Chapter 11
2MGM Chains and Balancing

11.1 Serial SCM and Balancing

11.1.1 Introduction

A significant number of researches have dealt with supply chain management (SCM) [1, 3]. Many studies have focused on the bullwhip effects and win-win strategy problems in the supply chain. The latter is generally treated as a problem of coordination/contract in enterprises.

This problem is here considered as a supply chain balancing issue in profit (economics) and lead time (reliability) [6]. Then, the supply chain is assumed to be the two-chain model consisting of the Management Game Models (MGMs) of service (sales) and manufacturing types [5, 7].

For balancing issues, the concept of integral optimization is first introduced in Chapter 2.2. The integral optimization in profit and lead time (workload) is the condition of integral balancing in a win-win strategy. This condition is discussed on the basis of the pair-matrix table (map) in MGM [9].

11.1.2 Balancing Problem

11.1.2.1 General Problem

The object of SCM is outlined in Fig. 11.1.1. The problem of SCM is to optimize the profit totally through the supply chain shown in Fig. 11.1.1, and to speed up the management by the reduction of lead time.

This problem is typically formulated as follows:

![Figure 11.1.1 The object of SCM](image-url)

Goal: Marginal Profit $=\text{Revenue} - \text{Operating Cost} \rightarrow \text{max}$ (11.1.1)
Constraints: Resource, Lead time, Environment, and soon. (11.1.2)

In this case, the collaboration of cost reduction and demand creation is important, and the cooperative game approach is introduced.

The SCM has a two-level structure [4] as shown in Fig. 11.1.2. If the structure is possible in duality division, the SCM can be handled in the conventional frame. However, it is impossible in duality division at a glance, and thus, it is the interest of this study.

This problem is optimistically the gain-sharing problem of the inter-enterprise, while it seems pessimistically to be the risk allocation problem such as the stock. For the reason, it is valuable to consider the upper level that adjusts the balancing of inter-enterprise (MGM agent).

### 11.1.2.2 M-M SCM Model

In [6], examples of MGM modeling are classified into two types: Series and parallel types of MGMS. For the series type, a general formulation and example are given in [8] under M/M enterprise type.

For win-win exploration, the focused series type is the Marketing-Manufacturing SCM model (M-M SCM). This model consists of a two-chain SCM of Marketing-MGM (MGM1) and manufacturing MGM (MGM2). The simple SCM and Assembly SCM models of marketing and manufacturing types also exist.

These two-chain SCM model is common as shown in Fig. 11.1.3. Figure 11.1.3 shows that customers arrive at demand speed, $d$, and are delivered at the speed, $d$. Under the condition, the pricing setting, $p_t$, and stock level, $N_1$, are considered.