CHAPTER 3 ENERGY MANAGEMENT

3.1. INTRODUCTION

Management is essential in any organized collaboration and should be implemented at all levels of an enterprise (Koontz [14] *et al.*). An organization has certain inputs to its disposal, be it human resources, funds, technology, skills etc. and it is the basic function of the manager in charge to efficiently manage these valuable inputs in pursuit of achieving predefined objectives in an optimum manner. In an industrial plant, like the cryogenic air separation plant, typical inputs are production personnel, the various maintenance departments (electrical, mechanical, instrument, turbo etc.), engineering, financial and information technology, among others and all these resources are normally subjected to some form of management. Energy is another important input to the plant; the plant needs energy to produce its products to the client's specification and given that cryogenic air separation plants are energy intensive by nature, efficient energy management will have a definite impact in the cost per product produced.

For instance, the oxygen plant at Sasol Secunda in South Africa is composed out of several trains, which collectively account for approximately 35% of the factory's total power consumption. In terms of the total operating cost of the oxygen plant itself, the energy cost constitutes 72% thereof compared to the 2% of labor costs and 8% of maintenance related costs [15]. This relatively large electricity cost is typical of cryogenic air separation plants (also refer to Sarkar [6] and Gupta *et al.* [9]) and it is quite possible to manage the usage of energy in such a way as to ultimately reduce the cost per product produced.

3.2. ENERGY MANAGEMENT AT CRYOGENIC AIR SEPARATION PLANTS

Turner [16] defines energy management as the control of energy consuming devices for the purpose of minimizing energy demand and consumption. Energy management is defined by Janse van Rensburg [17] to be the perspicacious and efficient usage of energy. Another definition is that from Ottaviano [18] where energy management is defined as the reduction of demand through conservation.

The aim of energy management is defined by Thuman *et al.* [10] as the reduction of energy expenditure for the purpose of reducing the cost of a product so as to increase competitive performance.

With the various energy management definitions in mind, one can come to the conclusion that energy management is some sort of process, ultimately resulting in reduced energy expenditure. How, then, would one go about describing this process which energy management is? In terms of energy management applied to cryogenic air separation plants, energy management may sufficiently be described as a transformation process and this will be the topic of the next section.

3.2. MODEL FOR ENERGY MANAGEMENT AT CRYOGENIC AIR SEPARATION PLANTS

The Oxford dictionary [19] defines a model as a representation of reality, a simplified description of a complex system. The model developed here serves as a generic framework for energy management at cryogenic air separation plants and provides insight and understanding of the energy management process as well as giving structure to this understanding; it is a product of systems thinking and takes on a holistic approach towards energy management. A basic outline of the model is presented in figure 3.1.

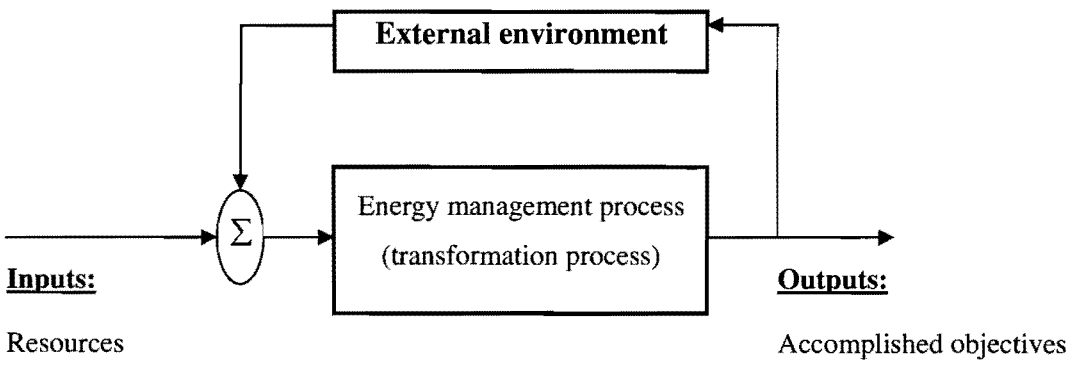

Figure 3.1: Basic outline of the energy management model.

The basic function of the energy manager is to transform the inputs (resources), in an effective and efficient manner, into outputs of higher value. With the available resources as levers and with the expected objectives in mind, the energy manager has to convert the resources into the pre-defined objectives by means of a transformation process. This transformation process is the organizational structure of the energy management program for which the management thereof is the responsibility of the energy manager.

The organizational structure of the energy management program is part of larger systems such as the industry to which it belongs, social systems, economic systems and even the natural environment and this is accounted for by the inclusion of the external environment. Typical inputs from the external environment are resources like capital, skills, facilities and people and, as shown in the figure, the external environment is ultimately affected by the outcomes of the energy management program.

3.3. ENERGY MANAGEMENT SYSTEM: THE TRANSFORMATION PROCESS

It is generally accepted that the fundamental components of management are planning, organizing, staffing, leading and controlling (Koontz *et al.* [14]). Energy management is a managerial action and most of these functions also apply to the energy management system. Figure 3.2 depicts the energy management model and states the components of the transformation process.

Through organizing the energy management program the energy manager gives it definition and structure. It mainly involves identification and classification of required activities and the grouping of these activities in a structured and meaningful way.

Planning involves the decision-making process. This is where policies are set, objectives are determined and the strategies in attaining these objectives are established.

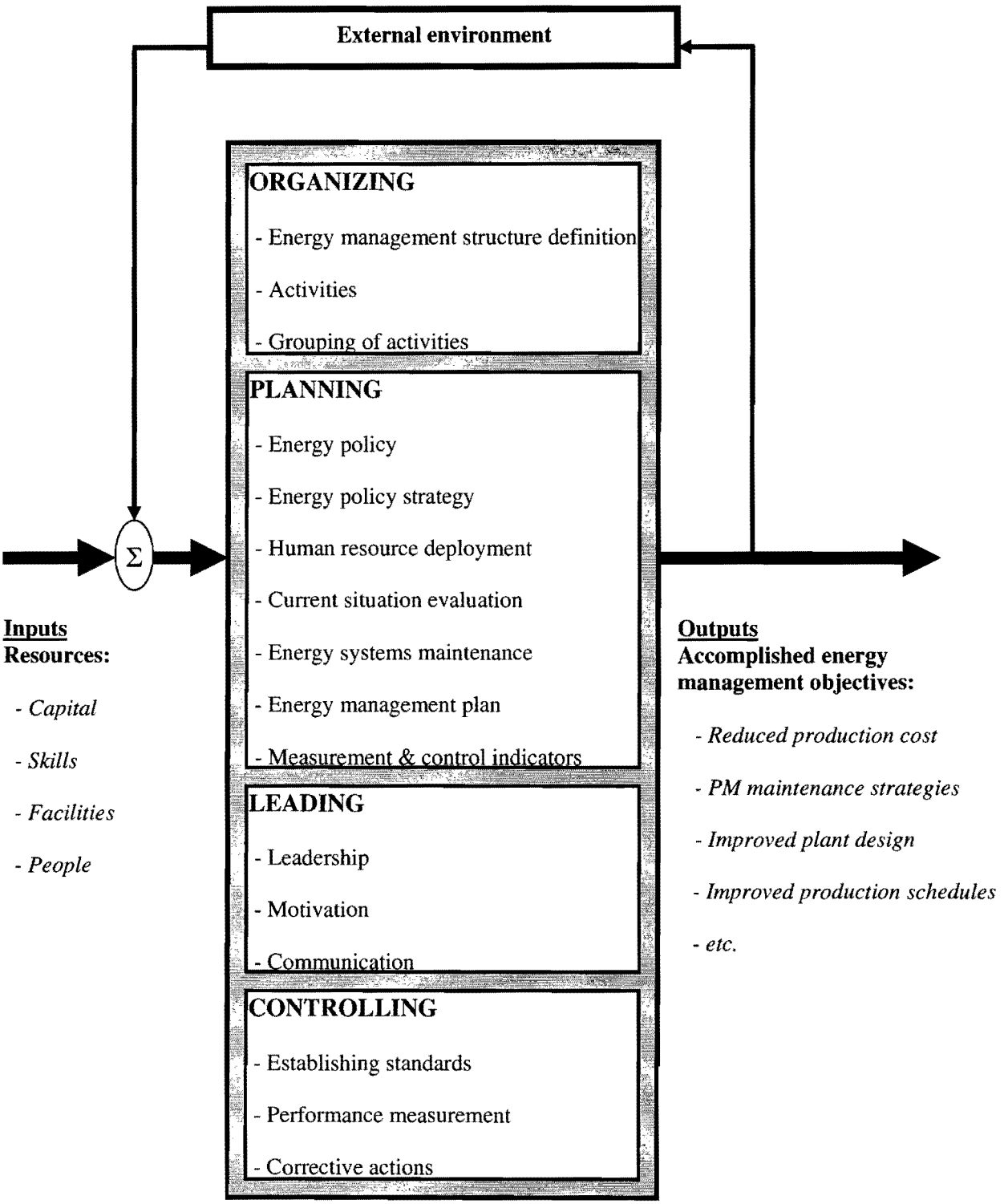

Figure 3.2: The energy management model.

Leading refers to the process of influencing people so that they will strive willingly and enthusiastically toward the achievement of energy management goals.

Controlling is the measurement and correction of performance in order to ensure that objectives and the plans devised in attaining them are being accomplished.

These managerial functions make up the transformation process and in performing these functions, the energy manager enables an efficient and effective process for achieving energy management objectives. Analysis of each of these functions will be given in the chapters that follow.

3.4. CONCLUSION

In this chapter a model for energy management is given; the energy management process is modeled as a transformation process, in which resource inputs are converted into outputs of higher value.

The model entails the transformation process, its inputs and outputs and the external environment as well as the interaction between all of these. Inputs are resources like people, skills and facilities; outputs are the accomplished energy management objectives like improved preventive maintenance schedules, optimized production schedules and reduced energy cost.

The external environment accounts for the higher-order systems to which the energy management system belongs. The transformation process involves the managerial functions of organizing, planning, leading and controlling, which are the core managerial functions the energy manager has to perform. Each function entails various activities and will be explained in more detail in the chapters that follow.