Experiences in Designing Board-type Simulation Games for Center-Satellite Industrial Systems*

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Abstract

In order to help introduce systems thinking and organizational learning to the center-satellite industrial systems in Taiwan, we have designed a series of board-type simulation games sponsored by Taiwan's Center-Satellite Development (CSD) Industrial Coordination Center. Through these games, we hope to improve managers' understanding of dynamic complexity problems. In this paper, we will discuss the original idea, evolution of design, and some experiences from the successes and failures in our works.

Introduction

Better coordination in any industrial systems is always one of the major challenges for their related firms advantages. However, there are many counterintuitive decision-makings among center-factories and satellite-factories in Taiwan's networked industrial system. In this study, we first designed a Center-Satellite System simulation game (we called it *CSS Game*) for better understanding the interactions in decision-makings and their unintended consequences in the long run. We then developed some board-type simulation games based on some of systems archetypesthat (Senge, 1990); we called them *SAB Games* (Systems Archetypes-Based Simulation Games). Because of systems archetypes' advantage of generalizing dynamic complex system, it is hoped that managers can better understand dynamic complexity problems through practicing these simulation games as transition objects. Two systems archetypes "growth and underinvestment" and "fix that fail," were choosen for their characteristics quite match with our center-satellite industrial systems. In this paper, we will describe how *CSS Game* and *SAB Games* we are developed. We believe that more this kind of games of various types for various purposes and various systems are needed in the future.

Task Debrief

(I) The CSS Game

A commonly concerning issue among "JIT technique," "time-based competition" (Stalk and Hout, 1990), "fast cycle time" (Meyer, 1993) or "business process reengineering" (Hammer and Champy, 1993) is how to reduce the impact of time-delay In "Industrial Dynamics" Forrester (1961) had shown how the structure of the multi-stage production-distribution

* Center-satellite industrial systems are industrial coordination network systems in Taiwan with over 120 center-factories, each with up to 400 networked satellite-factories.

systems tends to amplify disturbances that occur at the previous stage. The improvement of part may be resulted in counter-productive consequences by systemic structure (Sterman, 1989; 1994). Therefore, the objective of *CSS Game* is to simulate some dysfunctional consequences if the JIT technique is implemented in the center-factory only. There are two center-factories in the *CSS game* (see Figure 1), one center-factory has the opportunity to shorten the delay time (that is, implementing JIT), while the other remains the same. The conditions of the satellite-factories are all the same; their capacities are all constrained. The constrained capacities represent the lack of fundamental solution (i.e., the satellite factories implement JIT at the same time). Therefore, this game is to simulate how good-will policy of center-factory resulted in trade-offs of Q, C, D (Quality, Cost, and Delivery time) among those networked companies and to help them have better understanding about systemic problems among center-factories and satellite-factories. The fundamental solution of this problem should be to implement JIT technique at the satellite-factories at the same time. However, due to the deeply imbedded "company boundary" in managers' mental model, the center-factories either unaware of this need, or unwilling to help the satellite-factories.

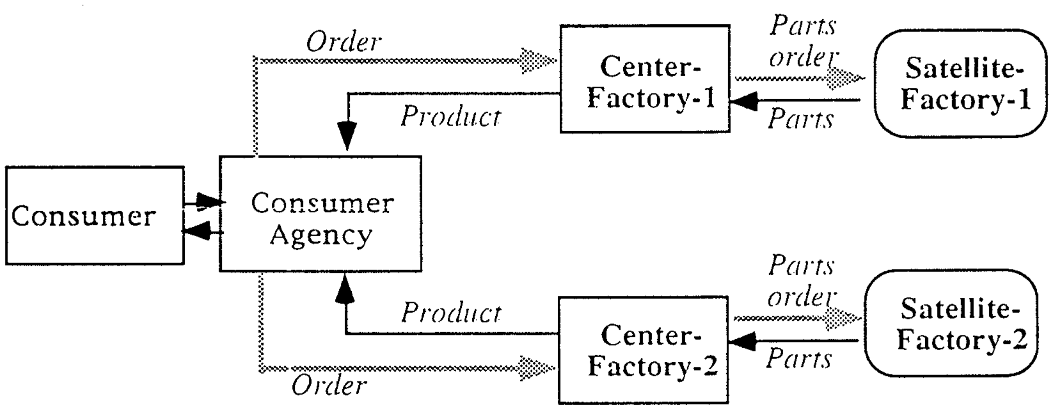

Figure 1: CSS Simulation Game System Map

(II) The SAB Games

We then developed the *SAB Game* which focused on some specific issue in dynamic system. Some systems archetypes are classified into four categories (see Table 1): (1) single / growth type (i.e., growth and underinvestment), (2) single / problem-solving type (i.e., fix that fail), (3) two-sides / growth type (i.e., success to successful), and (4) two-sides / problem-solving type (i.e., escalation). In this stage, we concentrated on the archetypes of "growth and underinvestment" and "fix that fail" to study the center-satellite industrial systems.

Table 1: The Classification of Some Systems Archetypes

	Single	Two-Sides
Growth	single / growth (growth and underinvestment)	two-sides / growth (success to successful)
Problem-Solving	single / problem-solving (fix that fail)	two-sides / problem-solving (escalation)

Originally, the works of *SAB Games* were designed to be simulated on board-type for participants. However, in order to (1) reduce the complicated operation, (2) increase the times of number, and (3) raise the degree of freedom about simulation, we changed board-type design to worksheet design (see Table 2). Before running the *SAB Game*, we introduce the case study, and asked the participants to write down the principles of their decision-makings. Then, participants start by themselves to play the simulation game without any instructions. Finally, the causal loop diagram, principles and patterns of behavior for the specific systemic structure were discussed.

Table 2: Worksheet simulation game of "growth and underinvestment"

	Personel-Sector		Production-Sector		Sales-Sector		Finance-Sector		
Time	hiring	salesmen	capacity -order	capacity	order	backlog	rev.	cost	profit
1									
2									
• • •									
50									

Summary

"Board-type simulation game," "worksheet simulation game" and "management flight simulator" that are important transition objects (or microworld) for better understanding the dynamic complexity issues. However, there are different learning effects and levels among these various kinds of microworlds (see Table 3). "Board-type simulation game" provides awareness of dynamic complexity. "Worksheet simulation game" allows participants better understanding of he dynamic complexity. Finally, we could get insight about the dynamic complexity through play the "management flight simulator."

Table 3: Learning effect of different kinds of games

Learning effect or level	Types
Awareness	Board-type simulation game
Understanding	Paper worksheet simulation game
Insight	Management flight simulator

There are three main stages in running these games: (1) case study, (2) decision-making prior to run the microworld, (3) discuss the relationships among event; pattern of behavior; and systemic structure. We believe that more this kind of games of various types for various purposes and various systems are needed in the future. We propose three dimensions of game designing: purpose, systemic structure, and industry category (see Figure 2). For example, there is one game designed for better understanding the systemic structure of "growth and underinvestment" for life insurance industry. The more kind of games developed, the more insights about dynamic complexity would be gotten.

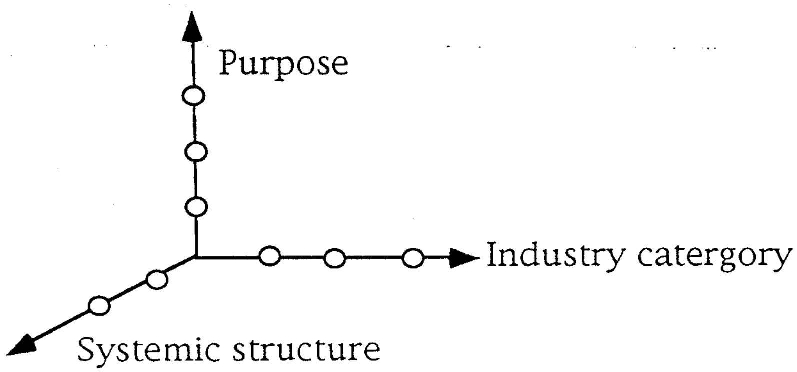

Figure 2: Dimensions of various types of games

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