LEARNING CURVES, USAGE OF LEARNING CURVES IN REDUCING WORKFORCE COSTS AS A TOOL AND AN EMPIRICAL STUDY

Öğrenme Eğrileri, İşgücü Maliyetlerini Azaltmada Öğrenim Eğrilerinin Bir Arac Olarak Kullanılmasına ve Bir Ampirik Çalışma

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Özet
Öğrenme eğrileri, endüstriyel şirketlerdeki üretim miktarı ile üretim için harcanan doğrudan işgücü süresi arasındaki ilişkiyi göstermektedir. Öğrenim eğrilerinin uygulanmasıyla işgücü girdi maliyetleri büyük oranda düşmektedir. Ayrıca öğrenme eğrileri vasıtasıyla ileride yönelik maliyet tahminleri ve karar alma mekanizması optimal bir şekilde işletilebilmektedir. Bu yüzden, öğrenme eğrilerinin bilhassa imalat sanayinde optimal bir şekilde uygulanması ve etkin bir şekilde uygulanması gerekmektedir. Bu çalışmanın amacı, öğrenme eğrilerinin işgücü maliyetlerini düşürme konusunda etkinliğin boyutunu göreceli olarak göstermektedir.

Anahtar Kelimeler: Öğrenme Eğrileri, İşgücü Maliyetini Azaltma Teknikleri.

Abstract
Learning curves indicate the relation between the production quantity in industrial corporations and direct workforce period of time spent for production. With fulfillment of learning curves, costs of workforce input decreases largely. On the other hand, by means of learning curves, cost estimations towards future and mechanism of decision have been able to be performed optimally. Therefore, learning curves should be internalized and fulfilled especially in production industry in an effective way. The aim of this study is to show the dimension of effectiveness of learning curves in respect of reducing workforce costs relatively.

Key Words: Learning Curves, Techniques of Reducing Workforce Costs

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1. Introduction

In industrial corporations, production has an important role in terms of costing, productivity, controls and saving the cost in a proper level. Each corporation working in free market conditions should control its costs in order to improve and save its existence. So, learning curves may take an important part in this process.

Learning or experience curve theory is a significant tool for application in the business sector. In manufacturing, it has been used to estimate the time for product design in addition to costs in recent times.

Learning curves are considered to be one of the most significant developing tools and sometimes overlooked as one of the JIT (Just in Time) systems. They are also an integral part in planning such corporate management strategies as prices, capital investment decisions, and operating costs based on learning or experience curves.

In today's world, rapid changes in manufacturing techniques and diversification cause new earning fields to come into existence. So in this study, it was searched for the roles of learning in reducing the costs of production.

In the first chapter of this study, it was given general concepts of learning. In the second one, the relationship between learning and costs was held. In the third one, the techniques of reducing costs were searched for and in the final one, an empiric study was realized.

2. General Concept of Learning

Learning may be defined in different ways. For instance, it may be defined that it is a reduction of costs by realizing a process again (Bursal and Erca. 1990; 167). Learning also causes to reduce labor costs since it supplies the compromise between the work and employee (Güneş and Otlu, 2003; 102). Learning curves may be defined as a line displaying the relationship between the unit production time and the number of consecutive units produced (Chase and Aquilano. 1995; 457).

Learning curves are important for automated productivity analysis, cost estimation, and resource allocation decisions. Learning curves present the relationship between cost (or time) and level of activity on the basis of the effect of learning. An early study by Wright (1936) disclosed the "80% learning effect, which indicates that a given operation is subject to a 20% productivity improvement each time the activity level or production doubles. A learning curve can serve as a predictive tool for obtaining time estimates for tasks in a project environment. Typical learning rates that have been encountered in practice range from 70% - 95%. Learning curves are also referred to as progress function,
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cost-quantity relationship, cost curve, product acceleration curve, improvement curve, performance curve, experience curve, and efficiency curve (http://members.aol.com/AllenWeb/learning.htm).

On the other hand, learning curve theory is based on three assumptions (Chase and Aquilano, 1995; 458):

- The amount of time required to complete a given task or unit of a product will be less each time the task is undertaken,
- The unit time will decrease at a decreasing rate,
- The reduction in time will follow a predictable pattern.

As a result, when any work is realized for the first time, it means that both the work and working methods have been tried but when the process is realized again, it becomes easier and labor costs begin to reduce. Learning states this situation.

3. Relationships Between Learning and Costs

Cost is a total expense measured by money, which is a devotion tolerated by a corporation in order to reach its aim (Büyükmirza, 2000: 44). In other words, it is the monetary equivalent of items and services used and consumed concerning production (Çetiner, 2000; 10), and it is also the totality of tolerations endured in order to reach any aim or have any object (Yükcü; 1999; 39).

The effects of learning on manufacturing costs have been applied in many application fields. Especially they have been largely applied in industries where workforce is intensive (Baloff. 1977; 332-339). The effect of experience on costs, which is obtained by repeating the process is summed up by means of learning rate (Bursal and Yücel. 1990; 167).

Not only should learning be held as the meaning of increasing working hours since the employees are used to working conditions but it should also be considered to be useful for reducing general expenses since they will use raw materials as an effective way (Güneş and Otlu, 2003;102).

The ratio of learning (RL) may be shown as follows (Shillinglaw, 1997; 609-621):

\[
RL = \frac{\text{Labor cost of the second working method}}{\text{Labor cost of the first working method}}
\]

3.1. The Reasons and Necessity of Learning

The main purpose of all the organizations and corporations is to be successful and increase the productivity. Learning has an important role during this process. Learning is
a matter of training, so it is necessary to realize such training activities as training courses, conferences, seminars etc. These activities supply the participants with the following benefits (Güneş, 2003; 283):

- Establishing the habits of strategic thinking,
- Showing members of any management their shortcomings and positive qualifications in a better way,
- Improving abilities of social relationship,
- Increasing the tendency of adapting to changing,
- Increasing information, knowledge and qualification, by means of those collective activities, more than individual ones.

On the other hand, employees improve themselves when they repeat these kinds of activities and gain skill and efficiency from them. Some general guidelines to improve individual performance based on learning curves (Chase and Aquilano, 1995; 465):

- Proper Selection of Workers: A test should be administered to help choose the workers. These tests should be representative of the planned work: A texterity test for assembly work, a mental ability test for mental work, tests for interaction with customers for front office work, and so on.
- Proper Training: The more effective the training, the faster the learning rate.
- Motivation: Productivity gains based on learning curves are not achieved unless there is a reward. Rewards can be money (individual or group incentive plans) or non-monetary (such as employee of the month, etc.).
- Work Specialization: As a general rule, the simpler the task, the faster the learning. Be careful that boredom doesn't interfere; if it does, redesign the task.
- Do One or Very Few Jobs at a Time: Learning is faster on each job if completed one at a time, rather than working on all jobs simultaneously.
- Use Tools or Equipment That Assists or Supports Performance: It is essential that performance should be supported by means of various tools or equipments.

The factors mentioned above show that learning curves are necessary for all of the organizations and working places.

### 3.2. The Effect of Learning

Organizational learning results from practice and comes from changes in administration, equipment, and product design. In organizational settings, it is expected to see kinds of learning which occurs simultaneously and often describe the combined effect with the learning curve (Chase and Aquilano, 1995; 457).
It is claimed that learning is more effective in labor intensive manufacturing systems than in capital intensive ones. It has been observed that learning in a corporation where the production system is applied according to labor intensive production system proportionally (that's to say, 75 % of production is realized according to labor intensive manufacturing system and 25 % of it is realized according to capital one) has been more effective than the one which is realized according to capital one. The ratio has been determined as 80 % (Gűneş and Otlu, 2003; 102).

4. Techniques of Reducing Costs

Techniques of reducing costs in industrial corporations may be held as follows (Çapçı, 1994; 23):
- Process and Method,
- Structure of Products,
- Management,
- Labor.

4.1. Loss of Time (Over working hours) due to Process and Method

Various factors resulting in loss of time due to process and method during working cause to reduce the productivity and performance in working places. These factors are process planning, programming the method in accordance with aim, determining targets properly and organizing the working place (Çapçı, 1994; 23).

4.2. Loss of Time Resulting from the Structure of Products

Increases likely to happen in work coverage due to characteristics of products produced in industry will affect labor costs directly. These are usage of the most economical method in manufacturing products, appraisal the quality of products, structure of machines used in manufacturing and models of products (Erol, 1996; 68).

4.3. Loss of Time Owing to Deficiency of Management

The responsibility of management in reducing working hours which are ineffective is very important. Costs of products increase due to implementing works without planning, deficiency of organization and of control policy. Activities of management concerning controlling costs of labor and reducing costs of products can be mentioned as follows (Çapçı, 1994; 24, Ergun, 1992; 278-279):
- Planning of organization and workforce,
- Choosing and training the staff for organization,
- Preparing for work study,
Waging,
Work appraisal.
Planning of manufacturing,
Internal control system,
Establishing suitable checking systems,
Employing qualified staff.

The most important functions of an effective management are as follows (Güredin, 1987; 166):

- Obtaining confidential information,
- Saving sources and items of any firm,
- Increasing productivity,
- Being in accordance with determined policies.

**Loss of Time Due to Employees**

Whether or not all the time is used effectively depends on employees. If any employee works inefficiently, sometimes gives up working, comes to work late, leaves work early, all of these factors affect productivity and costs negatively. Since bad working conditions cause employees to have a rest from time to time, employees begin to work slowly or give up working. That's why, in order to increase productivity and performance of workforce, it is necessary to supply employees with good working conditions and nutrition (Selçuk, 1982: 162).

On the other hand, absenteeism and coming to work late are the other problems for industrial enterprises. Both of them affect the efficiency negatively. Although coming to work late is less negative behaviour of any employee, it is the reason for loss of efficiency and money (Bingöl, 1990; 184).

5. An Empirical Study

5.1. The Purpose of Study

This study was realized in order to use "learning" in reducing costs as a tool.

5.2. The Coverage of Study

The coverage of study is the region of Biga in Çanakkale. A firm producing wooden gates was in this framework.

5.3. The Method of Study

Sample case study as regards determining costs was realized by visiting the firm
and interfering with manufacturing and observing the employees in the working place itself.

As is known, it is essential that a systematic research should be implemented and analyzed on one or more enterprises, any certain group or society in the method of sample cases during a certain period of time since the method of this study is a method of sample case (Altunışık and et al, 2004; 221-222).

On the other hand, sample case method is the one which supplies with systematic research of a private situation based on a kind of field background in the study of management and costs (Taş and Güner, 2003; 7).

5.4 Findings of Empirical Study
The findings of empirical study may be introduced as follows:

5.4.1. Species of the Firm
The corporation in which we realized the empirical study is the one which produces serial and standard items by means of using the final techniques and runs in full capacity. This firm produces the products by means of raw material intensive way. Production consists of 50 % raw material, 40 % workmanship and 5 % general production expenditure.

5.4.2. Observation of the Manufacturing System of the Firm Before and After Learning
We observed a master workman and his manufacturing method, who completed his former training, during our first visit in order to determine the level of costs and affecting level of labor costs. The worker completed the production of a wooden door by working 8 hours during his first working process (that's: 8x60: 480 minutes). This door cost 135 New Turkish Liras. The analysis of this manufacturing cost is as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material</td>
<td>74 NTL</td>
</tr>
<tr>
<td>Labor cost</td>
<td>54 NTL</td>
</tr>
<tr>
<td>General manufacturing</td>
<td>7 NTL</td>
</tr>
<tr>
<td>expenditure</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>135 NTL</td>
</tr>
</tbody>
</table>

During the second visit, we determined that the same workman produced the same type of door in 5 hours (on condition that the other factors were the same): 5x60mins: 300mins.

According to this situation, we can analyse the cost ratio as follows:
Duration of workmanship = \frac{\text{Duration of the second working method}}{\text{Duration of the first working method}} = \frac{300}{480} \times 100 = 63\%

This ratio shows that labor duration decreases during learning and experience process of any worker.

That is to say;

\[ RL = \frac{\text{Labor cost of the second working method}}{\text{Labor cost of the first working method}} = \frac{34}{54} \times 100 = 63\% \]

On revising the costs again after learning ratio, the analysis of total cost is as follows:

- The raw material is: 74 NTL
- Labor cost is: 34 NTL
- General manufacturing expenditure is: 7 NTL
- Total: 115 NTL

Decreasing 20 NTL in the costs stems from reducing in the labor costs. This shows that learning and experience affects costs are being used, as a tool, in reducing costs.

**Conclusion**

Rapid global competition and technological changes require that changes should be realized in the fields of management approaches and applications firstly. These changes and management styles not only affect the systems of costs and management in the business world but also cause to have the present systems look for new approaches.

It is essential that labor cost which is one of the most effective factors for the results of manufacturing activities should be checked and saved in a proper place continuously since the control mechanism of costs has very important role in view of competition and continuity.

Our study shows that learning and experience can be used, as a tool, in reducing of labor costs. The business which realizes learning and experience intensive mechanism as a tool has better competition advantage than the one which never realizes them. On the other hand, learning has also an important role in technological changes.

As a result, in this study, the usage of learning in reducing costs as a tool has been held by means of sample case study method.

**Sources**


BİNGÖL, Dursun, Discipline of Workplace and Peace of Working. Özgün Printing Press, İstanbul. 1990

BÜYÜKMİRZA, Kamil, Costing Management Accounting, Gazi Bookshop Pub., Ankara, 2003


EROL, Mikail, "Control of Labor Costs in Industrial Corporations in View of Productivity and an Application in Textile Industry" Doctorate Thesis Which Has Not Been Published Yet", 1996

ERGÜN, Ülkü, "JIT as a New Approach in Increasing the Efficiency of Production" DU, Faculty of Economics and Administrative Sciences Journal, Vol., 7, Number: 1, 1992


SELÇUK, Yalcın, Management of Staff (Lesson Notes), Faculty Publications, İstanbul, 1982


