail complexity [4].

Simulation and Gaming approach can be used for understanding the complexity of supply chain because its capability to provide environment similar to real supply chain system and can be used for experimenting decision without real world consequence [5]. The use of simulation game for supply chain field was started in 1960 through beer game supply chain released by Massachusetts Institute of Technology (MIT) [6]. Beer game was designed for showing the bullwhip phenomenon in supply chain [7]. Beer game did not emphasize more extensive supply chain learning concept. Earlier version of beer game was also board game type hence causing difficulties in distributing the game. In 2004, department of industrial engineering of university of Indonesia designed a web based version of beer game, hence easier the distribution the game of, but still retain the characteristic of original beer game [8]. Because of the limitation of learning point in original beer game, In 2008, [9] beer was a redeveloped by adding internet technology and expanding the model hence adding support for more extensive learning of supply chain concept like multi role aspect. In order to the contribute advancement of the usage of simulation game in supply chain field, this research discusses the design of web based supply chain simulation game with multi role capability and market competition to teach the complexity of supply chain.

## 2. LITERATURE REVIEW

### 2.1. Simulation Game

Simulation game or business game is combination of gaming in simulation context. Simulation game combines attributes of game: competition, cooperation, rule, participation, and role with simulation [10]. Advantage attribute of simulation games is experiential learning because the process of knowledge creation relies on the transformation of self-experience [11]. These characteristic of the simulation game make simulation game become suitable for learning supply chain because cooperation and sharing information, which is encouraged in the simulation game, can increase the efficiency of supply chain [13]. The artificial nature of simulation game mean player can freely test their strategies

and trial-and error without real world impact. Another advantage of learning in simulation game learning over traditional method like lecturing or reading book are simulation game give more excitement for student, encourage student to actively involved in decision making process, and simulation game can enriched participator learning [14]. Student can also learn problem solving skills from simulation through implementation of learning-by-example, trial-and-error, analytical reasoning strategies [15].

Recent survey of the business simulation chain suggest that instead of just demonstrating single phenomenon like bullwhip effect in beer game, most modern simulation game cover much more complex management issue. Modern simulation game, even the board one, can be used to teach ordering strategies and the importance of modern inventory management [16].

Recently, there are growing number of web based simulation games because of the advancement of web technology. The advancement of web technology has a lot of contribution to simulation game. The contributions are:

1) Providing player with simulated environment, which is similar with real life counterpart for decision making.
2) Providing opportunities to construct a more complex and realistic environment
3) Web technology can embed algorithms for making decision in simulation game (Houten & Jacobs, 2004).

## 3. ENTERPRISE GAME

### 3.1. Overview

Enterprise Game is multi role web based supply chain game. Enterprise Game is built on system dynamic simulation software Powersim then converted into flash technology and published by using Forio™ platform. The unique point of Enterprise Game simulation game from the previous recent simulation game is Enterprise Game is consisted of independent multiple roles for each team instead of just one like in Distribution Game and there are interdependency between decision made by one team with opposing team. Another advantage of this simulation game is this simulation game is played on real-time basis which player is allowed to insert decision and receive response form simulation any time instead of turn-by-turn basis like on the beer game. Another key advantage of Enterprise Game is Enterprise Game is built on web technology hence Enterprise Game can be played with any kind of computer with regular browser without special software and can be accessed from the entire world.

### 3.2. Gameplay

In Enterprise Game, each team will play as a company. A company consists of three role, they are purchasing, Production Planning and Inventory Control (PPIC), and marketing. Each role is working separately and no voice communication or direct discussion is allowed. Each role also has different key decision and information (see Table 3). This separation of information, decision, and working condition are used to represent real condition in the company and to endorse the communication and collaboration between roles. The main task for purchasing is to ensure the availability of material for production by buying from supplier. The main consideration for purchasing is material requirement planning and supplier information. Material requirement planning is should be issued by PPIC role while supplier information is stated in game scenario which consist of supplier delivery lead-time and price. Purchasing must carefully release purchase order to supplier by considering the price of material to help reduce production cost and the lead-time of supplier to ensure the material come on needed time. There is trade off in selecting the supplier. There are suppliers with long lead-time but lower price hence reducing flexibility in production but the help reducing production cost and vice versa, there are suppliers with short lead-time with higher price hence supporting more flexible production schedule but with higher cost. PPIC role main responsibility is ensuring the availability of finished product to be sold with

the production lowest cost as possible. In order make sure there are required product to be sold, PPIC must plan the production schedule based forecasted sales and available capacity. PPIC also must lower the production cost by minimizing the amount of finished product hence reducing material carrying cost and reducing the overtime production which have higher production cost. In collaboration with purchasing role, PPIC must ensure there is no sudden change in production schedule because it may force purchasing to buy unplanned material or increase the raw material stock. The last role is marketing. Marketing role main responsibility is balancing the demand and supply of product by implementing marketing strategy like price, promotion, and market research to affect the demand of product. For example, when there are too many inventory, marketing can increase marketing campaign or cut the price to boost the demand and vice versa. Marketing role is also responsible in forecasting the potential demand by reading the historical data of total demand. Marketing also must carefully watch opponent's team marketing strategy because their strategy can affect the demand of the company for example if competitor's price is lower than their price, their company might have lower demand hence we should change the price. In order to stay competitive, a team must respond competitor's strategy. Table 2and

Table **3** show key decision and learning point for each role. Figure 2 Marketing Interfaceis the interface used by marketing role to insert decision and Figure 1 shows the industrial situation, which is used for formulating strategy. The information provided by game, processing information into action on every role, and interaction with another role and team are the means of this simulation game to give learning by doing experience. The detailed learning point in Enterprise Game is summarize in Table 1.

### 3.3. Evaluation Method

Enterprise Game is tested by undergraduate students majoring industrial engineering because this industrial engineering learn about supply chain management and marketing course. The participants consist of 6 undergraduate students and divided into two teams. Each participant takes one of the roles on each team. Before the participant tried the simulation game, they were given the briefing about the overview, rule, and possible scenario of the game. The participant then teamed up and developed strategy together. They also got time to familiarize their self with interface of the simulation game. Simulation game is held for 45 minutes net. After the simulation game, the participant is interviewed and asked to fill the questionnaire. The interview and questionnaire result is used for reflection and evaluation of Enterprise Game.

## 4. FINDING

### 4.1. Participant Perception about the Simulation Game

After the participants have played full session of the game, they are asked about their opinion toward the simulation game by having them filled a questionnaire. Six items is asked on a likert scale of 1 to 5 (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree and 5 = very strongly agree). The seven items in questionnaire represent the ability of simulation game to teach basic SCM concept and the importance of communication and collaboration in SCM. The summary result of the questionnaire is showed on Table 1 Questionnaire Result. Questionnaire result shows that for question number 1, 2, 4, and 6 which represent the ability of this simulation game to teach basic SCM concept, majority of the item's rating in questionnaire is more than four hence this score confirm the ability of this simulation game to teach basic SCM concept. Question numbers 3, 5, and 7, which represent the ability of simulation game to teach the importance of communication and collaboration in SCM, have more than four rating hence confirm the hypothesis.

### 4.2. Participant Strategy Analysis

During the simulation game, there are some remarkable strategies made by the participant, each teams made their own information system Because of the separation of information on each role and each role was prohibited to communicate directly, each team made a simple Enterprise Resource Planning (ERP) by using cloud document service. Each team's Sales role use ERP for informing PPIC about the forecasted sales hence PPIC can make better decision planning based on forecast data. PPIC also use for production planning for quickly transform its production planning data into material requirement planning which used by purchasing role. The creation of simple ERP system demonstrated that multi role aspect of this game contributes to create the awareness of the importance of collaboration and communication. Another strategy used by the participant is they use higher cost strategy. Participant did not play too intense because since this is just a game, they just play It the fun way, hence they use higher cost strategy because higher cost strategy require less calculation and easier to implement.

The interdependency of decision on each team also affects team's decision. Each teams formulates their strategy by considering strategy taken by opponent teams. For example, they adjust their price strategy based on opponent's price to maintain the demand of product and profitability.

## 5. CONCLUSION

Based on questionnaire result, Enterprise Game effectively teaches participant the concept of supply chain, knowing the importance of communication and collaboration, and endorses the participant to communicate and collaborate effectively between different roles. Participants also formulate their strategy based on opponent's strategy because there is interdependency in decision between teams.

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## AUTHOR BIOGRAPHIES

**Armand Omar Moeis** is a lecturer in Department of Industrial Engineering, University of Indonesia and researcher in System Engineering Modeling and Simulation (SEMS) lab. He received his master degree from TU Delft in Engineering and Policy Analysis program. He is also a member of International Simulation and Gaming Association (ISAGA). His email address is armand.moeis@gmail.com.

**Rama Raditya** is a master student in Department of Industrial Engineering, University of Indonesia. He received his bachelor degree Department of Industrial Engineering, University of Indonesia. Right now his research interest is supply chain simulation and gaming. His email address is rama.raditya90@gmail.com

**Akhmad Hidayatno** is a senior lecturer in Department of Industrial Engineering, University of Indonesia and head lab of System Engineering Modeling and Simulation (SEMS). He received his PhD degree from Department of Chemical Engineering, University of Indonesia. His email address is ui.hidayatno@gmail.com.

## Appendix: Table and Figure

**Table 1 Questionnaire Result**

| | | Means | Standard Deviation |
|---|---|---|---|
| 1 | This simulation game helps understanding the interaction between marketing, production, and purchasing division | 4.5 | 1.0 |
| 2 | This simulation game give understanding about the tradeoff between product stock, inventory cost, and backlog | 4.0 | 1.0 |
| 3 | This simulation game teach the importance of integrated demand generation function with another function in supply chain | 4.7 | 0.6 |
| 4 | This simulation gave give understanding about importance factors which must be considered in purchasing materials | 4.2 | 0.5 |
| 5 | This simulation game gives understanding of the importance of capacity management for fulfilling demand | 4.2 | 0.6 |
| 6 | This simulation game shows the importance of demand forecast | 4.2 | 0.5 |
| 7 | This simulation game teach the importance of communication and team work between division in the company | 4.8 | 0.5 |

Table 2 Learning Points

| Role | Input | Process | Output |
|---|---|---|---|
| Marketing | Demand historical data | A. Forecasting<br>• Determining forecasting method<br>• Creating demand forecast | • Potential demand forecast |
| All | All information from game and team member | B. Sales and Operation Planning<br>• Determining the amount of demand through price, promotion, and research.<br>• Create production schedule | • Demand Forecast<br>• MPS |
| PPIC | • MPS<br>• BOM,<br>• Inventory data<br>• Cost Data<br>• PPIC Data | C. Material Requirement Planning<br>• Calculating material requirement schedule<br>D. Capacity Management<br>• Calculating Production Capacity<br>• Calculating Capacity Requirement<br>• Determining Capacity Level | • Material requirement schedule |
| PPIC | • Material Requirement Schedule | E. Creating Workstation Working Schedule | • Work station job order |
| Purchasing | • Material Requirement Schedule<br>• Supplier Information | F. Determining Purchasing Strategy | • Purchase order |

Table 3 Key Decision and Information

| Role | Key Decision | Key Information |
|---|---|---|
| Purchasing | Purchase order to each supplier | • Material cost<br>• Lead time material<br>• Inventory carrying cost<br>• Level of Inventory |
| PPIC | Job order to each work station | • Workstation capacity<br>• Inventory carrying cost<br>• Manufacturing Cost<br>• Level of Inventory |
| Marketing | Price, Marketing, and Research budget | • Level of Inventory<br>• Market demand<br>• Revenue and cost<br>• Competitor price<br>• Market share |

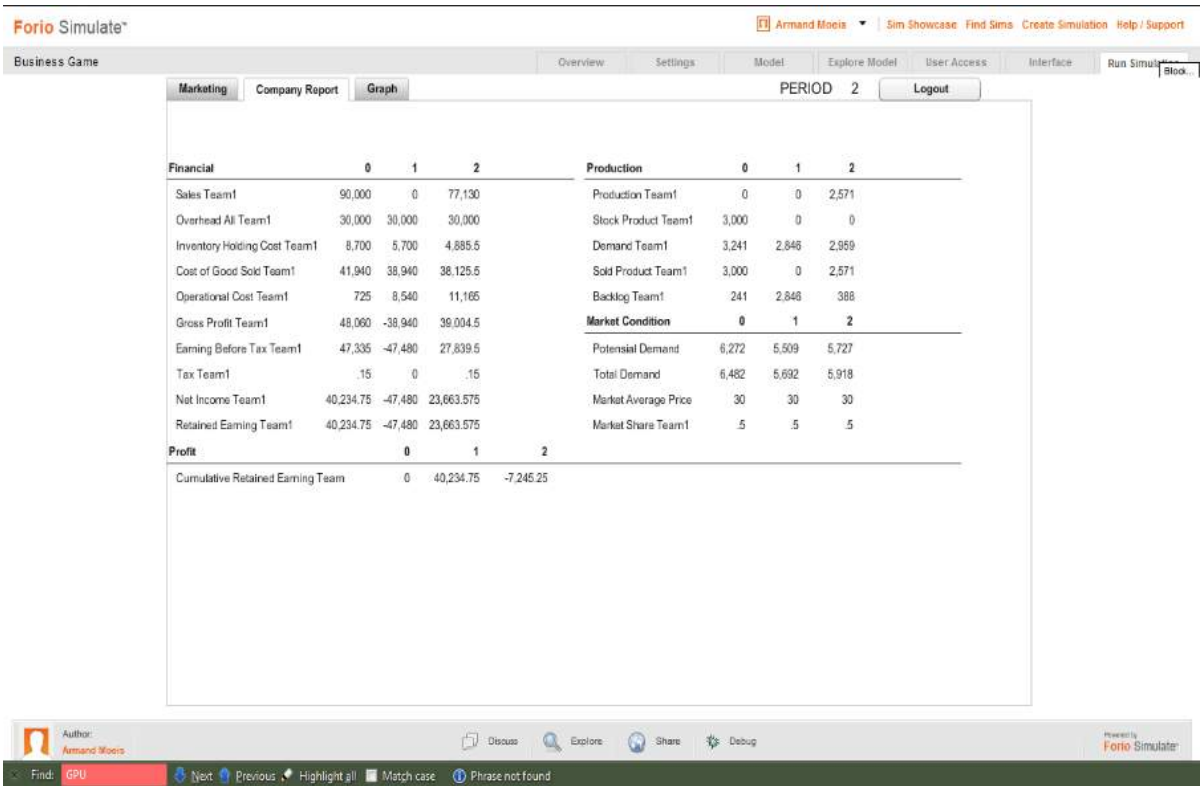


Figure 1 Industrial Report

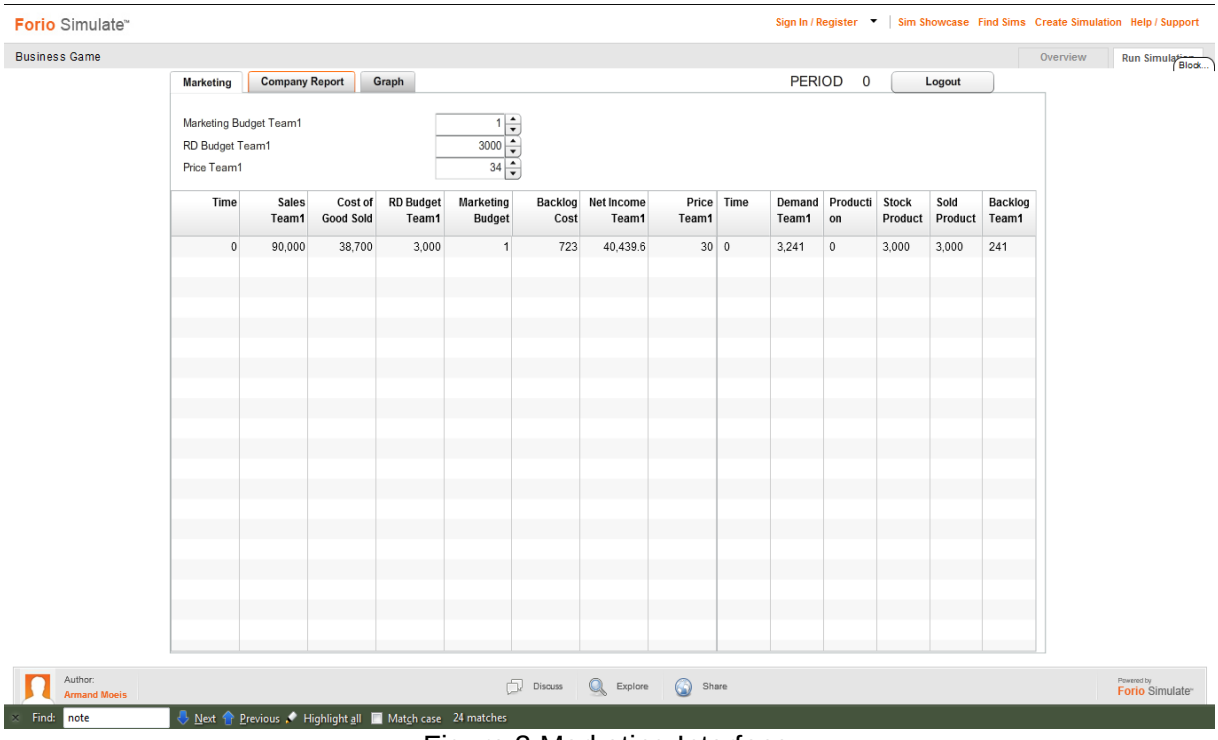


Figure 2 Marketing Interface