4.2 Service Versus Manufacturing Model

4.2.1 Introduction

Traditionally, there has been a noncooperative problem of marketing and manufacturing since M. P. Follet [15]. Marketing (sales center) is concerned with sales, whereas the manufacturing (production center) is concerned with costs. This factor often falls in the theory of constraints [4], and it is not necessarily directed to profit maximization.

This two-center problem is first discussed in a job-shop model with order-selection [8, 9]. Recently, this two-center model has been developed into a Management Game Model (MGM) [11], and the ellipse theory with pair-pole has also been found in the pair-matrix table in FMS [14] and in job-shop [12] types.

However, the discussion involves a somewhat limited manufacturing type. In modern society, the service economy [3] is growing, and service management has become important. Some contribution [1, 5, 6, 7, 16 etc.] to this subject have been made, but their magnitude is not generally known.

Here we examine the basic model (MGM), which consists of sales and production centers, which works for generalization of the service system type [11]. The service (manufacturing) type involves the case in which the idle (busy) cost is the constant with respect to the traffic/utilization rate.

First, the service-type MGM versus manufacturing-type MGM is defined, and the traffic accounting is introduced. Next, the service-type MGM is discussed for the existence of optimal traffic. Finally, the common ellipse theory is ascertained on the pair-matrix table, and its common usage is discussed under a strategic goal. Throughout the chapter, the service versus manufacturing system type is noted.

4.2.2 Management Game Model

4.2.2.1 Explanation of the Model

In Chapter 4.1, we proposed the basic model, MGM, which gives an optimal relationship between economics (profit) and reliability (lead time). The MGM consists
of the sales (demand) center pursuing profit maximization and the production (supply) center pursuing cost minimization. The problem involves maximization of the difference (profit) under a shorter lead time, but it is dependent on the cooperation of the two-center model.

This enterprise model is formulated in the queueing form. For simplicity, let us consider an enterprise model of $M/M/1$ type. In this type, the mean operating cost, $EC$, per unit time is given by

$$EC = \alpha_1 \frac{\rho}{1 - \rho} + \alpha_2 \rho + \alpha_3 (1 - \rho), \quad \rho < 1 \quad (4.2.1)$$

This cost system is based on the traffic/utilization rate, $\rho$, and is called here the traffic accounting. Generally, the traffic/utilization rate, $\rho$, is obtained from the work sampling in IE, or from the occupation divided by the capacity of the system.

In the traffic accounting, Eq. (4.2.1) is transformed in two ways as follows:

$$EC = \begin{cases} \alpha_1 \frac{\rho}{1 - \rho} + (\alpha_2 + (\alpha_3 - \alpha_2) (1 - \rho), \quad \alpha_2 \leq \alpha_3. \quad (4.2.2a) \\ \alpha_1 \frac{\rho}{1 - \rho} + (\alpha_3 + (\alpha_2 - \alpha_3) \rho), \quad \alpha_2 > \alpha_3. \quad (4.2.2b) \end{cases}$$

The Eq. (4.2.2a) is the case of manufacturing-type MGM (Fig. 4.2.1a), and the Eq. (4.2.2b) is the case of service-type MGM (Fig. 4.2.1b). In the manufacturing type, the busy time occurrence becomes larger, and thus, the production availability becomes larger in the case of $\alpha_2 \leq \alpha_3$. From Fig. 4.2.1a, the busy cost is fixed, and the idle cost is variable with respect to traffic/utilization rate, $\rho$.

In the service type, the idle time occurrence becomes larger, and thus, the customer availability becomes larger in the case of $\alpha_2 > \alpha_3$. From Fig. 4.2.1b, it is noted that the idle cost is fixed, and the busy cost is variable with respect to $\rho$.

### 4.2.2.2 Objective Functions

Generally, the mean sales reward, $ER$, per unit time is given by

$$ER = \frac{p}{d}. \quad (4.2.3)$$

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**Fig. 4.2.1** Cost structure of MGM