OPERATIONS MANAGEMENT

İNCİ ŞENTARLI

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PREFACE

This textbook aims at the undergraduate and graduate level courses and includes the fundamental topics of operations management. A flexibility is provided so that topics and the order of topics can be selected to be adapted to different course contents and depth of the topics selected also depends on the course targets. Through the use of this book the students are expected to be challenged to reach an academic maturity at the required levels.

As highlights of the text, interactive teaching approach is targeted. The author expects the students to be involved in active argumentation, analysing complex alternatives and assumptions for validity, and making contingency involving judgements.

Various examples throughout the chapters demonstrate detailed solutions to understand the quantitative material. At the end of each chapter, the problems presented reinforce basic concepts and emphasize the models. It is expected that when the students are doing the problems, their understanding of the techniques is enhanced and their problem solving capabilities are highly improved.

The author assumes that the students possess a tendency to have the curiosity and skepticism, to provide solutions to resolve the contradictions in the problems. The student is expected to underline the clear statement of the problem, search for the reasons of the problems, and when seeking information weigh the precision of the information and credibility of sources of information.

Creative thinking abilities of students are expected to be improved, especially in chapters involving design processes, such as product design, job design, process design etc. The student is expected to look for options and deal with the components of the problem to reach an entire solution to the original problem.

Open ended questions are presented at the end of each chapter to comprise interpretations and discussions and encourage critical thinking and a desire to learn. The text aims to help the students develop their critical thinking skills with these questions and problems provided at the end of each chapter.

All of the changes that have been made in the second edition support the over all text philosophy. In this new version, some additional material is included; and some of the examples, questions, and problems are totally new.

This edition retains the six parts and the overall structure of the old version. Part I provides the introduction to operations management and deals with the philosophy and fundamentals of operations management and provides an extensive discussion of the role of operations in business life and consists of 1 chapter.

Part II deals with the fundamentals of quality management and consists of two chapters. Chapter 2 deals with the philosophy of quality management and important concepts in quality systems. Chapter 3 deals with the statistical foundations of quality control and offers a detailed coverage of techniques used

for these purposes. Part III deals with the forecasting issues and examines different forecasting techniques used in business systems and the philosophies behind them, and consists of 1 chapter.

Part IV deals with the system design in operations management and consists of 5 chapters. Chapter 5 presents the importance of product design and patterns for designing products in the context of production system. Chapter 6 deals with the issues relating to job design and emphasizes work measurement techniques. Chapter 7 offers a detailed coverage of various types of production sytems in business organizations. Chapter 8 deals with the strategic capacity planning and facility location in business sytems. Chapter 9 is devoted to the design of production systems, various heuristic approaches are emphasized for product layout as well as process layouts.

Part V deals with the inventory management and consists of 2 chapters. Chapter 10 deals with the methods used in inventory management with independent demand. Chapter 11 gives an overview of the principles used in inventory management with dependent demand. Part VI deals with the queuing systems and offers a detailed coverage of different queuing models and consists of 1 chapter. Part VII is composed of one chapter, and focuses on planning, scheduling, time-cost trade-offs and probabilistic computations in project management.

Setting all the topics down on the paper and bringing the book to its final stage required a lot of work and lots of patience and lots of support as well. Initially, I would like to thank our chairman, Prof. Dr. Hasan Işın Dener, who first encouraged me to start writing books and who even has offered races, between me and him, in the writing process. I am indepted to his continued encouragement in the months, and in the years that followed, and the support that enabled me to accomplish this first actual book.

My special thanks go to all the colleques in my department, especially Prof. Dr. Ahmet Yalnız, our former dean of the faculty, for their support throughout all the years I had been teaching at Çankaya University. I also would like to thank the many students I have taught over the past 12 years for the extraordinary ideas they put forward, along with the projects they have suffered and during the class discussion of challenging issues.

Many of the changes in the second edition are based on extensive feedback from those who have used the book. My sincere thanks go to my students who contributed to the improvement of the text and I would greatly appreciate all the feedback and suggestions I received after the first edition of this text.

I also wish to express my appreciation to Sarie Brits Şentarlı. I am fortunate in having such an outstanding friend and gratefully acknowledge her for her expert assistance in re-proofing the text. I wish to thank the director of Efil Publishing Company, Fethiye Çolak, and Prof. Dr. Ömer Faruk Çolak for their professional approach and distinctive publishing insights of the text. I would like to congratulate the abstract artist, Türkan Sarı, who created compositions of balance and harmony throughout the text and designed another extraordinary cover for the second edition. Finally, I would like to thank my family for their support and patience they have displayed through all the stages of the writing process I spent in isolation.

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PART 1

INTRODUCTION TO OPERATIONS MANAGEMENT

CHAPTER 1

OPERATIONS MANAGEMENT, OPERATIONS STRATEGY AND PRODUCTIVITY

Chapter 1

Operations Management, Operations Strategy And Productivity

CHAPTER OUTLINE

CHAPTER 1

OPERATIONS MANAGEMENT, OPERATIONS STRATEGY AND PRODUCTIVITY

Operations management is at the heart of substantial amount of changes affecting the business world. It promotes the creativity, and has a critical, strategic role in the organizations. Operations Management is concerned with producing tangible and intangible goods upon which we all depend and producing goods is of the vital reason for any organization's existence.

All organizations including not-for-profit organizations can be expressed as production systems. They convert a set of tangible or intangible goods into one or different type of products which may also be called as tangible or intangible products or a combination of them. The inputs can be materials, labor, equipment, money, management, energy etc. The outputs can be cars, computers, refrigerators, food, textile, legal services, a holiday program, insurance, education, a TV program, etc.

Operations management is simply the management of productive systems. In other words, it is the management of all activities needed to create a value in the form of goods and services in business organizations. These activities extend from supplier to customer along a value chain. The primary activities in operations management include developing projects, selecting processes, locating facilities, designing production systems, arranging layouts, designing jobs, organizing work, measuring performance, managing quality, scheduling work, managing inventory and so on.

Operations are indeed transformation processes and exist in the systems of any kind of production (Figure 1).

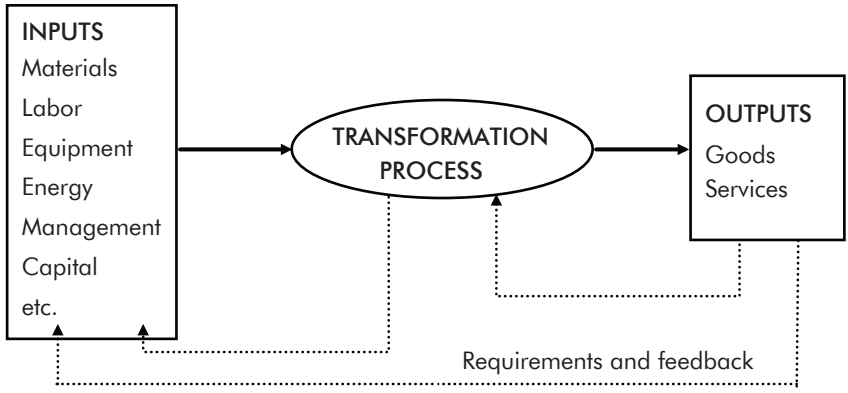

FIGURE 1.1 A Production System

The transformation process may be psychological like in the entertainment sector, informational like in communication sector, physiological like in healthcare sector, physical like in manufacturing operations or locational like in transportation operations etc. Operations management is concerned with creating goods and services to satisfy the needs of the customers (Figure 2).

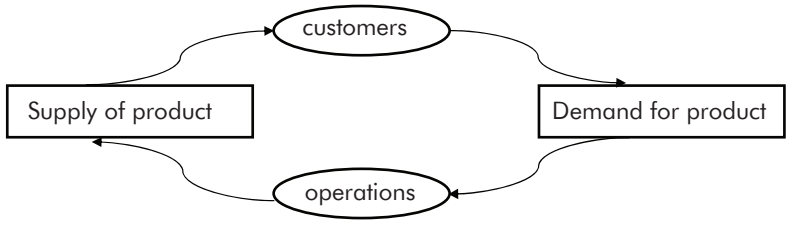

FIGURE 1.2 Demand-supply loop between customers and operations

The Role Of Operations Managers In Organizations

Operations managers responsibility for the management process in operations function area consists of planning, organizing, staffing, leading, and controlling. For all decisions of the management process, an operation manager needs information which is specific to the production system (Figure 3). The information may be related to inputs, transformation process where operations exist or outputs.

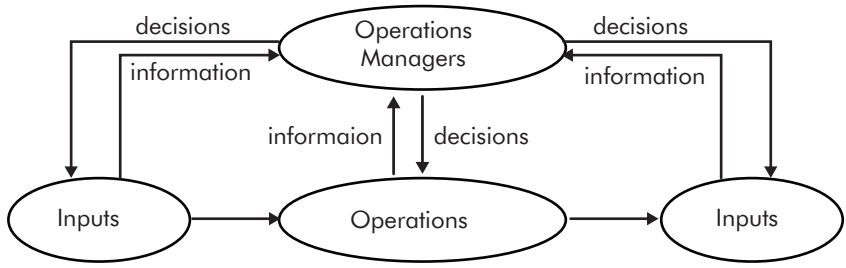

FIGURE 1.3 The role of an operations manager in the operations system

The critical decisions of operations managers cover product design, process selection, capacity planning, facility layout, job design, production system design, inventory management, materials requirement planning, supply chain management, and quality management. To be successful in making those decisions related to all these critical issues, operations managers need technical, conceptual, and behavioral skills.

Another prime task of operations managers is promoting the creativity which will allow organizations to respond to so many changes. The operations managers as a production manager, a plant manager, a shop manager, a supervisor, a chef, a production engineer, an operations analyst, a site manager etc, all are expected to cope with the changes in the environment and bring innovation to the operations system continuously.

Effective operations managers put the emphasis on improving revenues and at the same time, enabling goods and services to be produced more efficiently. It is this combination of higher revenues and lower costs which is very important to any organization.

Operations As One Of The Three Primary Functions Of Organizations

Operations, finance and marketing are the three primary functions in business organizations. These functions overlap as shown in Figure 1.4 below:

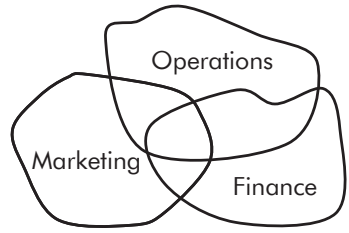

FIGURE 1.4 Primary functions in an organization

In the central area where the three functions overlap, the related activities of all functions are resembled. The areas where pairs of functions overlap denote the related activities of those primary functions. In the rest of the area, the functions have different activities and work independently to make their contributions. In the overlapping areas, the primary functions are dependent on each other and they all interact to achive the goals of the organization.

The success an organization reaches is not only due to how well each area performs but also how well the areas are consistent with each other. For instance, if a decision is taken to use a long production run by the operations function, whereas if the marketing function has the decision to customize the product and use a unique structure each time, the result will be a catastrophe.

Strategical Operations Management

The strategical management system of an organization covers the whole organization and the strategical operations management is a subsystem of it. To have an effective operation's strategy, it should be consistent with the overall organization's strategy. The operations function is most likely to be successful when the operations strategy is integrated with other functional areas of the company, such as marketing, finance, human resources.

From strategical point of view, any operations function may have three primary roles to play in the organization. First, it may act as a driver of the organization's strategy. Secondly, it may act as an implementer of the organization's strategy and as a third role, it may act as a supporter of the organization's strategy.

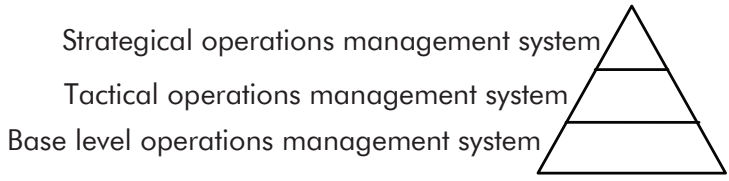

FIGURE 1.5 Subsystems of the operational management system

The above structure represents the framework for operational management systems and may be used to compare strategical operations management subsystem with tactical operations management subsystem and base level operations management subsystem when we consider the whole operations management system of the organization. In

strategical operations management system, problems are addressed by top management. In the top level, long-range analysis and predictions are involved and the activities are goal oriented.

Operations strategy deals with operational aspect of the organization's strategy. Strategical decisions relating to operations strategy includes product design, quality, process design, choice of technology, new facilities, location selection, etc. and any other operational systems must align with the strategic goals.

Dynamics Of Operations Management Strategy

Since every field of company is subject to change and there are always changes occuring in the competitive environment, operations management strategy has to change constantly. For instance, operations management strategies of the company should change due to the changes in the life of the product produced.

In the birth phase of the product's life cycle, product design and development is critical. Frequent product and process changes may be needed to be planned and the relevant decisions needed to be taken by the strategical operations management at this stage. Utilizing different proto-type studies to find out the most economic approach for larger volume production is looked for throughout this stage and there may be few or no competitors accordingly. For the growth phase, competitive product improvements and differentiation providing flexibility in options, and increasing capacity may be needed to be planned in the operations management subsytem. Increasing number of competitors may appear along this period. When the product's maturity phase is reached, decisions may be taken like long production runs with most economic capacity, more minor and less rapid product modifications and the number of competitors stabilizes within this period. After the decline phase, reducing capacity with little product differentiation can be considered as operations management strategy of the company since termination of that type of production is going to be discussed in the near future and the number of competitors decline in the same way.

Critical Success Factors In Operations Management

Critical factors help the operations management function provide a competitive advantage. Those factors are relatively few activities that make a difference between having and not having a competitive advantage and that's why we call them critical. The critical success factors of operations management may overlap with the other primary functional areas of the company such as marketing or finance.

Once a strategy and critical success factors have been identified in the strategical operations management subsystem, the necessary activities should be grouped in the organizational structure. Then plans, budgets, and programs are needed to be built successfully to implement strategies that achieve missions.

If a differentiation is chosen to be achieved via innovation and new products, the critical success factor of the system may be product design. For the differentiation via quality, the critical success factor would be institutionalizing the quality. Or differentiation, also may be related to process, layout, location, human resource, supply chain, inventory, maintenance, scheduling etc.

Achieving Competitive Advantage Through Operations Management

If an organization carefully focuses attention on operations strategy, the organization becomes more competitive than the other companies. When a company wishes to have a competitive advantage, a system with a unique advantage over competitors is needed to be created.

The operations managers achieve competitive advantage via differentiation, low cost, response, and any other order winning dimensions. Either pure forms of these strategies or some combination of them will be implemented to create customer value in an efficient and sustainable way.

When competing on differentiation is chosen, the organization's opportunities should be utilized not only for creating uniqueness located within a particular function or activity, but also everything that the firm does. Differentiation should include everything about the tangible or intangible product like physical characteristics and service attributes, which influences the value that the customer derive from it.

The company may compete on low cost by identifying the optimum size and utilizing the facilities effectively and may become a low-cost leader among other companies. That company may also generate the competitive advantage through flexible, reliable, quick response which ought to have a value to the end customer. Through these specific strategies, operations management can increase productivity, and generate a sustainable competitive advantage.

PRODUCTIVITY

The term productivity is used to see the achievement of productive use of organization's resources in a company. In general, productivity measures amount of output produced per unit of input used as resource. The most general formula of productivity is expressed as the ratio of output to input.

$$\text{Productivity} = \text{Output} / \text{Input} \qquad 1\text{-}1$$

When we measure productivity of a system, we have to choose the boundaries of the system in the most appropriate way. The system may resemble a department, an organization, a sector in industry, entire industry or a country and the system boundaries should be chosen accordingly. Then how effectively resources are used can be tracked over time. For instance, by combining productivity measures of various companies in a sector based on a definite time period, aggregate results might be found.

An operation manager is concerned with productivity to make more profit or increase the market share of the company. Minimizing wastes when using resources also brings solutions to the environmental pollution issues. National productivity is also one of the primary concerns at a country, since high level of productivity brings high standards of living. When we consider the economy of a nation, increasing the wages or prices without an increase in national productivity may result in inflationary pressures on the nation's economy.

Productivity is measured in different ways depending on the type of comparison bases. If the productivity measure is based on only one type of output and a single input, partial productivity of the system is measured. If productivity of products based on more than one type of input is measured, multifactor productivity of the system is concerned. If all the outputs and inputs are included into the calculation, total productivity of the system is calculated.