Market, Location and Feasibility Analysis of Baby Diaper Production

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Industrial Engineering
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ABSTRACT

MARKET, LOCATION AND FEASIBILITY ANALYSIS OF BABY DIAPER PRODUCTION

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Feasibility analysis is used to determine probable success of a new business or project and it contains several decision making problems. The quality of a decision directly affects the quality of the feasibility study and the performance of the project. Industrial Engineering deals with the solution of the problems that occur during the phases of planning, design, implementation and development in organizations and work to eliminate waste of time, money, materials, energy, and other commodities. Therefore involvement of an Industrial Engineer is necessary during the feasibility analysis is being made to increase quality of the decisions given.

Disposable diapers have entered to lives because of their health and performance benefits. In this thesis, a market, location and feasibility analysis for disposable baby diaper production is made according to a feasibility framework and some of the most common decision making tools has been used. A disposable diaper market assessment and a SWOT analysis have been made and a business strategy has been built by making a business portfolio analysis. Both the technical and financial feasibility has been made on this basis. A multi criteria, group decision model has been developed and the location selection problem has been solved by using an analytical hierarchy process (AHP). Cost/benefit analysis is used for technology selection problem. A scenario has been built and a 3 year projection has been made. According to the projections; break-even analysis, payback analysis, cash flow scheduling, net present value, and the internal rate of return for the proposed investment have been calculated and a sensitivity analysis has been made to measure the impact of change on main projection parameters. It is concluded that the baby diaper investment is viable and profitable.

Key Words: baby diaper, feasibility analysis, location selection, technology selection.

ÖZET

BEBEK BEZİ İMALATI İÇİN PAZAR, YERLEŞİM YERİ VE FİZİBİLİTE ÇALIŞMASI

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Temmuz 2006, 197 sayfa

Fizibilite analizi yeni bir iş ya da projenin başarılı olup olmayacağını tespit etmek için yapılır ve birçok karar verme problemleri içerir. Endüstri Mühendisliği bir organizasyon içerisinde planlama, dizayn, uygulama ve geliştirme aşamalarındaki problemlerin çözümü ve zaman, para malzeme, enerjinin daha verimli kullanılması üzerinde çalışır. Dolayısıyla bir fizibilite çalışmasında daha kaliteli kararlar verilebilmesi için Endüstri Mühendisliği önem kazanmaktadır.

Bebek bezi kullanımındaki hızlı artış ve kullan-at bebek bezlerinin piyasaya her geçen gün daha fazla nüfuz etmesi ile yeni fırsatlar oluşmakta ve artan talebi karşılamak üzere yeni yatırımlar gerçekleşmektedir. Bebek bezi pazar araştırması ile birlikte pazara SWOT analizi ve portföy analizi yapılarak bir işletme stratejisi geliştirilmiştir. Teknik ve ekonomik fizibilite çalışmaları bu strateji çerçevesinde yapılmıştır. Çalışmada analitik hiyerarşi sürecini temel alan çok kriterli, çok kişili bir karar destek modeli oluşturulmuş ve bebek bezi imalatı için kuruluş yeri seçimi yapılmıştır. İmalatında kullanılacak teknoloji seçimi ise Fayda/Maliyet analizi ve grup karar verme mekanizması yardımıyla tespit edilmiştir. Teknik fizibilitenin diğer temel basamakları da tamamlanarak, 3 yıllık üretim ve satış senaryosu oluşturulmuş ve projeksiyon yapılmıştır. Oluşturulan senaryoya göre, kırılma noktası analizi, geri ödeme süresi analizi yapılmış; nakit akım çizelgesi oluşturularak bugünkü net değer tespiti ve yatırım geri dönüş oranı hesaplanmıştır. Senaryoda öngörülen satış miktarı ya da fiyatı üzerindeki değişikliklerin gelir tablosuna nasıl yansıyacağı da yapılan duyarlılık analizi ile belirlenmiştir. Çalışma neticesinde, Türkiye'de yıllık %2'lik büyüme oranı olan tek kullanımlık bebek bezi imalatı yatırımının uygulanabilir ve karlı bir iş olduğu sonucuna varılmıştır.

Anahtar Kelimeler: bebek bezi, fizibilite analizi, kuruluş yeri seçimi, teknoloji seçimi,

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dedicated to...

my wife

my son

&

our families

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS AND ABBREVIATIONS

λ_{max}: the minimal Eigen value of matrix
a_{ij} :Matrix element
c_i: Criteria i
w: Empirical, non-negative weight, relative importance of a criteria.
C_0: First Investment Cost,
C_t: Cash Flow at period t
T: Number of periods
r: Interest rate of discount rate
ADL: Acquisition / Distribution Layer
AHP: Analytical Hierarch Process
BCG: Boston Consulting Group
CBA: Cost Benefit Analysis
CI: Consistency Index
CR: Consistency Ratio
DEA: Data Envelopment Analysis
EDANA: European Disposables and Nonwovens Association
GDP: Gross Domestic Products
GE: General Electric Company
GNP: Gross National Products
HAPCO: Hygiene Absorbent Products Manufacturer's Committee,
IE: Industrial Engineering
IRR: Internal Rate of Return
JIT: Just-in-Time
KC: Kimberly and Clark Company
LCA: Life Cycle Assessment
MAS: Multi-media Authorizing System
MCDM : Multi Criteria Decision Making
MENA: Middle East North Africa Countries
MSW: Municipal Solid Waste
NPV: Net Present Value
NWC: Networking Capital
PE: Polyethylene
P&G (or PG): Procter and Gamble Company
PP: Polypropylene
PPP: Purchasing Power Parity
R&D : Research and Development
RI : Random Index
ROI: Return on Investment
SAP: Super Absorbent Polymers
SBU: Strategic Business Unit
SCA: Svenkska Cellulosa Aktiebologet Company
SIDS: Sudden Infant Death Syndrome
SME: Small and Medium Enterprises
SMS: A Meltblown layer sandwiched in between two Spunbond nonwoven layers
SWOT: Strengths, Weaknesses, Opportunities and Treats analysis.
TCT: Time Compression Techniques
TQM: Total Quality Management
VAT: Value Added Tax

CHAPTER 1

SCOPE OF THE WORK AND OBJECTIVES

1.1 Introduction

Diapers are hygiene absorbent products engineered to absorb and contain urine and faeces of a baby. Diapers have been used since ancient times, however since 1960's today's disposable diapers has started to be used. Use of disposable diapers is increasing each day and therefore new diaper production machines come on stream as well. The population, especially the birth rates, is very important in the disposable baby diaper segment of the business. With its young population and increase in people's income levels make Turkey an interesting and growing market for baby diaper manufacturers.

1.2 Objectives of the Thesis

Investment decisions are very complex decisions. There are several multi-criteria decision making processes involved in such projects and the cost of a mistake would be very high. Most SME's give investment decisions according to the intuitive methods. It is probable that one specific reason or advantage of the project may result the disadvantages or major obstacles to be miss out. In addition, it is probable that one of the decision givers may dominate the others and lead the project in direction that may cause failure of the project.

Industrial Engineering (IE) deals with the solution of the problems that occur during the phases of planning, design, implementation and development in organizations, which produce goods or services. Especially the efficient use of scarce production resources and the development of methodologies and techniques to increase quality in production are its basic functions. Industrial engineering uses the knowledge and skills of mathematics, natural and social sciences, engineering analysis and design to

achieve this aim. Industrial engineers, engineer processes and systems that improve quality and productivity. They work to eliminate waste of time, money, materials, energy, and other commodities. Most important of all, IE's save companies money.

For a company who is interested in investing a baby diaper manufacturing machinery there are several steps that needs to be clarified or studied. The market has to be analyzed, the competitors shall be investigated and a target a market segment has to be defined. A strategy has o be made and depending on this strategy an investment has to be made on baby diaper production machinery. So there will be a technology selection problem that needs to be answered. In addition to these, in parallel with the business strategy developed a facility location has to be selected. Costing of a diaper shall be studied and a financial feasibility analysis shall be done to determine weather or not the company should do this investment get in this business. Objective of the thesis is to use a feasibility framework by using decision making tools aiming to increase the quality of the decisions given. Another objective of this thesis is to make a case study including a feasibility framework that might be used as a guideline for a company who may be interested in disposable baby diaper production.

1.3 Methodology and Materials

In this study, a feasibility analysis framework has been used. These steps are shown on figure 1.1. As briefly listed on the figure, a qualitative marketing research has been done by means of focus groups and interviews. The study revolves around observing competitors, reviewing the market structure and understanding economic trends that make up the business environment. Personal interviews are conducted one-on-one and lasted between 30 and 60 minutes. The rich dept of information proved that it is the best method for in-depth probing of personal opinions, beliefs and values. The group dynamics are useful in developing new streams of thought and covering an issue thoroughly. Historical and statistical data available in the literature has been reviewed. To determine the pricing strategy a market-price analysis has been made at several supermarkets. A SWOT analysis has been made to the baby diaper market segment and depending on this analysis and the market information a corporate business strategy has been developed by making a business portfolio analysis.

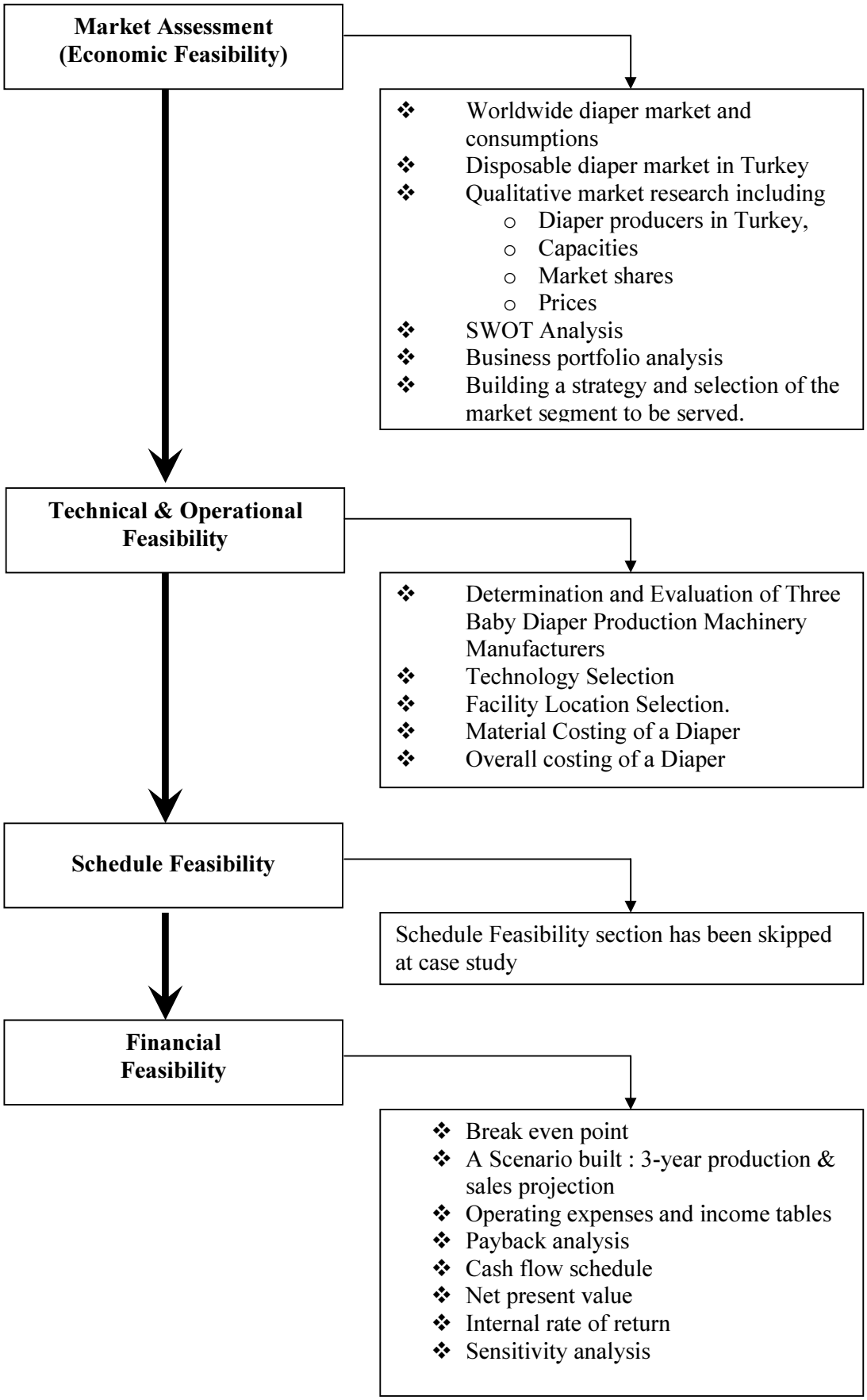


Figure 1.1 Feasibility analysis framework showing the methods and materials used

A technology portfolio analysis has been made, a candidate system matrix has been formed and a technology for baby diaper production machinery has been selected by using cost benefit analysis.

For the selection of the production facility location, Analytical Hierarchy Process (AHP), a very useful technique in solving complex decision problems has been used. AHP is a method for ranking decision alternatives and selecting the best one when the decision maker has multiple objectives, or criteria, on which to base the decision. To obtain most accurate result and to avoid time consuming calculations; an AHP based software has been used for location selection.

After completion of technical feasibility studies, the economical feasibility is made. For this purpose cost calculation of a baby diaper is made and a scenario has been built. A 3-year production and sales projection has been made and break-even analysis, payback analysis, cash flow scheduling is done. The net present value and the internal rate of return for the proposed investment have been calculated and a sensitivity analysis has been made to measure the impact of change on income, with the change on sales price and production and sales capacity.

1.4 Organization of the Thesis

This thesis consists of 4 main sections. The first section is the scope of the work and objectives. The second section describes a baby diaper, gives description of the main components, compares it with re-usable diapers and gives information on the life cycle assessment of disposable diapers. It also includes a literature review on the decision making tolls used at the following chapters. It should be noted that the methodology and the tools that have been used are explained in the beginning of each respective chapter. The next main section includes the baby diaper market and gives market information both worldwide and for Turkey. It discusses trends in the diaper segment, gives information about competitors and prices. This is the section that builds a corporate strategy so that a feasibility analysis can be made. Next is the section that makes technology selection. In this chapter the best technology according to the business strategy is selected. This section includes a facility location analysis is made and a plant location is selected. After this a financial feasibility

study is made and finally conclusion and discussions are made. Below Figure 1.2, shows the structure of the thesis.

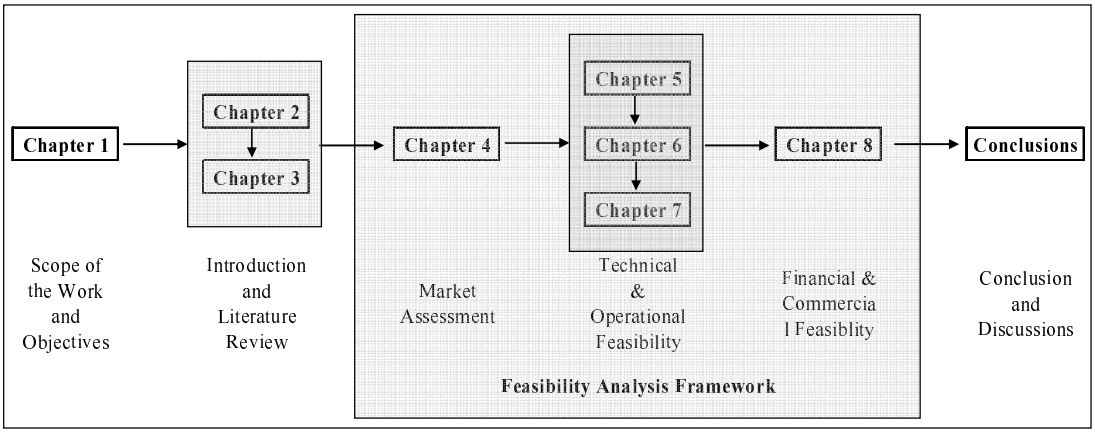


Figure 1.2 Structure of the thesis

CHAPTER 2
FEASIBILITY ANALYSIS

2.1 Introduction

In this chapter the definition and importance of a feasibility analysis will be given. The phases of a feasibility analysis will be defined and these phases will briefly be explained.

2.2 What is Feasibility Analysis and Why is It Necessary?

A feasibility analysis is designed to discover if a business is "feasible" or not. It will answer questions such as "will It work or won't" and "will it be profitable?" The feasibility study addresses the two factors that are critical to the success of any venture: supply (production) and demand (marketing). A feasibility study should be the first step in planning a new enterprise. It is an essential first step before spending money and time on more detailed plans.

A comprehensive feasibility study allows the user to:

- Determine if a market for a product exists.
- Develop and describe the production processes required.
- Determine the costs associated with producing the product.
- Determine if the enterprise is profitable.

There are four tests for feasibility: Operational Feasibility, Technical Feasibility, Schedule Feasibility, and Economic Feasibility [1].

"Operational feasibility" is a measure of how well the project will work.
"Technical feasibility" is a measure of the practicality of a specific technical solution and the availability of technical resources and expertise.
"Schedule feasibility" is a measure of how reasonable the project timetable is.

"Economic feasibility" is a measure of the cost-effectiveness of a project or solution. The feasibility subject shall be assessed according to environmental and regulatory issues as well. Figure 2.1 shows the feasibility assessment diagram.

There are 3 objectives that should be met by the feasibility study in order for the study to be of value. The first is to learn more about your prospective client's needs. Once the needs of the client are determined the second objective is to clearly define the product or service that you wish to offer these clients and estimate the cost. In other words, find a need and fill it. The third objective is to determine how much revenue this product or service will generate. Revenue and expense information is then incorporated in a cash flow projection, which gives you a measure of the feasibility of the venture [1].

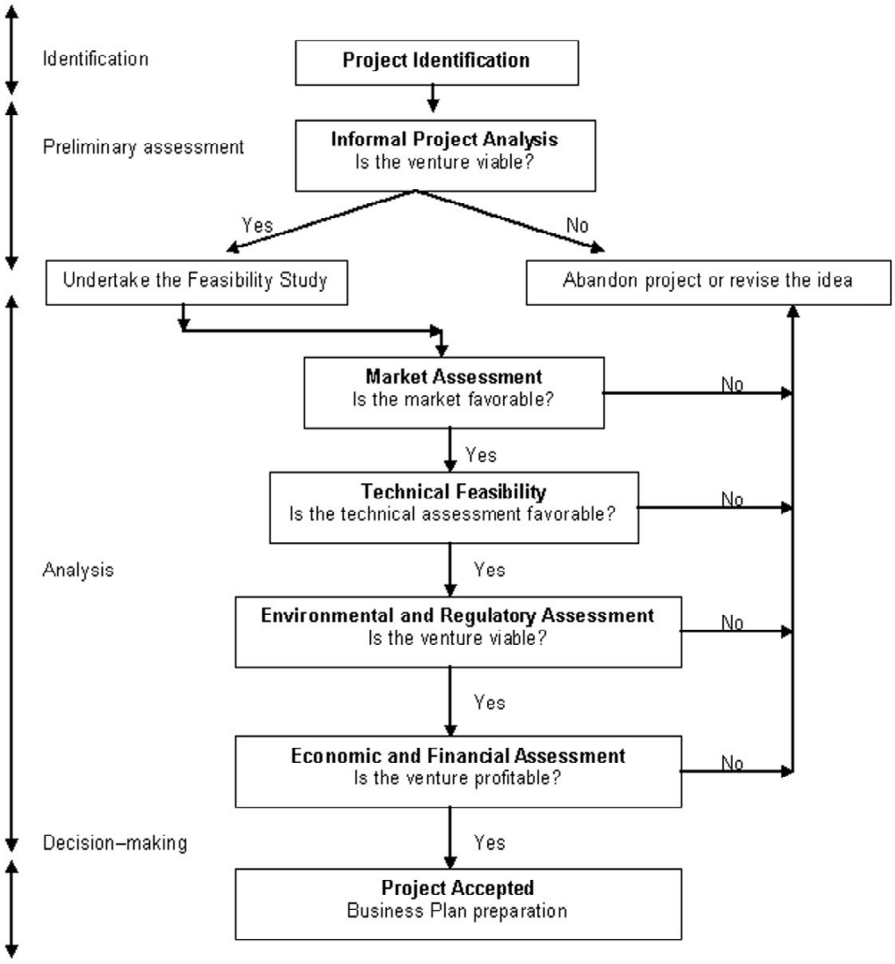


Figure 2.1 Feasibility assessment diagram [2]

2.3 Framework of Feasibility

A feasibility study shall look at the following criteria: consumption, markets, distribution system and market entry, buyers, selling arrangements, prices, production processes, facility determination, investment capital needs and profitability. Apart from these, working capital is also an important factor in feasibility studies. These, forming the framework of a feasibility study will be explained briefly. The questions to be answered also have been given [3].

1. **Consumption**
   - ❖ What is the current consumption of the product or service?
   - ❖ What are the current trends in consumption?
   - ❖ How is the product or service being consumed? (Packaging, volumes)
   - ❖ What is the quality of the product that is being consumed?
   - ❖ Who consumes the product?
   - ❖ What are their demographics? (Age, income, educational levels, marital status, family size)
   - ❖ Are these demographic segments growing or shrinking?

2. **Markets**
   - ❖ What is the current structure of the marketplace?
   - ❖ Who is currently supplying these products to customers?
   - ❖ What will be the reaction of these firms if a new firm enters the market?
   - ❖ Can the firm compete with existing firms or other potential entrants?
   - ❖ What are the implications for a firm who wants to expand its market?
     - o What are the costs?
     - o What revenues can be expected?
   - ❖ Where are the markets (customers) located?
   - ❖ Are they local, regional, national, or international?
   - ❖ What will it cost to serve them? (Transportation cost to be considered)

3. **Distribution system**
   - ❖ Will it be necessary to provide delivery services?
   - ❖ What delivery schedules will be required?
   - ❖ What common carrier options are available?

- ❖ Should the firm provide delivery itself?
- ❖ Should delivery equipment be purchased or leased?

4. Market entry

- ❖ How will the product or service be introduced to the market?
- ❖ Will the product be marketed under the company's name or under some other name?
- ❖ What will attract buyers?
  - o low prices,
  - o advertising,
  - o promotion,
  - o customer service, or some other method

5. Buyers

- ❖ Will you sell directly to consumers or go through a "middleman" buyer?
- ❖ What types of buyers will purchase the product?
- ❖ Where are they located?
- ❖ What product specifications will they require?
- ❖ Have potential buyers expressed an interest in the product?
- ❖ What type of purchasing commitments are buyers willing to make?
- ❖ How reliable are the buyers?
- ❖ What type of payment schedules will be encountered?
- ❖ How severely will this affect the firm's cash position?

6. Selling arrangement

- ❖ What type of selling services will you need to provide?
- ❖ Will you need to employ a sales force or go through a buyer?
- ❖ If you employ a sales force, how many people will this require?
- ❖ What is their compensation plan?
- ❖ How will they be selling the product?
- ❖ What are the costs of these activities?
- ❖ Should you have sales offices located throughout your geographic market area?
- ❖ Why have you chosen one method of selling activities over another?

7. **Prices:**

Setting a price is a critical activity in the market portion of the study. The price must be high enough to cover all costs and provide you a profit, but low enough that customers will purchase the product or service.

- To help determine the price, should be looked at:
  - Past prices of the industry
  - Current price trends
  - Expectations of buyers (brokers)
  - Expectations of consumers
  - Quality levels of substitutes or competitors

8. **Production processes**

- Raw materials
  - Availability, future supply and price changes
- Facility determination
- Technology determination
- Investment capital needs
- Labor needs
- Production costs

9. **Facility Determination**

- The minimum size facility to make the enterprise economically feasible must be determined.
- Determining this size plant requires the simultaneous analysis of both demand (marketing) and supplies (production including raw product).
- The plant must be of sufficient size to maintain a low enough production cost per unit and but not large enough to overload the market niche.

10. **Investment capital needs**

- What is the required capital investment necessary to construct the production facility?
- What form of financing must be utilized to secure these funds?
- What is the cost of these funds and what restrictions are attached to their use?

11. Labor

- How many employees will be required to run the production facility?
- Compare facility needs to the local labor force.
  - What special skills will be required?
  - Are these available from the current labor force?
  - It should be noted that the local unemployment rate is not necessarily an indicator of the labor force.
- Where will management and technicians come from?
- What costs are involved in getting them to work for you?

12. Operational costs

- Includes items such as:
  - Wage rates
  - Management costs
  - Raw material costs
  - Utility rate structures
  - Fixed Costs (Depreciation, Taxes, Interest, Insurance)
- Costs should be broken down into a per unit basis

13. Profitability

Profitability is defined as the excess of revenues over expenses. Given the estimated revenues from the marketing section and the estimated costs from the production section, the profitability of the enterprise can be ascertained.

14. Working capital

Working capital is the cash used for day-to-day expenses such as the payroll, utility bills, etc. Adequate working capital is crucial to business survival. The cash flow statement demonstrates the need for working capital at specific points in time

2.4 Conclusion

A feasibility study is used to determine the probable success of a new business. Feasibility studies save money and ensure that available funds go further. In this chapter the basics and importance of a feasibility study has been explained. A framework for doing a feasibility analysis and the feasibility assessment diagram has been given. Although the importance of doing a feasibility analysis is known by most

investors, it is the step that is mostly skipped. Making a feasibility analysis is a complex task and includes several decisions to be given. In most SME's and even the State Planning Organization of Prime Ministry are using intuitive methods and decisions in the studies. Especially, in SME's this may result that unintentionally one of the participants may dominate the others which potentially would cause failure of the project. "Decision Science" as falls in one of the main sphere of interest of Industrial Engineering; the decisions given would be more accurate and of high quality by involvement of IE in analysis steps. Therefore this study is made to let the investors give their own decision however by using some engineering tools and methodologies.

CHAPTER 3
BABY DIAPERS

3.1 Introduction

In this chapter the definition of baby diaper is made and history of diapers is reviewed. The components of a disposable baby diaper are explained. After comparing re-usable diapers with disposable diapers; the environmental effects of disposable diapers will be studied. The information has been gathered from various printed and digital media. Apart from introducing a disposable baby diaper together with its components; the comparison of the disposable and reusable diapers and analyzing their affects to environment and municipal waste is the primary aim of the chapter.

3.2 What is a Diaper?

Diapers are hygiene absorbent products engineered to absorb and contain urine and faeces of a baby. When used they are set and fastened around its legs and bottom. Diapers absorb urine, retain urine inside their absorbent core, contain faeces, isolate wetness from the baby's skin, and isolate urine and faeces from the baby's environment. These objectives have been achieved with a maximum of comfort for the baby, a good fit, good practical usefulness, less diaper rash for the baby [4].

A diaper (in USA) or nappy or napkin (in UK) is an absorbent garment by individuals who are incontinent, i.e. lack control over bladder or bowel movements. This group includes primarily infants and young children, as well as the elderly and the physically challenged. Diapers are occasionally worn by adults who are unable or not allowed to reach a toilet for longer than their bladders can hold out.

The word diaper originally referred to the type of cloth rather than its use. Diaper cloth was originally linen. While they are awake most children no longer need diapers when past four years of age. However night time diaper usage is quite

common up to the age of eight or beyond. A diaper's ability to absorb liquid can be increased using extra pads. This is useful for children who wet their diapers heavily or when frequent changes are not possible, for instance while away from home. A very thick diaper between the legs may decrease the child's mobility, but this must be weighed against the need to avoid leakage.

When to change a diaper is the decision of the caregiver. Some people believe that diapers should be changed at fixed times of the day to establish a set routine. To avoid skin irritation commonly referred to as diaper rash, the diaper should be changed as soon as possible after it is soiled. There are several cultures that forgo the use of diapers entirely. Parents adapt themselves to be sensitive to an infant's elimination schedules and signals. When it becomes evident that the infant needs to eliminate, he is taken to an appropriate area. In the West, this practice is often called infant potty training.

3.3 Disposable versus Re-usable Diapers

Diapers may be made of absorbent layers of cloth or terry toweling fabric, or of disposable absorbent materials. The choice to use either cloth or disposable diapers is controversial. While cloth diapers are certainly cheaper than disposables over time, environmental impact, health and convenience also play a role in the decision.

Cloth diapers are washable and reusable and place less stress on landfills; however, they also require large amounts of laundry detergent and water. Disposable diapers take a great deal of processing and their materials remain intact in landfills for many years. A recent development is a hybrid reusable / disposable system, with an outer plastic part which is re-used, and an interior absorbent part which is disposed and is fully biodegradable.

Disposable diapers are laced with chemicals obtained unintentionally in production, as well as intentionally in order to improve absorbency and pull wetness away from the skin. While this system works well in keeping skin dry, it also provides a potential skin irritant. Cloth diapers are most commonly made of industrial cotton, which is grown in conjunction with the heavy use of pesticides. The fabric is also usually bleached white. Alternative materials which are grown without pesticides, such as organic cotton exist.

Disposable diapers have the advantage of convenience for the parent. Cloth diapers, however, have become more user friendly in recent years. Pre-formed cloth diapers with snaps or velcro and all-in-one diapers with wet-proofing exteriors are now available in addition to the older pre-fold and pin variety. Some cities in United States offer a cloth diapering service which delivers clean diapers and picks up soiled ones for a fee. Cloth diapers in conjunction with elimination communication seem to be the method of choice when one wants the best of convenience both to the parent and child, while reducing environmental and health impacts to practically nothing [5,6].

Figure 3.1 Disposable diaper, re-usable (cloth) diaper and training pant

The disposable diaper industry is making claims to being better for the environment and baby. They claim "the amounts of energy, water and fuel used in the manufacturing, cleaning and pick-up/delivery of cloth diapers are considerably higher than those required for the manufacturing and use of disposable diapers. Next the disposable diaper industry claim cloth diapers not only create more water pollution, but use 2 times more energy than manufacturing disposable diapers. (Consume for laundering supplies, water and electricity). A 1990 study concluded that cloth diapers used twice as much energy and four times as much water as disposables, and created greater air and water pollution than disposables [7,8,9].

Where as the cloth diapers claims that disposable diapers have a tremendous negative impact on the solid waste resources (wasting paper, plastics, chemicals) and disposable diapers are not healthy to baby's skin advocating return to cloth diapers. Another potential problem could be leachate, primarily from older landfills, entering ground water supplies. Viruses excreted in human feces could pose health problems long term [9].

With disposables, the diaper lining wicks moisture away from the skin where as the cloth diapers allow your baby's skin to breathe and heal more quickly. This helps prevent and treat diaper rash. Cloth diapers are good for one use. The diaper has to be changed when it gets wet, because the second time it will leak. It should not be a good to feel the warm when you hold a toddler in your lap. Thanks to the super absorbents, when a disposable diaper is used which is available today, you can feel the weight of the diaper increased half kg and the skin of the toddler is still dry [10,11,12].

All parents want to do what's best for their baby, many parents feel, that cotton is a purer, softer, simpler choice than paper and plastic, and that if their babies could vote, they would choose cloth themselves however, it is true that the thought of rinsing, soaking, and laundering dozens of cloth diapers a week is overwhelming to most new parents. Although disposable diapers pose environmental concerns from a solid waste perspective, cloth diapers raise concerns regarding air and water pollution. None of the life cycle analysis studies did a very good job of estimating the cost of additional time that families might spend in diaper care if they switched to cloth. Cloth and single-use diapers both use natural resources and have environmental costs. But, these costs are difficult to estimate accurately. Choice of diapers, cloth or disposable, impacts on environmental, health and economic concerns. Currently, neither diaper type is clearly superior in all areas [8,9,10].

Independent organizations in several European countries have evaluated both cloth and disposable diaper systems. They have concluded that both systems impact the environment, albeit in different ways and that the environmental superiority of any one diaper option over the other cannot be determined [13].

The discussions about cloth versus disposable diapers are ongoing. However, diaper use is widespread and possibly even increasing across diverse populations ranging from infants to very old adults. Below table makes a comparison of disposable diapers with cloth diapers from the environmental, health, cost and convenience perspectives.

Table 3.1 Disposable vs. cloth diapers [9,14,15]

	Disposable Diapers	Cloth Diapers
Environmental Issues	Consumes both renewable and non-renewable resources in production.	Reusable/Recyclable
	Increased cost for solid waste management. Requires places at landfills. Recycling is still an issue that needs to be addressed.	Increased water and energy usage for laundry causing water and air pollution.
	Disposable diapers may cause skin irritations and rashes from skin sensitivity to the diaper's perfumes and/or chemical additives. Also, rashes may be caused by the excessive heat built up from prolonged wear of soiled diapers that "feel" dry.	Problem where water availability and air pollution concerns exist. Because requires considerable amount of water.
Health and Safety	Super absorbents reduce diaper rash better than regular disposables. Diaper rash can be reduced if correct changing period is applied.	Diaper rash reduced only with frequent changes.
	Diaper leakage/contamination reduced with super absorbents	Increased diaper leakage/contamination
	Solid waste goes to landfills.	Municipal sewage system handles solid waste
	Potential for diseases from landfills	No landfill or contamination problems. However
Cost and Convenience	More convenient, easy, clean and quick	Less convenient. Difficult to wrap, takes much more time.
	Higher purchase cost	Low purchase cost
	Does not require to change as often	Time and money cost for laundering

3.4 Baby Diaper History

It is know that there are special clothing used for the babies since ancient times. Milkweed leaf wraps, animal skins, and other creative natural resources, a far cry from today's disposable diapers.

Infants have been "wrapped in swaddling bands" in many European societies since antiquity. Swaddling bands were strips of linen or wool that were wrapped tightly around each limp and then crosswise around the body. In some Native American tribes, mothers packed grass under a diaper cover made of rabbit skin, as it was done by the Incas in South America. In warmer tropical climates babies were mostly naked and mothers tried to anticipate baby's bowel movements to avoid any mess near the house. In the American West of pioneer days, wet diapers were seldom washed, most times they just hung by the fireplace to dry and then use again; as you can imagine, skin rash was a serious problem. In Europe, it wasn't until the Industrial Revolution from 1820 onwards that the working people started taking pains to contain their baby's waste more carefully, having acquired sufficient wealth to buy household furniture and the need to protect it.

By the late 1800's infants in Europe and North America were wearing the progenitor of the modern diaper. A square of rectangle of linen, cotton flannel, or stockinet was folded into a rectangular shape and held in place with safety pins.

One of the first ways to reduce the diaper rash, was after there was a better understanding of bacteria, viruses, fungi, and was understood how to kill them, or at least how to control them. At the beginning of the 20th century, many concerned mothers started to use boiled water in order to reduce more effectively the common rash problem. Boiling a big pot with diapers required great amounts of energy and time [16,17].

To understand more on the development of the diapers; Historical data shall be reviewed. Before 1936 diapers were mainly either cotton-based ribbed toweling or a cotton muslin-type material both of which, with laundering, could be reused. These typically took the form of a square of material which was wrapped around the baby and fixed in place with safety pins. The diaper was then covered with reusable plastic or rubber pants with elasticized leg openings. In the late 1930s, early forms of tissue-

based disposable under pads and diaper inserts were introduced in Sweden. Developed by Paulistrom Bruk, a number of versions of this basic product emerged between 1936 and 1942 including the use of rubber pants to hold the cellulose pad in place. In 1950 the company introduced a new version of the product based on leached cellulose wadding with a knitted-mesh outer layer which could be inserted into a holding pocket in a rubber pant. In the same year Johnson & Johnson introduced a rectangular under pad product based on cellulose wadding with wet-strength tissue as the cover stock and plastic as the backing. In 1957 Mölnlycke (now SCA) introduced a 'pear-shaped' insert formed from de-fibred wood pulp with a knitted-mesh cover. The convenient disposable baby diaper is a relatively new invention; credited to Marion Donovan who in 1950 cut her shower curtain into plastic envelopes into which she slipped absorbent material, using snap closures to secure the diaper on her baby. This form of disposable diaper was an immediate success, due largely to the time saving attractions it offered to the increasing number of working mothers. However, the move towards disposable baby diapers began in earnest in 1961 when Procter & Gamble introduced the first Pampers in the USA, based on cellulose wadding with a plastic backing and a nonwoven topsheet. Subsequent developments saw the introduction of fluff pulps, the addition of adhesive tapes and the use of plastic backsheets. Further developments in the mid-1980s owed much to the availability of improved super absorbent polymers and better methods to add the polymer to the pulp core, as well as innovations such as frontal and re-sealable tapes and elasticized waists. The introduction in 1989 of the first disposable training pants by Kimberly-Clark and of diaper pants in 1991 marked the start of an extension of the normal diapering period into the child's toilet-training phase. The distinction between training pants and pant diapers originally related to the absorbent capacity of the product, with training pants having more limited absorption capacity. This distinction is less relevant now, with both types of product available with sufficient capacity for night-time use. Disposable diapers today are much thinner and more absorbent than their earlier counterparts and as a result are more effective. They are more comfortable for the infant to wear and more convenient for parents to use. In addition, their usage has been accompanied by a marked reduction in skin irritation in individual children and a decrease in the spread of infectious diseases amongst children in group care environments [13].

3.5 Milestones in Disposable Baby Diaper History

The most important events in the evolution of the disposable diapers can be listed as follows [18,19]:

1. Introduction of the fastening system integrated with the diaper, 1970
2. The use of fluff instead of creped Tissue, 1972
3. The use of Super absorbent polymer, 1986
4. The use of Frontal Tape and Hook and Loop systems, 1987
5. The addition of leg cuffs anti-leak barriers, 1989
6. The introduction of cloth-like back sheets, 1994
7. The training pant diaper for larger babies, 1994

3.6 Components of a Baby Diaper

A diaper is a huge part of your baby's wardrobe. Sometimes it's the only thing your baby will wear. So it's good to know what goes into a diaper. Below the main components of a diaper are briefly explained [20,21,22].

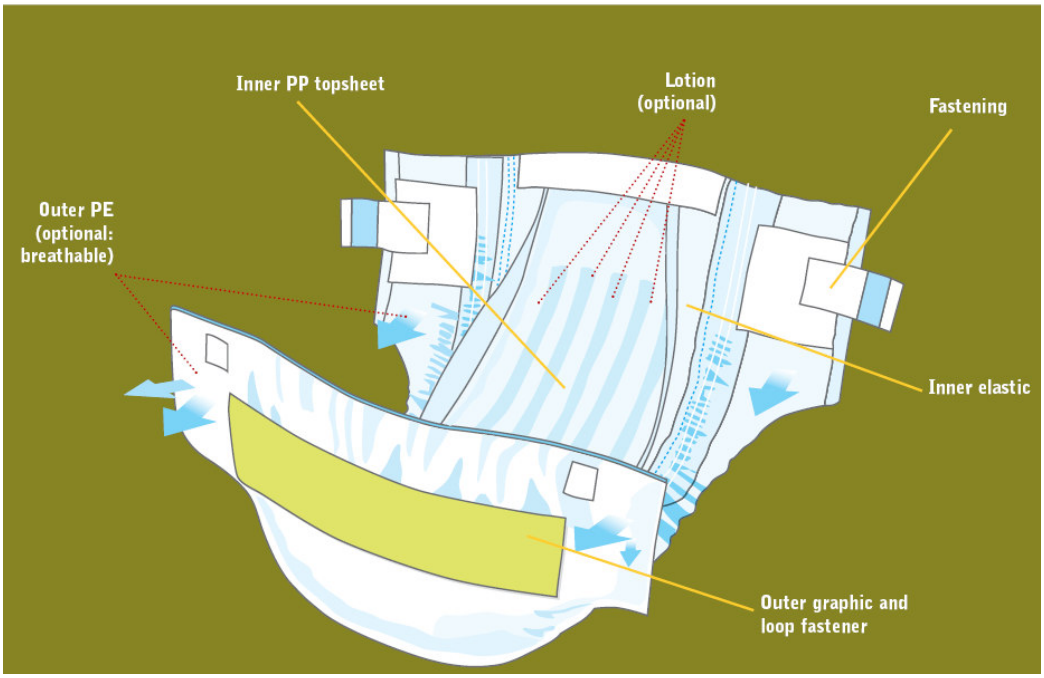


Figure 3.2 Main components of a diaper [13]

1. Acquisition/distribution layer(s) (ADLs): Receives the urine flow through the topsheet and effectively transfers it to the storage part of the ADL thereby making best use of the core. A number of different structures and materials are used for this.

2. Tissue wrap layer: Used in some diaper products around the absorbent core structure or the storage layer. This serves to contain the dry structure during manufacture and assists in preventing distortion or collapse of the core when saturated with liquid.

3. Absorbent core structure: Is the urine storage layer and is the key component in a modern diaper. It receives the urine that has been transported through the topsheet, distributed by the ADL and transferred to be locked within the core structure. It has to absorb the urine as fast as it is received and has to allow distribution of the liquid through the structure so that the whole core is utilized. There are normally two principal components in a modern diaper core – fluff pulp and super absorbent polymers (SAP). The early diaper core was 100 % fluff pulp. It acted like a sponge; consequently, just a small amount of pressure to a saturated core could cause the absorbed liquid to be released. The super absorbent polymers used today are almost entirely based on cross-linked polyacrylate polymers. They now comprise 25 to 30 % of the content of the core and provide the 'fluid-locking' mechanism in the core – fluff pulp comprises up to 50 % of the core. On contact with the urine the polymer becomes a gel which can absorb many times its own weight in fluid; the fluid is not released, even under pressure.

4. Backsheet: It is either polyethylene (PE) film or, more recently, a nonwoven/film composite. Its role is to prevent wetness transfer to the baby's bed or clothes. It plays an important role in containment of the whole structure, especially when wet. This is usually the first material the parent comes in touch with on removing the diaper, so softness is perceived as important. The backsheet has to be sufficiently robust to be able to fulfill its purpose, but also needs to be thin and noiseless when the baby moves. Breathable film backsheets are widely used in modern-day absorbent products manufactured in Europe. These can help to keep the skin drier, which has been shown to have a positive impact on the skin condition in the diapered area, particularly in terms of occlusion, diaper dermatitis [13].

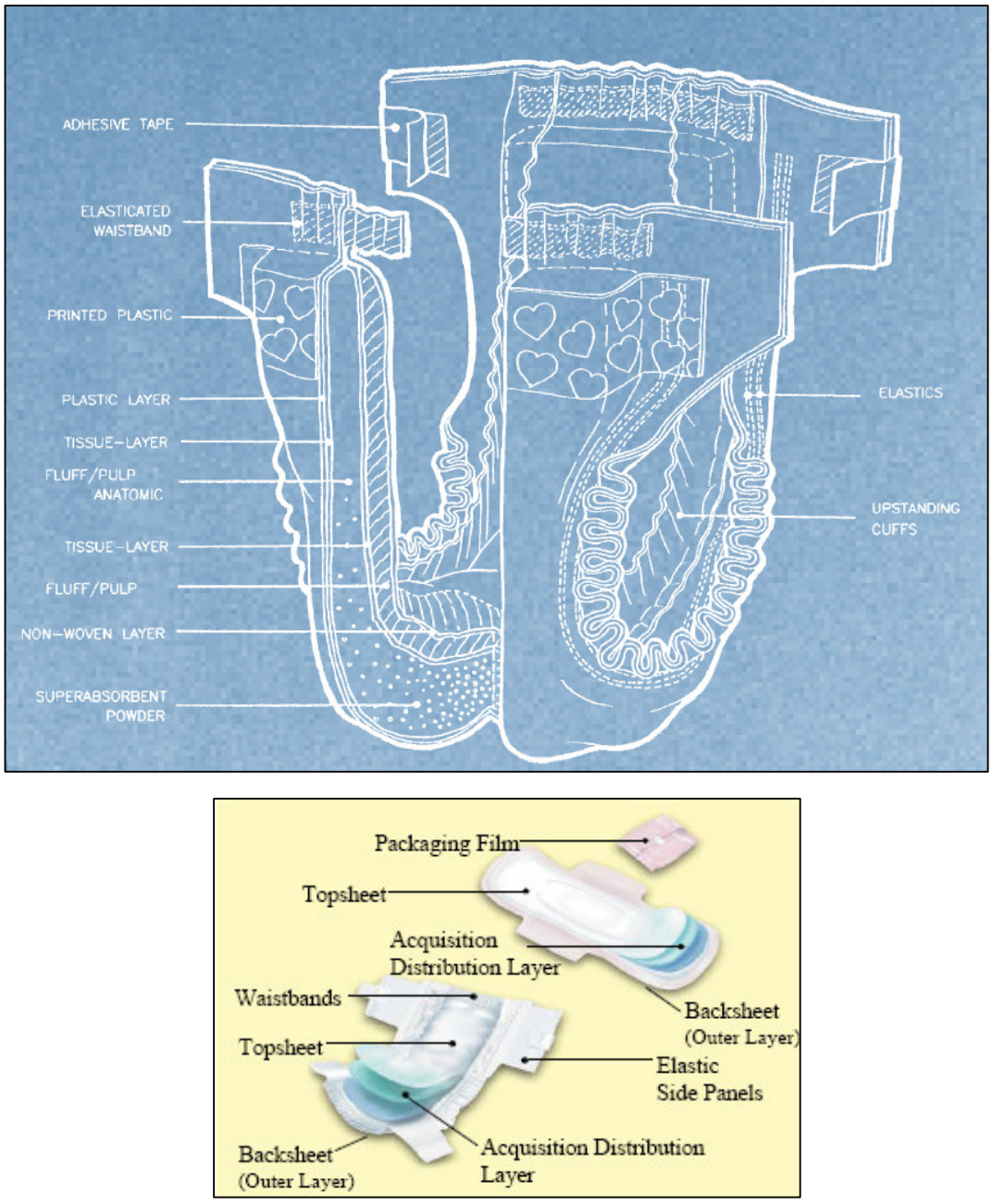


Figure 3.3 Components of a diaper [23]

5. Tissue: This is used to help the manufacturing process, it is used as a carrier for the pad (the pad is the core of the diaper). The tissue paper helps during the pad knife process, especially for machines equipped with continuous drum forming systems. Tissue helps the diaper by adding integrity and reducing the pin holes associated to the super absorbent particles damaging the inner plastic film. Tissue

comes from the Kraft paper process. A difference between this material and regular bathroom tissue is its higher elasticity and wet strength.

6. Hot Melts: They are used to glue the different components of the diaper, such as the pad and the elastics. They are made of a mixture of resins and oils. The hot melt adhesive is applied melted and when it cools down provides the bonding force to glue the materials.

7. Leg-Cuffs: Also may be known as hydrophobic nonwovens. It is used as a top sheet for the leg cuffs, it will not allow water to pass trough. It is made of polypropylene resin without any added surface surfactants. The hydrophobic nonwoven is used to make the leg cuffs that prevent leakage to the outside of the diaper provide a snug fit to help prevent leaks. Currently a three layer fabric is used fort his purpose. A meltblown layer sandwiched in between two spunbond layers (SMS) is used for this purpose.

8. Top Sheet: Known as hydrophilic nonwoven as well. It is the main top sheet, the top surface that is in contact with the baby's skin allowing the liquids to flow into the diaper core. The difference between the two nonwovens (hydrophilic and hydrophobic) is the surfactant treatment used in the process. The surfactant treatment reduces the surface tension of the nonwoven, reducing the contact angle with the water and allowing it to pass. Flow dynamics within the diaper core prevent liquids from returning to the surface. Most nonwovens used in diapers are made with the spunbond process, however it is also possible to use thermal bonded nonwovens, which are softer but with lower resistance, and trough air bonded nonwovens which are loftier.

9. Elastics: Used to improve the fit of the diaper, usually made of polyurethane foam, rubber or lycra. They are used for the waist and also for the legs, they can also be used as lateral side panels and in tape construction. Most gasketing cuffs use Lycra to provide a seal with baby's legs.

10. Fastening System: These are used to make a complete wrap of baby with the diaper. Keeps the diaper where it should be. There are mainly 2 types of tapes used in a standard baby diaper, lateral and frontal tapes.

3.7 How Was the Diapers in year 1900 and How Will It be in Year 2100

An article published in an industry magazine traces the evolution of baby diapers, starting in the 20th century when everything was cloth, through today, and on to a potential future. It gives a good overview of the Diaper industry's evolution. It is believed that this is good information who might be interested in investing a disposable baby diaper manufacturing line. The article compares the diapers of 1900's with today's diapers and foresees the diaper of 2100's as follows [24].

Table 3.2 Evolution of diaper from 1900 to future [24]

Diaper Evolution			
Years:	**1900**	**2000**	**2100**
Cores	Textile, Cotton or Wool	Fiberized Pup, Pulp & SAP	SAP & Filaments
Top Sheet	Tissue, paper or Gauze	PP spunbond	PP/PE spunbond
Back Sheet	Repellent Canvas or Cloth	PP film	SMS
Attachments	Straps/ pins	Tapes/Hook & Loop	Hook & Loop
Bonding	Natural Adhesives	Synthetic Adhesives/Thermal & Ultrasonic Bonding	Adhesiveless
Elastics	Natural Latex Rubber	Synthetic Films & Strands	All-over Stretch
Treatments	- - -	No Active Odor Control Topical Additives	Active Odor Management Efficacious for Skin Health
Construction	- - -	Diaper-like Hot	Underwear-like Fit, Underwear-like Heat Dissipation, Functional Fecal Management

3.8 Environmental Issues Regarding the Diapers

United States where the disposables diapers are borne is also more involved in the environmental issues of the disposable diapers. Disposable diapers have become a powerful symbol of the "throwaway society".

Figure 3.4 Life cycle assessment of baby diapers [13]

Despite the popularity among consumers for its convenience, the disposable diaper was briefly a primary target of environmental groups in the late 1980s and early 1990s for filling America's landfills [25]. The depleting ozone layer, disappearing rain forests, and overburdened landfills were grabbing headlines in the late 1980s and early 1990s [26].

Despite the efforts of the environmental activists, cloth diapers are almost extinct today. The biggest factor in disposables' victory in the great diaper debate was an aggressive public-relations offensive by Procter & Gamble and Kimberly-Clark, who together share almost eighty percent of the $3.5 billion diaper business. The companies produced studies that said disposables took up less space in landfills than predicted, while cleaning and transporting cloth diapers emitted pollutants into the air and water If everyone switched into cloth diapers, all those diapers have to be washed in hot water, which requires energy and generates pollution from the use of detergents. For families using diaper services, the diapers have to be picked up and delivered by trucks that burn fuel, create fumes and worsen traffic congestion. By contrast, most disposables are purchased in shopping trips that would be made anyway [27].

Choosing a diaper system on the basis of only one environmental parameter, such as solid waste, ignores the contributions of other important parameters such as air and water pollution and the use of energy and water; as a result such a choice may finally not provide an overall improvement in Environmental quality. Whenever a diaper choice is made, a trade-off occurs. This has been shown in numerous lifecycle inventory studies that have been conducted around the world, including Germany, Scandinavia, The Netherlands, the U.S., and Canada. While there are numerical

differences due to a combination of different methods and assumptions, different geographies, and differences in regional infrastructure, the diaper LCA (life-cycle assessment) record supports the conclusion that all diapering options have environmental impacts and consume some energy, water, and raw materials; none of the diaper options is environmentally superior in all its aspects [4].

A Government commissioned life cycle assessment (LCA), coordinated by the UK Environment Agency, has been published today and shows through independent analysis that disposable nappies have no greater impact on the environment than cloth nappies. Specifically, the study confirms: Neither disposable or cloth nappy systems can claim overall environmental superiority and the differences in the impacts between the three nappy systems are not significant enough to voice support for one nappy type over the other on the basis of environmental factors alone [28].

3.9 Diapers in Municipal Solid Waste

Much of the discussion about baby diapers and the environment have focused on their contribution to solid waste. In those households where baby diapers are used, they naturally seem to represent a significant proportion of what goes into the bin. However, only one in 14 households on average will be using diapers at any one time. According to the studies made in European Union, waste from baby and Incontinence diapers only comprises between 0.3 and 0.4 % of total solid waste [13]. Diapers and incontinence products are compatible with prevailing waste disposal and treatment methods

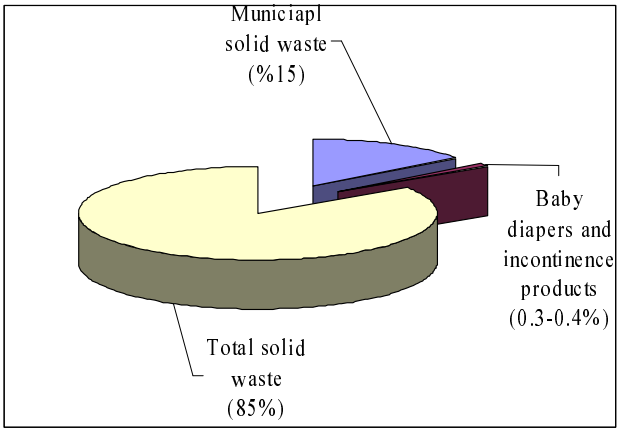


Figure 3.5 Baby diaper and incontinence products waste contribution to municipal and to total waste in the European Union

3.9.1 Landfill

Landfill stands alone as the only waste disposal method that can accept all materials in the solid waste stream. It is also considered the simplest, and in many areas the cheapest disposal method and has historically been relied on for the majority of solid waste disposal.

3.9.2 Incineration (thermal treatment)

Thermal treatment of solid waste within an integrated waste management system can include at least three distinct processes: mass burn, refuse-derived fuel burn, and paper and plastic fuel burn.

The incineration of solid waste can fulfill three distinct objectives:
1-Volume reduction,
2-Stabilisation of waste,
3-Recovery of energy from waste.

3.9.3 Biological treatment

Biological treatment can be used to treat both the organic and the non-recyclable paper fractions of solid waste. Biological treatment can be separated into two distinct processes – aerobic and anaerobic treatment – and therefore two main treatment types exist; composting (aerobic) and biogasification (anaerobic). Either can be used as a pretreatment to reduce the volume and stabilize material for disposal in landfills or as a way of producing valuable products from the waste stream such as compost and (from biogasification) biogas plus compost. Today's diaper and incontinence product raw material composition is compatible with composting provided there is appropriate technology available to separate the biodegradable, cellulose-based parts from the synthetic pieces.

3.9.4 Mechanical-biological treatment

Mechanical-biological pretreatment is a hybrid technology. It is a combination of mechanical sorting and biological treatment, and sometimes a processing stage to convert the residual material into refuse-derived fuel. The mechanical stage separates recyclables and rejects (batteries, tires, etc.) to leave an organic fraction. The reject

fraction can be incinerated or land filled. The organic fraction is sent for treatment using composting or anaerobic digestion techniques. The remaining material is of low compost quality and is required to be incinerated or can be land filled if it is biologically inert.

3.9.5 Recycling

Material recycling is a valuable component of an integrated solid waste management strategy. It can help conserve resources, it can divert waste from final treatment and disposal and it involves the general public in waste management (e.g., cans, paper, and bottles). Unlike reuse, recycling typically involves an industrial process which differs from the original process, primarily in that some of the virgin resources have been replaced by secondary ones. While recycling as a waste treatment option might be technically conceivable for baby diapers and incontinence products, there is a high level of uncertainty about the marketability or reuse of the end products. The economic feasibility of recycling diapers and incontinence products would be constrained by the high costs of collecting the soiled products as an individual fraction of waste. In addition, the environmental benefits for separate recycling of a relatively small waste fraction such as baby diapers and incontinence products are questionable and would be disproportionately small in relation to the economic costs.

In recent years, recycling has been receiving increasing support, as it facilitates waste reduction and may encourage the conservation of natural resources. Different projects have focused on comprehensive investigations of technical and economic feasibility, with a major emphasis on characterizing potential markets for recycled pulp and plastic. Recycling has also been studied for hygiene paper products such as baby diapers and adult incontinence pads. Results indicated that while a commercial operation is technically feasible, the economic feasibility of recycling diapers was found to be constrained to a limited set of conditions, mostly related to the high cost of collecting soiled diapers as an individual fraction of waste. Although interest in diaper recycling continues, and some small companies have begun business to support the idea, current information indicates that it is not economically feasible in most areas. In addition, no environmental benefits have been demonstrated for separate recycling of a relatively small waste fraction such as hygiene absorbent products [4].

3.10 Conclusion

In this chapter, baby diapers have been reviewed in detail. The history of baby diapers is reviewed. A comparison of disposable and re-usable diaper has been made. Advantages and disadvantages of both have been discussed and their affects to environment has been analyzed. Components of a disposable baby diaper have been explained. The environmental issues with the baby disposables and how they affect the municipal waste has also been discussed. It has been observed that disposable diapers are becoming indispensable parts of our lives because of its benefits and conveniences.

CHAPTER 4
BABY DIAPER MARKET ASSESSMENT
(ECONOMIC ANALYSİS)

4.1 Introduction

In this chapter, brief information is given about marketing research, strategic management, SWOT analysis and business portfolio analysis. The world-wide diaper market has been analyzed and the trend has been studied. Disposable diaper producers in Turkey are listed and their product prices have been obtained. A SWOT analysis is to be made to baby diaper market segment. A business portfolio analysis will be made, corporate strategy will be built and the target market for the investor will be determined.

4.2 Marketing Research

Research is the search for and retrieval of existing, discovery or creation of new information or knowledge for a specific purpose. Research has many categories, from medical research to literary research. Marketing research (also called consumer research) is a form of business research. It is a form of applied sociology which concentrates on understanding the behaviors, whims and preferences, of consumers in a market-based economy. The field of marketing research as a statistical science was pioneered by Arthur Nielsen with the founding of the AC Nielsen Company in 1923 [29]. In addition to marketing research, other forms of business research include: Market research, Product Research and Advertising Research.

Market research is broader in scope and examines all aspects of a business environment. It asks questions about competitors, market structure, government regulations, economic trends, technological advances, and numerous other factors that make up the business environment. Sometimes the term refers more particularly to the financial analysis of companies, industries, or sectors. In this case, financial analysts usually carry out the research and provide the results to investment advisors and potential investors.

Product research looks at what products can be produced with available technology, and what new product innovations near-future technology can develop. Advertising research attempts to assess the likely impact of an advertising campaign in advance, and also measure the success of a recent campaign [29].

4.2.1 Marketing research techniques

Marketing research techniques come in many forms, including [29]:

- **Test marketing :**A small-scale product launch used to determine the likely acceptance of the product when it is introduced into a wider market
- **Concept testing:** To test the acceptance of a concept by target consumers
- **Mystery shopping:** An employee or representative of the market research firm anonymously contacts a salesperson and indicates he or she is shopping for a product. The shopper then records the entire experience. This method is often used for quality control or for researching competitors' products.
- **Store audit:** To measure the sales of a product or product line at a statistically selected store sample in order to determine market share, or to determine whether a retail store provides adequate service
- **Demand estimation:** To determine the approximate level of demand for the product
- **Sales forecasting:** To determine the expected level of sales given the level of demand
- **Customer satisfaction studies:** Exit interviews or surveys that determine a customer's level of satisfaction with the quality of the transaction
- **Distribution channel audits:** To assess distributors' and retailers' attitudes toward a product, brand, or company
- **Price elasticity testing:** To determine how sensitive customers are to price changes
- **Segmentation research :** To determine the demographic, psychographic, and behavioral characteristics of potential buyers
- **Consumer decision process research :** To determine what motivates people to buy and what decision-making process they use

- **Positioning research:** How does the target market see the brand relative to competitors? - What does the brand stand for?
- **Brand name testing:** What do consumers feel about the names of the products?
- **Brand equity research:** How favorably do consumers view the brand?
- **Advertising and promotion research:** How effective are ads - do potential customers recall the ad, understand the message, and does the ad influence consumer purchasing behavior [29]?

4.2.2 Marketing research methods

Methodologically, marketing research uses four types of research designs, namely[29]:

- **Qualitative marketing research -** generally used for exploratory purposes - small number of respondents - not generalizable to the whole population - statistical significance and confidence not calculated - examples include focus groups, depth interviews, and projective techniques
- **Quantitative marketing research -** generally used to draw conclusions - tests a specific hypothesis - uses random sampling techniques so as to infer from the sample to the population - involves a large number of respondents - examples include surveys and questionnaires
- **Observational techniques -** the researcher observes social phenomena in their natural setting - observations can occur cross sectional (observations made at one time) or longitudinal (observations occur over several time-periods) - examples include product-use analysis and computer cookie traces
- **Experimental techniques -** the researcher creates a quasi-artificial environment to try to control spurious factors, then manipulates at least one of the variables - examples include purchase laboratories and test markets

Researchers often use more than one research design. They may start with secondary research to get background information, and then conduct a focus group (qualitative research design) to explore the issues. Finally they might do a full nation-wide survey (quantitative research design) in order to devise specific recommendations for the client. The combination approach integrates the rational/functional aspects of

market behavior, with the psychological aspects and the conceptual structure of the consumer [29].

4.3 Strategic Management

Strategic management is the process of specifying an organization's objectives, developing policies and plans to achieve these objectives, and allocating resources so as to implement the plans. It is the highest level of managerial activity, usually performed by the company's Chief Executive Officer and executive team. It provides overall direction to the whole enterprise. An organization’s strategy must be appropriate for its resources, environmental circumstances, and core objectives. The process involves matching the company's strategic advantages to the business environment the organization faces. One objective of an overall corporate strategy is to put the organization into a position to carry out its mission effectively and efficiently. A good corporate strategy should integrate an organization’s goals, policies, and action sequences (tactics) into a cohesive whole, and must be based on business realities. Business enterprises can fail despite 'excellent' strategy because the world changes in a way they failed to understand. Strategy must connect with vision, purpose and likely future trends [30].

4.3.1 Developing a corporate business strategy

Strategy is a very broad term which commonly describes any thinking that looks at the bigger picture. Successful companies are those that focus their efforts strategically. To meet and exceed customer satisfaction, the business team needs to follow an overall organizational strategy. A successful strategy adds value for the targeted customers over the long run by consistently meeting their needs better than the competition does.

Strategy is the way in which a company orients itself towards the market in which it operates and towards the other companies in the marketplace against which it competes. It is a plan an organization formulates to gain a sustainable advantage over the competition. Road-mapping leads to effective project portfolio development and management. It provides for company-wide technological strategy development and technology assessment, as well as division-level project evaluation and strategic

aligning. Road-mapping tools provide also a common language for innovation and building bridges between technologists and business managers within the corporation, and with major suppliers and customers.

A full statement of a selected business strategy is a business plan defining:

- The company objectives
- The strategy and tactics that will enable the company to reach those objectives
- The resources required, and how they are going to be obtained;
- What the main milestones and steps are along the way;
- Who is responsible for causing each step to occur;
- What are the company's business risks and external factors that need to be kept under review for indications that a change in strategy or plan may be required?

The major outcome of strategic road-mapping and strategic planning, after gathering all necessary information, is the setting of goals for the organization based on its vision and mission statement. A goal is a long-range aim for a specific period. It must be specific and realistic. Long-range goals set through strategic planning are translated into activities that will ensure reaching the goal through operational planning.

An objective is a specific step, a milestone, which enables the company to accomplish a goal. Setting objectives involves a continuous process of research and decision-making. Knowledge of the unit is a vital starting point in setting objectives.

Strategic planning takes place at the highest levels; other managers are involved with operational planning. The first step in operational planning is defining objectives - the result expected by the end of the budget (or other designated) cycle.

Setting right objectives is critical for effective performance management. Such objectives as higher profits, shareholder value, and customer satisfaction may be admirable, but they don't tell managers what to do. "They fail to specify priorities and focus. Such objectives don't map the journey ahead - the discovery of better value and solutions for the customer. The objectives must be: focused on a result, not an activity, be consistent, specific, and measurable. It must be related to time and shall be attainable [31,32].

4.3.2 SWOT analysis

SWOT analysis is a strategic development tool that matches internal organizational strengths and weaknesses with external opportunities and threats. (SWOT is an acronym for a firm's Strengths and Weaknesses and its environmental Opportunities and Threats) SWOT analysis is based on the assumption that if managers carefully review such strength, weaknesses, opportunities and threats, a useful strategy for ensuring organizational success will become evident to them.

A SWOT analysis looks at a company's strengths to build on, weaknesses to cover, opportunities to capture and threats to defend against.

A SWOT analysis aims to reveal the company's competitive advantages, Analyze company's prospects for sales and profitability, prepare the company for problems and allow for the development of contingency plans.

Below list has been provided to give an outline of which subjects can be considered during making a SWOT analysis. The effect of these items and how it influence on performance can be considered for a good analysis.

Table 4.1 Things to consider when making a SWOT analysis [69]

MARKETING	**ECONOMIC**
Company's image	Growth of economy
Level of planning/Marketing skills	Size of market for products, growth rate
Company's reputation for quality	Foreign exchange position
Company's reputation for service	Stability of currency, convertibility
Accessibility to raw materials	Per capita income, rate of growth
Information availability	Income distribution
Familiarity with market	Balance of economy
Company's market share	Rate of inflation
Market size	
Market growth	**POLITICAL/LEGAL**
Pricing strategy	Stability of government
Research and development	Tariffs
Sales force	Regulations in competitive practices
Marketing positioning, ease of entry	Product labeling requirements
Distribution strategy – domestic	Consumer information requirements
Distribution strategy – export	Product standards
Advertising and promotion	Government controls regulating business
Geographical proximity	Non tariff barriers

Table 4.1 cont. Things to considered when making a SWOT analysis

FINANCIAL	**SOCIAL AND CULTURAL**
Cost of capital	Lifestyle trends i.e. health and fitness
Financial stability	Ethnicity of the population
Profitability	Changes in consumer tastes
Return on equity	Business ethics
Debt to equity ratio	Social factors in business
	Other trends
MANUFACTURING	Change in cultural values
Manufacturing facilities	
Economies of scale	**ENVIRONMENTAL / TECH.**
Capacity to increase production	Importance of environmental issues
Ability to deliver on time	Pace of technological change
Technical and manufacturing skills	Innovational opportunities
Manufacturing costs	
	COMPETITION
ORGANISATIONAL	Dominant market players
Company's leadership	Number of players
Management aspirations for company	Production capability
Dedication and skill of workers	
Entrepreneurial orientation	**RESEARCH AND DEVELOPMENT**
Flexibility and adaptability	Price advantages/Disadvantages
Staff relations/Administration skills	Distribution advantages/Disadvantages
Ability to respond changing conditions	Market segmentation
Relationship with suppliers	Product quality
Language abilities & qualifications	Product positioning
Technical qualifications (TQM)	Supplier power
Marketing knowledge	Customer Power
Information management/Use of it	Threat of substitution
Technology management	Threat of new entrants
	Intensity of industry rivalry
DEMOGRAPHIC	
Population trends	**EXTERNAL ENVIRONMENT**
Age distribution	Transportation costs/Availability
Birth, death and marriage rates	Distribution within market
Lifestyle trends	reliability of postal and phone systems
Mobility trends	
Population's level of education	
Change in buying patterns	

4.3.3 Vision and mission statements

Vision is a short, succinct, and inspiring statement of what the organization intends to become and to achieve at some point in the future, often stated in competitive terms. Vision refers to the category of intentions that are broad, all-intrusive and forward-thinking. It is the image that a business must have of its goals before it sets out to reach them. It describes aspirations for the future, without specifying the means that will be used to achieve those desired ends. The corporate success depends on the vision articulated by the chief executive or the top management. For a vision to have any impact of the employees of an organization it has to be conveyed in a dramatic and enduring way. The most effective visions are those that inspire, usually asking employees for the best, the most or the greatest. Make sure you keep stretch in your vision, communicate it constantly, and keep linking the events of today to your vision, underscoring the relationship between the two [31,32]

A mission statement is an organization's vision translated into written form. It makes concrete the leader's view of the direction and purpose of the organization. For many corporate leaders it is a vital element in any attempt to motivate employees and to give them a sense of priorities. A mission statement should be a short and concise statement of goals and priorities. In turn, goals are specific objectives that relate to specific time periods and are stated in terms of facts. The primary goal of any business is to increase stakeholder value. The most important stakeholders are shareholders who own the business, employees who work for the business and clients or customers who purchase products and/or services from the business [31,32].

4.3.4 Business portfolio analysis

Business portfolio analysis is a strategy development tool that has gained wide acceptance. Business portfolio analysis is an organizational strategy formulation technique that is based on the philosophy that organizations should develop strategy much as they handle investment portfolios. Just as sound financial investments should be supported and unsound ones discarded, sound organizational activities should emphasized and unsound ones deemphasized. Two business portfolio tools are the BCG Growth –Share Matrix and the GE Multifactor Portfolio Matrix.

4.3.4.1 The BCG growth-share matrix

The Boston Consulting Group (BCG), a leading manufacturing consulting firm, developed and popularized a portfolio analysis tool that helps managers develop organizational strategy based on market share of businesses and the growth of markets in which business exist.

The first step in using the BCG Growth –Share Matrix is identifying the organization's strategic business units (SBUs). A strategic business unit is a significant organization segment that is analyzed to develop organizational strategy aimed at the generating future business or revenue. Exactly what constitutes an SBU varies from organization to organization. In larger organizations, an SBU could be a company division, a single product or a complete product line. In smaller organizations it might be entire company. Although SBUs vary drastically in form, each has the following four characteristics:

1. It is a single business or collection of related businesses,

2. It has its own competitors,

3. It has manager, who is accountable for its operations,

4. Its an area that can be independently planned for within the organization,

After SBUs have been identified for a particular organization, the next step in using the BCG matrix is to categorize each SBU within one of the following four matrix quadrants.

Stars: SBUs that are "stars" have high share of a high-growth market and typically need large amounts of cash to supports their rapid and significant growth. Stars also generate large amounts of cash for the organization and are usually segments in which management can make additional investments and earn attractive returns

Cash Cows: SBUs that are cash cows have a large share of a market that is growing only slightly. Naturally, these SBUs provide the organization with large amounts of cash, but since their market is not growing significantly, the cash is generally used to meet the financial demands of the organization in other areas, such as the expansion of a star SBU.

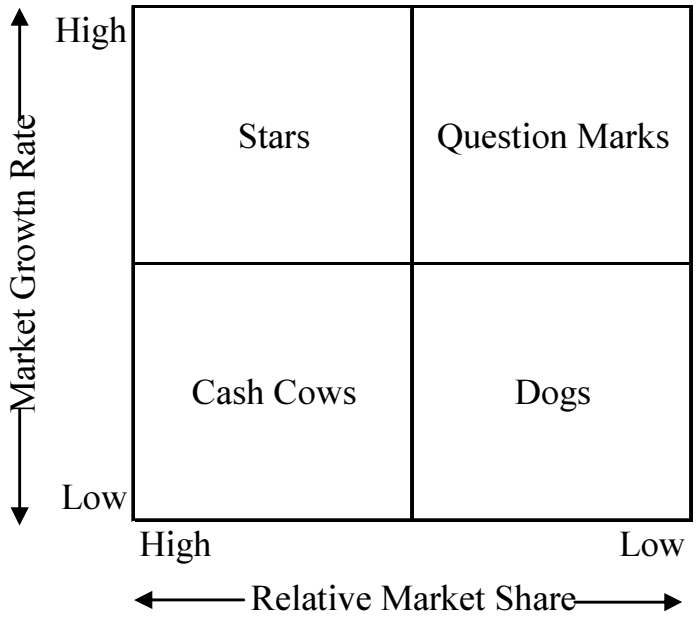


Figure 4.1 The Boston Consulting Group (BCG) growth-share matrix [33]

Questions Marks: SBUs that are questions Marks have a small share of high-growth market. They are dubbed "questions marks" because it's uncertain whether management should invest more cash in them to gain a larger share of the market or deemphasize or eliminate them. Management will chose the first option when it believes it can turn the question mark into a star and the second when it thinks further investment would be fruitless.

Dogs: SBUs that are dogs have a relatively small share of a low-growth market. They may barely support themselves; in some cases, they actually drain of cash resources generated by other SBUs. Examples of dogs are SBUs that produce typewriters or cash registers.

This technique, however, has some potential pitfalls. For one thing, the matrix does not consider such factor as various types of risk associated with product development, threats that inflation and other economic conditions can reason in the future, and social, political, and ecological pressures. These pitfalls may be the reason for recent researches results indicating that the BCG Matrix does not always help managers make better strategic decisions. Managers must remember to weigh

such factors carefully when designing organizational strategy based on the BCG Matrix [32,33].

4.3.4.2 The GE multifactor portfolio matrix

With the help of McKinsey and Company, a leading consulting firm, the General Electric Company (GE) has developed another popular portfolio analysis tool called the GE Multifactor Portfolio Matrix, this tool helps managers develop organizational strategy that is based primarily on market attractiveness and business strengths. The GE Multifactor Portfolio Matrix was deliberately designed to be more complete than the BCG Growth-Share Matrix [32].

Each of the organization's businesses or SBUs is plotted on matrix in two dimensions: industry attractiveness and business strength. Each of these two dimensions is actually a composite of a variety of factors that each firm must determine for it, given its own unique situation. As examples industry attractiveness might be determined by such factors as the number of competitors in an industry; the rate of industry growth and the weakness of competitors within an industry; while business strengths might determined by such factors as a company's financially solid positions, its good bargaining position over suppliers, and its high level of technology use.

Several circles put, each representing a company lie of business or SBU. Circle size indicates the relative market size for each line of business. It can have a shaded portion (or percent value) of a circle represents the proportion of the total SBU market that a company has captured.

Specific strategic for a company are implied by where their business (represented by circles) fall on the matrix. Businesses falling in the cells that form a diagonal from lower left to upper right are medium-strength businesses that should be invested in only selectively. Business above and to the left of this diagonal are the strongest and the ones that the company should invest in only selectively. Businesses above and to the left of this diagonal are the strongest and the ones that the company should invest in and help to grow. Businesses in the cells below and to the right of the diagonal are low in overall strength and are serious candidates for divestiture [33].

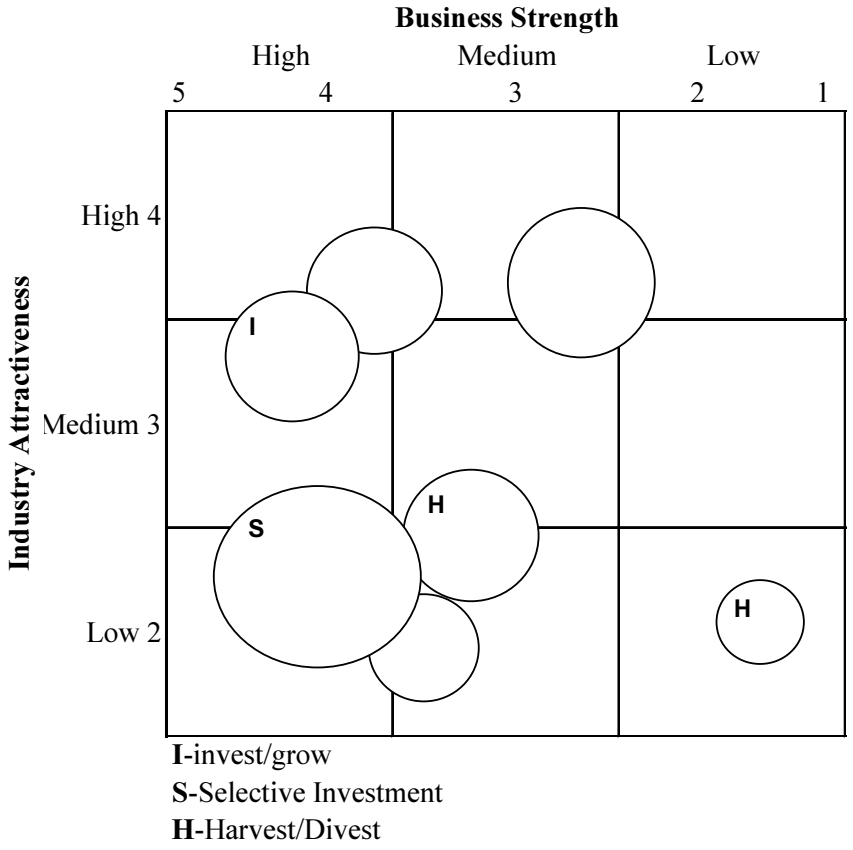


Figure 4.2 GE's multifactor portfolio matrix [33]

Portfolio models are graphic frameworks for analyzing relationship among the businesses of an organization, and they can provide useful strategy recommendations. However, so such model yet devised gives managers a universally accepted approach for dealing with these issues. Portfolio models then should never be applied in a mechanistic fashion and any conclusions they suggest must be carefully considered in light of sound managerial judgment and experience [32,33].

4.4. Baby Diaper Market

Disposable baby diapers are a part of global hygiene products. Since 1960's it has been started to be used and since that time it has been widely accepted. It has reached a good market penetration values in developed countries and has a positive market growth at almost all developing countries. Below both the worldwide baby diaper market and diaper market in Turkey has been analyzed.

4.4.1 Disposable diaper market worldwide

Global Hygiene products include diapers and pants, sanitary protection, wipes, incontinence products, and cotton wool/buds. Widely viewed as a commodity product, the diapers/pants sector captures the largest share of total (46%) hygiene product sales globally, followed by sanitary protection with 35%. Below graph shows the global hygiene product sales by sectors [34].

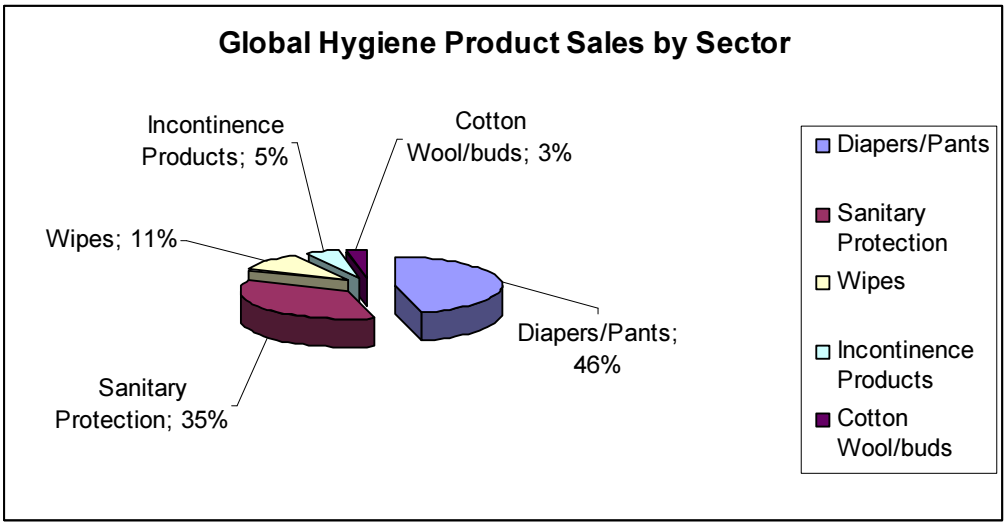


Figure 4.3 Global hygiene products sales by sector [34]

It has been announced by HAPCO, Hygiene Absorbent Products Manufacturer's Committee, that Western European Markets for absorbent hygiene products which includes the complete European Union, Iceland, Norway and Switzerland has a disposable baby care products volume of 17 billion pieces. This includes all-in-one diapers, training pants, pant diapers and inserts. However, all-in-one diapers represent over 95 % of consumption [35].

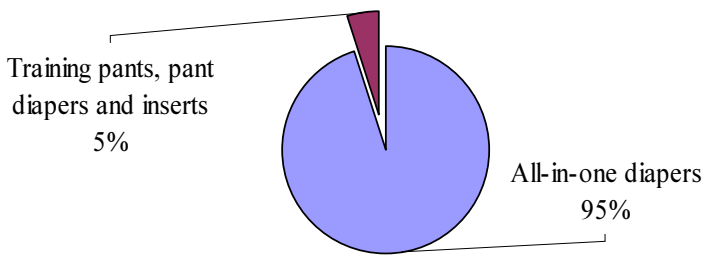


Figure 4.4 Consumption at Western European market [35]

Undeniably the global economy has faced weakening business due to several reasons. Countries having recessions and macro-economic problems, the war in the Middle East region, Euro gaining value against US Dollars and so on has moved some stones in the global economy and supply chain. Troubled economies have included mature markets such as U.S. and Germany. Asia-Pacific region is recovering from its 1998 financial crisis; however China and India have remained strong. Contrary to the past, Japan is no longer the driving engine of Asian Growth. Although some markets in Latin America, such as Brazil and Mexico, witnessed moderate growth in recent years, Argentina and Venezuela had very tough times.

Industry growth is highly dependent upon population, household formation and income. Global population has now surpassed 6 billion, but only 1.2 billion of that is concentrated in the G7 countries, which are expecting growth of only another 4% in the next twenty years. The annual population growth rates of complete World, India, USA, China, UK, Japan and Germany are given on below graph [34].

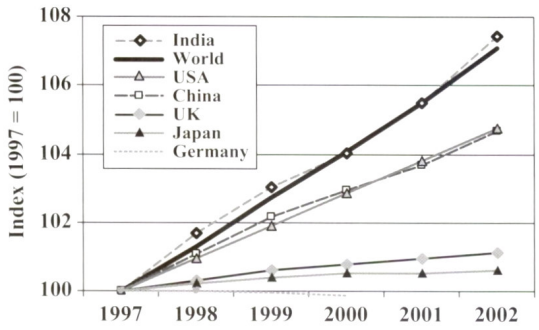


Figure 4.5 Annual population growth rates [34]

The population, especially the birth rates, is very important in the disposable baby diaper segment of the business. The global hygiene products market is experiencing a healthy growth of 3.1% over the previous year [34].

When looked at the regional performances; North America and Western Europe represents a combined share of over 50% of the global hygiene products market, holding nearly equal portions of around 26% of value sales globally.

With the U.S. largely dividing sales in North America, the region has seen its most dynamic performance in the last 10 years, increasing by an exceptional 23% in value since 1997. However this growth was restrained in 2002 as a slowing economy.

Western Europe benefits from wealthy nations such as the UK, France, Germany and their particularly high consumer spending patterns. It should be noted that development, in dollar terms, was significantly effected by unfavorable exchange rates in 2000 and a very strong Euro in 2002, resulting in an inflated 12.3 % growth in the latter year.

At 22% in 2002, the Asia-Pacific regional share comes in third, with its third fastest growth rate since 1997 at 14%. The region's performance has been somewhat subdued by the economic depression in Japan.

A 12% share puts Latin America in fourth place, with Africa and Middle East, Eastern Europe and Australasia accounting for the remaining 14%. Eastern Euro has increased its share by almost 40% since 1997 till 2002, albeit from a very low base [34].

The size of the European market for disposable hygiene products is comparable with the US market. There are, however, significant variations between countries in terms of market penetration.

In 2004 the annual volume of disposable baby diaper products sold was estimated to be 20.25 billion units with an annual market value in 2004 of some 4.5 billion euros;

Over the past 2 years the total European baby diaper market is estimated to have grown by 2.7 %. Many of the established European markets are mature now and given current demographic trends are only growing slowly. The newer markets have grown by 9 % in the same period and are expected to continue to grow in coming years; The total estimated volume of incontinence products sold in Europe, the Middle East and Africa in 2004 is around 5 billion units with an estimated revenue value to manufacturers of some 1.5 billion euros [13,36].

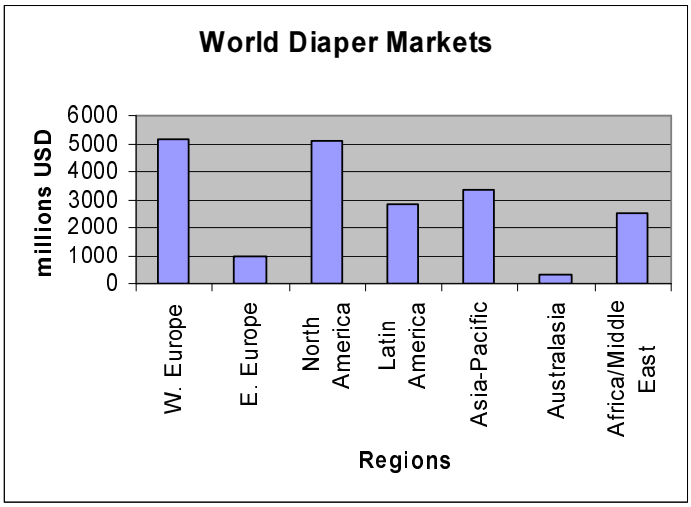


Figure 4.6 World diaper market [36]

It has been decided that Middle East area, which is a big potential market for Turkey, may be interesting for diapers as well. The region of the Middle East and North Africa is collectively known as MENA and includes mainly three areas: Golf State Countries, Other Middle East Countries and North Africa.

Golf States Countries are: Saudi Arabia, Kuwait, Qatar, Oman, United Arab Emirates and Bahrain. All of the above listed Golf State Countries listed above has a baby diaper market penetration of over 90%.

As for the other Middle East Countries: Lebanon, Syria, Jordan, Iran, Iraq and Yemen. The market penetration of the disposable baby diapers are respectively: 80%, 25%, 75%, 20%, 10%, 18%

North Africa Countries; Egypt, Libya, Algeria, Tunisia and Morocco has the market penetration of 10%, 80%, 35%, 25%, 15% respectively. These figures have been collected on Table 4.2 below.

These MENA countries comprise 325 million people. In respect to hygienic disposables, an annual birthrate of 6.8/ million illustrates the potential of these markets. MENA markets for diapers are put at an annual 4.4 billion pieces with penetration rates averaging 25% and varying 90% in Gulf Countries to just 10% in Iraq and Egypt [37].

Table 4.2 Baby diaper market penetration in Middle East and North Africa Countries [37]

MENA Countries					
Golf State Countries		**Middle East Countries**		**North Africa Countries**	
Country	Market Penetration	Country	Market Penetration	Country	Market Penetration
Saudi Arabia	>90%	Lebanon	80%	Egypt	10%
Kuwait		Syria	25%	Libya	80%
Qatar		Jordan	75%	Algeria	35%
Oman		Iran	20%	Tunisia	25%
U. Arab Emirates		Iraq	10%	Morocco	15%
Bahrain		Yemen	18%		

4.4.2 Baby diaper consumption

Once all available data are taken into account, it can be estimated that a total number in a range of 3.700 to 4.200 diapers used during the entire life of the baby. There are many regions of the world that use fewer diapers than USA. China and Russia are good examples as they are probably the very best at potty training. Parents in these countries are able to achieve this goal before the age of 20 months, instead of 33 in the USA. The rest of the world is considered somewhere in the middle [37].

A good estimate for the total potential market for baby diapers in the world is to add the total number of babies between the ages of 0 to 2.5 years old and multiply by 4.2 diapers per day and a total of 365 days per year. The number 4.2 diapers/day is the average over the "whole life" of the baby and not the typical consumption when he is less than a year old. Babies use more diapers per day when they are small and much less when they grow older. There are about 321 million babies in the world with ages in the range of 0 to 2.5 in year 2005. This means the world requires 15.600 diapers per second if every single baby in the world used disposable diapers. If a typical diaper machine runs at 6 diapers per second then you will need 2.600 machines to satisfy the need for the world. In reality, estimated total number of baby

diaper machines today to be around 550. This does not count the 100's of "home garage" micro machines, especially in US [19].

Table 4.3 A baby's diaper consumption [38]

Age	Average Units/Day
0-12 months	4,8
12-24 months	4,2
24-36 months	1,9
36-42 months	0,4
Approx 4100 units/baby	

According to birth rate trends, it is estimated that for year 2025 the whole world will have 328 million babies at the same range of 0 to 2.5 years of age. Actually these calculations are not realistic, as not every baby in the world uses a disposable baby diaper and obviously the market is not saturated yet, this is also the reason why there are not 2.600 machines in the world. Today less than 1 baby in every 5 uses a disposable diaper. The actual number of baby diapers required in year 2025 will be in direct correlation to the economic indicators for the world at that time [19].

The personal estimation of a diaper consultant Carlos Richer is that in year 2025 one in every 3 babies will use a disposable diaper, doubling the current size of the disposable baby market of today. According to his study, the disposable baby diaper market worldwide is estimated by a mathematical model. Model that takes into account the number of babies in each country, the Purchasing Power Parity (PPP) of each market segment of the population, and his own equation that correlates PPP with the probability of a parent to buy a diaper based on the percentage of the disposable income left for diapers.

The gross domestic products GDP of a country is defined as the market value of all final goods and services produced within a country in a given period of time. For comparison of economic aggregates among countries Gross National Products (GNP) and Gross Domestic Products (GDP) values are converted to common currency unit generally to US dollars. Due to the differences between official and free market exchange rates and differences of the countries' price levels, the exchange rates are

generally considered to be less reliable in such international comparisons. This situation caused to improve the Purchasing Power Parity (PPP) method which eliminates the weakness of the exchange rates [39,40]. The adjustment by PPP is controversial because of the difficulties of finding comparable baskets of goods which are needed to compare purchasing power across countries. The adjustment may be necessary because comparing the gross domestic products (GDP) using market exchange rates may not accurately measure differences in income and consumption. Market exchange rates fluctuate widely, but many people believe that PPP exchange rates reflect the long run equilibrium value. The distortions caused by using market rates are accentuated because prices of non-traded goods and services are usually lower in poorer economies.

For example, a US dollar exchanged and spent in China will buy much more than a dollar spent in the United States. The differences between PPP and market exchange rates can be significant. For example, GDP per capita in China is about USD 1.500, while on a PPP basis, it is about USD 5.000. At the other extreme, Japan's nominal GDP per capita is around USD 37.600, but its PPP figure is only USD 31.400 [41].

So, in the mathematical model made by the marketing consultant [19], the PPP already takes into account the differences in the standards of living of each country and adjusts the disposable income based on these differences. This way when for the same PPP it means it would be an equivalent disposable income in dollars as compared to the United States. According to the study, the only missing data is the one that has to do with cultural barriers.

The total population, birth rates, number of babies that are 0-30 months old, and the purchasing power parity of some countries has been provided at Table 4.4. These are considered to be the factors that are affecting the baby diaper purchases. Table 4.5 shows the potential versus estimated diaper uses by country. Table 4.6 shows the results of the mathematical model developed by Carlos Richer [19,42].

Table 4.4 Factors affecting baby diaper purchase by country [42]

Country	Total Population (million)	Birth Rate per 1000	Number of Babies 0-30 months	Below Poverty (%)	(%)PPP Lowest 10% (PPP1)	%PPP Highest 10% (PPP2)	Per Capital PPP (USD)	Lowest 10 % PPP1 (USD)	Highest 10% PPP2 (USD)	Middle 80% PPP3 (USD)
India	1.065	22.8	60.709.025	25	3.5	34	2.900	1.015	9.715	2.284
China	1.298	12.98	42.147.605	10	2.4	30	5.000	1.200	15.200	4.200
Nigeria	137	38.24	13.121.400	60	1.6	41	900	144	3.672	648
Indonesia	238	21.11	12.584.355	27	4.0	27	3.200	1.280	8.544	2.772
Pakistan	159	31.22	12.425.274	35	4.1	28	2.100	861	5.796	1.772
Bangladesh	141	30.03	10.611.136	36	3.9	29	1.900	741	5.434	1.603
United States	293	14.13	10.351.199	12	1.8	31	37.800	6.804	115.290	31.998
Brazil	184	17.25	7.939.360	22	0.7	48	7.600	532	36.480	4.874
Ethiopia	68	39.23	6.654.514	50	3.0	34	700	210	2.359	554
Congo Dem.	58	44.73	6.521.403	NA	NA	NA	700	NA	NA	NA
Mexico	105	21.44	5.625.834	40	1.6	36	9.000	1.440	32.040	7.065
Philippennes	86	25.8	5.562.589	40	1.7	38	4.600	782	17.664	3.444
Egypt	76	23.84	4.536.598	17	3.7	30	4.000	1.480	11.800	3.340
Vietnam	83	19.58	4.047.652	37	3.6	30	2.500	900	7.474	2.078
Tanzania	37	39	3.567.352	36	2.8	30	600	168	1.806	503
Sudan	39	35.79	3.502.782	NA	NA	NA	1.900	NA	NA	NA
Russia	144	9.63	3.461.560	25	5.9	47	8.900	5.251	41.830	5.240
Afganistan	29	47.3	3.371.742	23	NA	NA	700	NA	NA	NA
Uganda	26	46.31	3.056.986	35	4.0	21	1.400	560	2.940	1.313
Japan	127	9.56	3.043.259	NA	4.8	22	28.200	13.353	61.194	25.909
Turkey	69	17.22	2.965.883	18	2.3	32	6.700	1.541	21.641	5.477

Table 4.5 Potential versus estimated diaper use by country [42]

Country	Total Population (million)	Birth Rate per 1000	Number of Babies 0-30 months	Below Poverty (%)	(%)PPP Lowest 10% (PPP1)	%PPP Highest 10% (PPP2)	Per Capital PPP (USD)	Lowest 10 % PPP1 (USD)	Highest 10% PPP2 (USD)	Middle 80% PPP3 (USD)
India	1.065	22.8	60.709.025	25	3.5	34	2.900	1.015	9.715	2.284
China	1.298	12.98	42.147.605	10	2.4	30	5.000	1.200	15.200	4.200
Nigeria	137	38.24	13.121.400	60	1.6	41	900	144	3.672	648
Indonesia	238	21.11	12.584.355	27	4.0	27	3.200	1.280	8.544	2.772
Pakistan	159	31.22	12.425.274	35	4.1	28	2.100	861	5.796	1.772
Bangladesh	141	30.03	10.611.136	36	3.9	29	1.900	741	5.434	1.603
United States	293	14.13	10.351.199	12	1.8	31	37.800	6.804	115.290	31.998
Brazil	184	17.25	7.939.360	22	0.7	48	7.600	532	36.480	4.874
Ethiopia	68	39.23	6.654.514	50	3.0	34	700	210	2.359	554
Congo Dem.	58	44.73	6.521.403	NA	NA	NA	700	NA	NA	NA
Mexico	105	21.44	5.625.834	40	1.6	36	9.000	1.440	32.040	7.065
Philippennes	86	25.8	5.562.589	40	1.7	38	4.600	782	17.664	3.444
Egypt	76	23.84	4.536.598	17	3.7	30	4.000	1.480	11.800	3.340
Vietnam	83	19.58	4.047.652	37	3.6	30	2.500	900	7.474	2.078
Tanzania	37	39	3.567.352	36	2.8	30	600	168	1.806	503
Sudan	39	35.79	3.502.782	NA	NA	NA	1.900	NA	NA	NA
Russia	144	9.63	3.461.560	25	5.9	47	8.900	5.251	41.830	5.240
Afganistan	29	47.3	3.371.742	23	NA	NA	700	NA	NA	NA
Uganda	26	46.31	3.056.986	35	4.0	21	1.400	560	2.940	1.313
Japan	127	9.56	3.043.259	NA	4.8	22	28.200	13.353	61.194	25.909
Turkey	69	17.22	2.965.883	18	2.3	32	6.700	1.541	21.641	5.477

Table 4.6 Results of forecast model prepared by Carlos Richer for year 2025 [19]

No	Countries Organized by Population (1000's)	Total. Population 2005 (1000's)	1000's Babies [0-2]		1000's Diapers/year Max. Market Pot.		Market Penetration	1000's Diapers Estimated.
			2005	2025	2005	2025	2005 (estimated)	
			The model assumes babies only from 0 to 2 years old, some areas like USA babies continue to use diapers until 2.5 years old, others like China stop using diapers before 2 years of age.		To calculate 2025 diaper consumption, the model assumes the current rate of improvement for diaper performance is mantained so there are less diapers required per day in 2025 in comparisson to 2005.		A model based on known market penetration, disposable income and poverty levels to forecast countries without market data.	
1	China	1,313,973	47,238	40,614	76,209,065	60,185,146	6%	4,191,499
2	India	1,095,351	57,681	55,631	93,055,951	82,439,579	2%	1,861,119
3	United States	298,444	9,609	11,759	15,502,200	17,425,662	96%	14,820,103
4	Indonesia	245,452	12,003	10,931	19,363,633	16,198,649	6%	1,161,818
5	Brazil	188,078	8,299	6,858	13,387,970	10,162,129	31%	4,150,271
6	Pakistan	165,803	11,235	10,925	18,124,619	16,189,017	3%	543,739
7	Bangladesh	147,365	7,942	10,246	12,812,022	15,183,547	1%	128,12
8	Russia	142,893	3,156	2,756	5,090,768	4,083,375	21%	1,069,061
9	Nigeria	131,866	9,664	15,865	15,590,931	23,510,344	1%	155,909
10	Japan	127,463	3,018	2,29	4,868,939	3,393,551	97%	4,722,871
11	Mexico	107,449	5,638	5,124	9,095,785	7,592,515	56%	5,093,640
12	Philippines	89,468	5,273	5,499	8,506,931	8,148,968	29%	2,467,010
13	Vietnam	84,402	3,83	3,374	6,178,132	4,999,190	7%	432,469
14	Germany	82,422	1,966	1,701	3,171,748	2,519,971	96%	3,044,878
15	Egypt	78,887	4,402	4,359	7,101,747	6,459,602	31%	2,201,541
16	Ethiopia	74,777	5,656	6,785	9,124,825	10,053,951	1%	91,248
17	Turkey	70,413	3,017	2,566	4,866,519	3,802,555	44%	2,141,269
18	Iran	68,688	3,002	2,737	4,842,320	4,055,219	31%	1,501,119
19	Thailand	66,004	2,644	2,168	4,265,565	3,212,018	42%	1,791,537
20	Congo (Kinshasa)	61,895	4,99	8,389	8,050,367	12,431,659	1%	80,504
21	France	60,876	1,843	1,656	2,972,505	2,454,026	95%	2,823,880
22	United Kingdom	60,609	1,784	1,667	2,878,127	2,469,586	95%	2,734,221
23	Italy	58,133	1,319	1,048	2,127,943	1,552,290	96%	2,042,825
24	Korea, South	48,604	1,641	1,115	2,647,425	1,652,319	85%	2,250,312
25	Ukraine	47,138	1,144	1,007	1,844,809	1,492,273	24%	442,754
26	South Africa	44,187	2,311	1,541	3,727,530	2,282,867	49%	1,826,490
27	Colombia	43,593	2,226	2,23	3,591,206	3,304,637	55%	1,975,163
28	Burma	43,085	2,021	1,49	3,259,673	2,208,031	6%	195,58
29	Sudan	41,236	2,983	3,43	4,811,667	5,082,917	8%	384,933
30	Spain	40,397	927	746	1,494,722	1,104,756	93%	1,390,092
31	Argentina	39,921	1,687	1,475	2,721,637	2,185,062	42%	1,143,088
32	Poland	38,646	1,009	852	1,627,013	1,261,838	21%	341,673
33	Tanzania	37,445	2,829	3,48	4,564,026	5,157,012	1%	45,64
34	Kenya	34,707	2,307	2,289	3,721,076	3,391,328	4%	148,843
35	Morocco	33,241	1,77	1,727	2,855,541	2,558,500	21%	599,664
36	Canada	33,098	924	979	1,489,883	1,450,780	96%	1,430,287
37	Algeria	32,93	1,51	1,358	2,435,276	2,012,420	20%	487,055
38	Afghanistan	31,056	2,161	3,91	3,485,535	5,793,488	1%	34,855
39	Peru	28,302	1,487	1,298	2,398,977	1,922,765	26%	623,734
40	Nepal	28,287	1,844	2,09	2,974,119	3,097,171	5%	148,706
41	Uganda	28,195	2,339	5,39	3,773,509	7,986,700	5%	188,675
42	Uzbekistan	27,307	1,458	1,734	2,352,191	2,569,615	n.a.	n.a.
43	Saudi Arabia	27,019	1,681	1,989	2,711,151	2,947,499	42%	1,138,683
44	Iraq	26,783	1,766	2,102	2,848,281	3,114,213	6%	170,897
45	Venezuela	25,73	1,255	1,205	2,023,885	1,785,690	55%	1,113,137
46	Malaysia	24,385	1,337	1,573	2,156,982	2,331,029	42%	905,932
47	Korea, North	23,113	828	803	1,335,006	1,189,225	3%	40,05
48	Taiwan	23,036	745	602	1,201,909	892,104	96%	1,153,832
49	Romania	22,303	575	458	927,648	677,969	19%	176,253
50	Yemen	21,466	1,607	3,093	2,591,766	4,582,776	2%	51,835
51	Ghana	20,727	1,568	1,535	2,529,654	2,274,717	4%	101,186
52	Australia	20,09	629	640	1,014,766	948,416	89%	903,141
53	Sri Lanka	20,064	781	689	1,259,987	1,021,029	7%	88,199
54	Mozambique	19,406	1,479	1,488	2,386,071	2,205,067	1%	23,861
55	Syiria	18,448	1,247	1,192	2,011,785	1,766,425	4%	80,471
56	Madagazcar	18,04	1,598	2,572	2,578,053	3,811,447	1.5%	38,671
57	Cote D' Ivoire	17,298	1,324	1,505	2,136,009	2,230,260	3%	64,08
58	Cameroon	16,988	1,303	1,472	2,102,130	2,181,357	4%	84,085
59	Netherlands	16,407	481	454	775,997	672,783	92%	713,918
60	Chile	15,98	628	581	1,013,152	860,984	65%	658,549
61	Kazakhstan	15,185	550	512	887,315	758,733	32%	283,941
62	Cambodia	13,636	814	1,024	1,313,226	1,517,466	2%	26,265
63	Burkina Faso	13,491	1,258	1,99	2,029,531	2,948,981	2%	40,591
64	Ecuador	13,363	752	721	1,213,202	1,068,450	38%	461,017
65	Malawi	12,707	1,151	1,6	1,856,908	2,371,040	1%	18,569
66	Niger	12,162	1,183	1,752	1,908,534	2,596,289	1%	19,085
67	Zimbabwe	12,16	799	659	1,289,027	976,572	2%	25,781
68	Guatemala	12,013	875	873	1,411,638	1,293,699	18%	254,095
69	Angola	11,827	1,017	1,32	1,640,726	1,956,108	7%	114,851
70	Senegal	11,706	889	896	1,434,224	1,327,782	5%	71,711
71	Mali	11,415	1,129	1,894	1,821,416	2,806,719	2%	36,428
72	Cuba	11,346	350	295	564,655	437,161	25%	141,164
73	Zambia	11,261	999	1,204	1,611,687	1,784,208	1%	16,117
74	Serbia and Montenegro	10,829	321	263	517,869	389,74	10%	51,787
75	Greece	10,668	256	216	413,005	320,09	74%	305,624
				Total in 1000's	456,481,622	433,083,052		
				Required/sec	**14,475**	**13,733**		

In summary, it is possible to know the total numbers of diapers needed by country if every baby used a disposable diaper; In the mathematical model, the total number corrected by the actual economic indicators for each country (potential market share); and finally, a revised correction of the market share based on cultural resistance and unemployment data [19].

Another study is made by management consultants John R. Star Inc in year 2002 for a global outlook in hygiene absorbent products. According to this study the global baby diaper and training pant consumption in billion diapers is provided at Table 4.7

Table 4.7 Global outlook for baby diapers and training pant consumptions [43]

Global Outlook for Baby Diapers and Training Pant Consumptions **(including undeveloped markets in low per capital income countries)**			
billion diapers			
Year 1995	**Year 2000**	**Year 2001**	**Year 2006** (forecasted)
68,2	87,5	90,1	104,7
	(+5,1%)	(+3,0%)	(+3,0%)

4.4.3 Ten leading manufacturers of diapers and training pants

The listed top ten manufacturers take about 84 % of the global market [43].

1. Procter & Gamble, headquarter at U.S., has 34.2 % global market share.
2. Kimberly-Clark, headquarter at U.S., has 29.5 % global market share.
3. Tyco International, headquarter at U.S. has 5.5 % global market share.
4. SCA Hygiene Products, headquarter at Sweden, has 4.1% global market share.
5. Uni-Charm, headquarter at Japan, has 2.5 % global market share.
6. Grupo P.I. Mabe, headquarter at Mexico, has 2.4% global market share.
7. Ontex, headquarter at Belgium, has 1.7% global market share.
8. DSG International, headquarter at Hong Kong, has 1.6 % global market share.
9. Kao, headquarter at Japan, has 1.3 % global market share.
10. Paul Hartmann, headquarter at Germany, has1.2% global market share.

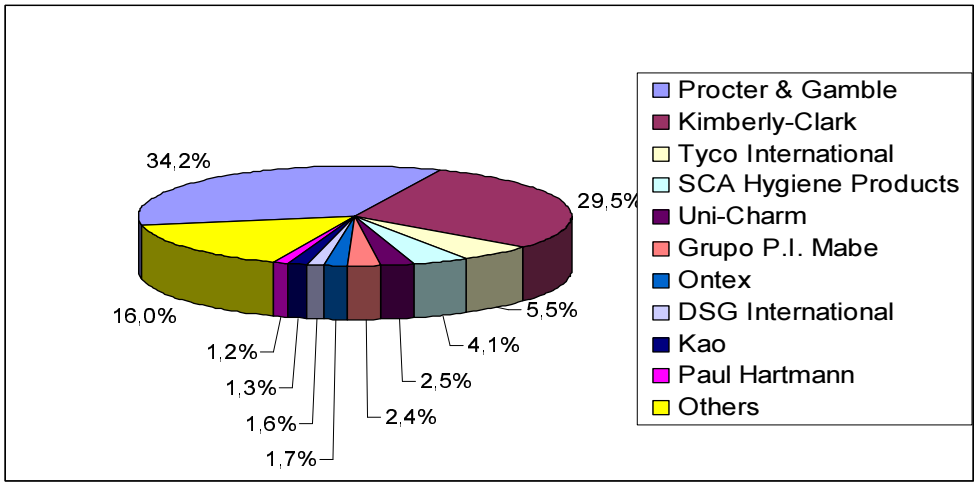


Figure 4.7 Top ten manufacturers' market share in diapers and training pants [43]

4.4.4 Disposable diaper market trend worldwide

World consumption of hygiene absorbent products, including disposable baby diapers, training pants, feminine protection and adult incontinence products approached 279 billion units in 2001. Global consumption of disposable baby diapers and training pants grew at an average of annual rate of 5.1% from 98 billion units in 1995 to 87.5 billion units in 2000. The forecasted continuing growth is at an average of 3% per year rate to approximately 104.7 billion units by 2006 [13,44].

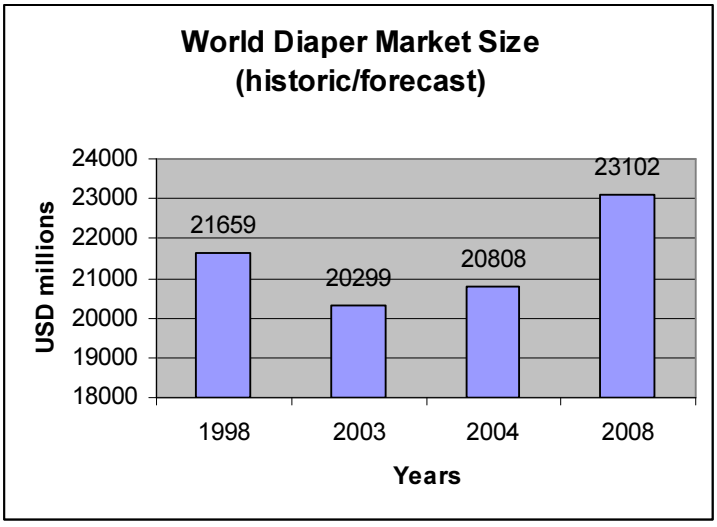


Figure 4.8 World market size of baby diapers [13]

The developing and underdeveloped market regions of the world continue to be the primary sources of this volume growth as the mature markets of the U.S and Canada, Western Europe and Japan are already highly penetrated. In most countries throughout the world, birth rates are gradually declining; however, infant populations continue to grow due to the increasing number of women entering the child-bearing age bracket [43,44].

The decline on birth rates in European Union Countries has been shown Figure 4.9

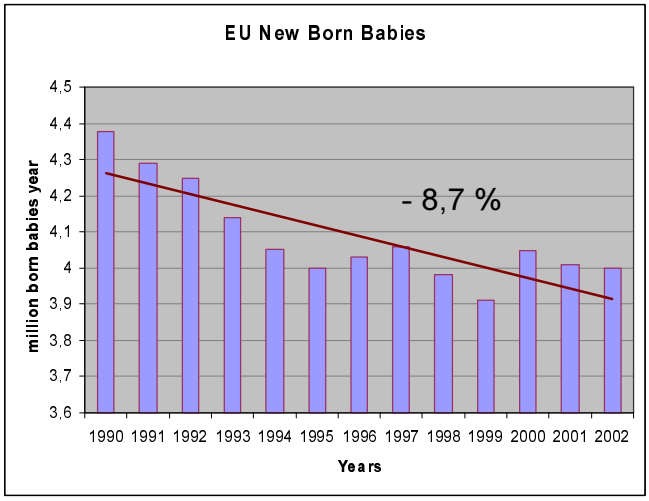


Figure 4.9 Number of new born babies in European Union countries [38]

The new lines from industry leaders K-C and P&G reflect a trend toward developing diapers in parallel with babies' development, not just size. One innovation this trend has created is additional stretch. Where once, stretch was limited to waistbands and leg cuffs; now it is being applied to the overall chassis of the diaper [45].

One requirement in the diaper industry is that a diaper offer convenience to parents. Consumers want a diaper that is easy to put on, remove and dispose of in a short amount of time. Manufacturers have responded by adding re-fastenable tabs and tapes so that parents can check to see if the diaper has been soiled and, if necessary, use the tapes to roll the diaper up and throw it away. With the push for increased comfort and ease of use comes another trend in diapers, an evolution toward looking and feeling like a big kid. Therefore, many manufacturers have added pull-up pants to the baby care lines. Although pull-up pants are more geared toward older children

who are undergoing toilet training, they can be pulled up and down to offer parents and children more convenience [45,46].

Although pull-up pant diapers are well received and not showing any signs of fading from the market, there are certain fads manufacturers have to remain aware of. For example, many companies are now adding cartoon designs and colorful graphics to a diaper's outer cover. While this does not boost the performance of the diaper, these trends could influence customer purchasing decisions [45,46].

No matter how many extra features a baby diaper has, one fact is clear—the diaper must protect against leaks and provide dryness. When looked at what baby diaper manufacturers are doing in order to attract consumers with value added products; it can be seen that; some companies are producing diapers decorated with college sports team logos. Another feature is using sensing technologies in diapers so that the wetness are monitored and sensed through a remote receiver similar to one-way intercom. Similarly, having patterns which fade when wet, to support toilet training process. Using flushable biodegradable components in diaper manufacture is another trend, pull-up diapers; producing diapers by using imprinted backsheet fighting against SIDS (Sudden Infant Death Syndrome) is another feature that a producer decided to put on a serial of diaper. Putting the diaper bundles in transparent printed package which allows shoppers to view the multi-colored diapers is another innovation made. One diaper manufacturer makes a change on diapers formulation which includes a hypoallergenic skin protectant that transfers lotion to the wearer's skin. The protectant is applied to the topsheet and leg cuff areas, is continuously transferred to the skin with each diaper change and is activated by body heat and movement [45,47,48].

While all of the extra features have become important when competing in the baby diaper market, concerns with costs are not going away. Consumers are still looking for the best quality at the best prices, but this varies throughout different regions. Although the diaper market is mature in developed areas such as North America, Western Europe and Japan, penetration in other areas is limited, making these regions more attractive to manufacturers

To gain market share in lower income regions, manufacturers must study consumer spending patterns in these regions. Some of their research shows that consumers in Third World nations buy diapers in much smaller quantities than in the U.S. and Europe because they do not have the disposable income and therefore cannot afford bulk packages.

In less developed areas such as Africa, people do not go through that many diapers in one day as they would in the U.S.—primarily because they cannot afford it. They are more likely to go to the store and buy two or three diapers at a time. In addition to smaller packages, diapers with lower quality and price are more attractive in less developed areas. Because customers are not as sophisticated in these regions, they tend to have lower standards than consumers in western nations [45].

According to a survey made at a conference that attracts 500-plus people at senior-level management from about 30 countries concludes that next year (mentioning year 2004) is expected to be better for the hygiene products industry [49].

4.5 Disposable Diaper Market in Turkey

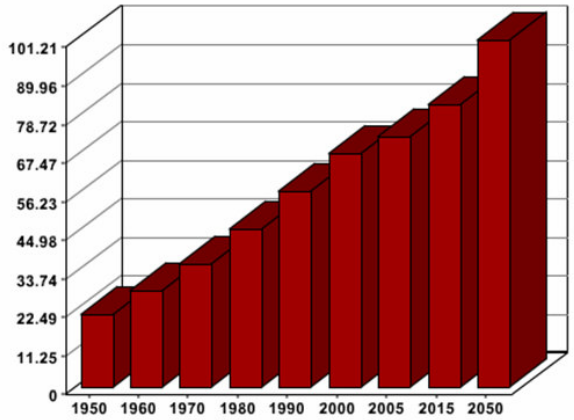
Parents expect nothing but the best when it comes to their babies' diapers. And, manufacturers have responded to these expectations with improvements to their diapers. Not only do diapers need to provide the best protection against leaks to keep babies dry, but they must also offer extra features that can provide comfort, breathability, stretch and convenience.

Diapers are achieving improvements, such as more elastic waistbands and leg cuffs and increased absorbency. The result is a marketplace where consumers have many options in choosing which diaper will best suit their babies' needs. In addition to fit and comfort, added features include softer and cloth-like outer coverings with colorful prints and cartoon designs and built-in lotions. All of these features can make one diaper stand out from another. The result of all of this innovation is a need among manufacturers to keep place with consumers' demands and expectations for baby diapers [45].

Leakage protection and dryness are the top two priorities, and if a diaper can not do this, it will not stand a chance on the market. Consumer demands are always the same: best possible fit, skin friendliness and high absorbency. A diaper shall be designed for a perfectly comfortable fit, whether the baby is lying down, crawling, or running [45].

The main absorbent hygiene products in Turkish market are baby diapers, feminine care products (sanitary napkins, panty shields, tampon), Wet wipes, Adult Incontinence diapers. Infant population (0-2.5 years) approx 3.5 millions with a percentage of 5 % of total population and has about 2 % increase per year [50].

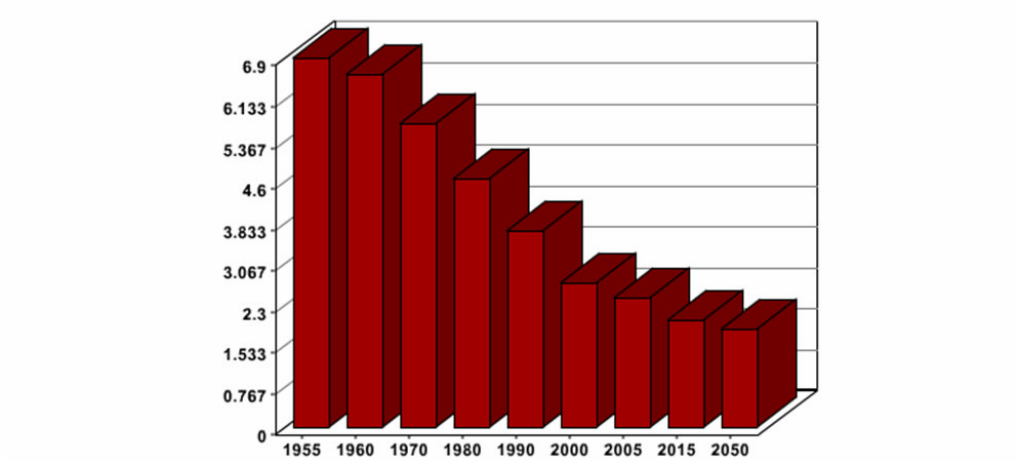
Below figure shows the change in Turkey's population starting from 1950 and projecting prognosis made for year 2050. As seen, Turkey has a positive growth of population. It shows the size of population according to United Nation's database. Turkey ranks 17 in the world population ranking for year 2005. The same study refers a 1.4 % average growth rate of national population for 2000-2005 years period [51]. There are about 1.5 million new born each year in Turkey which basically mean about 3.5 million everyday diaper users in Turkey [52].



Years & Total Population (million inhibitants)	1950	1960	1970	1980	1990	2000	2005	2015 (prognosis)	2050 (prognosis)
	21,48	28,23	36,21	46,32	57,3	68,23	73,19	82,64	101,21

Figure 4.10 Turkey's total population [51]

The population of babies is more important for a company who plans to make an investment for a product that is consumed by babies. Total fertility rate is an indication of the number of children, a women would have during her productive years if in each five-year age interval from ages 15 to 49 she had the number of children that women of that age currently have in the population as a whole. The data forming the figure is collected from the United Nations's common database and is measured as the average projected number of children for the period 2000-2050 [51].



Years & Total Fertility Rate	1955	1960	1970	1980	1990	2000	2005 (prognosis)	2015 (prognosis)	2050 (prognosis)
	6,90	6,60	5,70	4,65	3,70	2,70	2,43	2,02	1,85

Figure 4.11 Total fertility rates in Turkey [51]

Apart from the fertility rate, Table 4.8 shows the historic population data and projected population of year 2010. Table gives detailed information about the number of babies in the population. Baby population that is aged up to 1 year, babies that are between age 1 and 2 also age 2 and 3. In general, babies use diapers till they become 2.5 years old; which corresponds to 30 months.

Table 4.8 Table showing baby population in Turkey [50]

Infant Population in Turkey								
Age		0<X<1	1<X<2	2<X<3	0<X<3	0<X<2,5	Change	
Years	Total Population						0<X<2,5 Increase	Total Increase
1995	60.755.469	1.193.086	1.174.573	1.159.833	3.527.492	2.947.575	1,013	1,015
1996	61.692.236	1.214.562	1.192.191	1.173.751	3.580.504	2.993.629	1,016	1,015
1997	62.865.574	1.259.622	1.213.784	1.191.428	3.664.835	3.069.121	1,025	1,019
1998	63.865.865	1.286.578	1.258.816	1.213.008	3.758.402	3.151.898	1,027	1,016
1999	64.896.282	1.314.111	1.285.755	1.258.010	3.857.876	3.228.870	1,024	1,016
2000	65.957.651	1.342.233	1.313.270	1.284.932	3.940.434	3.297.968	1,021	1,016
2001	67.050.822	1.370.956	1.341.374	1.312.429	4.024.759	3.368.545	1,021	1,017
2002	68.176.669	1.400.295	1.370.079	1.340.515	4.110.889	3.440.632	1,021	1,017
2003	69.336.130	1.430.261	1.399.399	1.369.202	4.198.862	3.514.261	1,021	1,017
2004	70.530.115	1.460.869	1.429.346	1.398.503	4.288.718	3.589.466	1,021	1,017
2005	71.759.614	1.492.131	1.459.934	1.428.431	4.380.496	3.666.281	1,021	1,017
2006	73.025.660	1.524.063	1.491.176	1.459.000	4.474.239	3.744.739	1,021	1,018
2007	74.329.277	1.556.678	1.523.088	1.490.222	4.569.988	3.824.877	1,021	1,018
2008	75.671.572	1.589.991	1.555.682	1.522.113	4.667.786	3.906.729	1,021	1,018
2009	77.053.662	1.624.017	1.588.973	1.554.686	4.767.676	3.990.333	1,021	1,018
2010	78.476.711	1.658.771	1.622.977	1.587.956	4.869.704	4.075.726	1,021	1,018

According to a study [50] made in late 2004 by Hayat Kimya, Turkey's biggest Turkish producer of baby diapers producing diapers under Molfix brand name, the market penetration of diapers in Turkey is about to reach 45 % and has 2 % annual growth rate. Same study, advice an installed diaper production capacity of 4.5 billion diapers per year. Below Table 4.9 gives an outlook to baby diaper market

Table 4.9 Outlook to baby diaper market in Turkey [50,52,53]

Outlook to Diaper Market in Turkey	
Number of babies (0-30 month)	3.500.000
Market Penetration	45%
Annual growth rate	2%
Installed production capacity (diapers/year)	4.500.000.000
Capacity utilized (diapers/year) includes export volumes	3.000.000.000
Market Volume (USD)	450.000.000

Purchasing power parity, PPP, is the rate of currency conversion that equalizes the purchasing power of different currencies, in this case Turkish Lira, and eliminates the differences in price levels between countries. USD is taken as 1. Figure 4.12 shows the increase in PPP of Turkey which in return can be interpreted to be a show of the increase of people's ability to afford using disposable diapers for their baby.

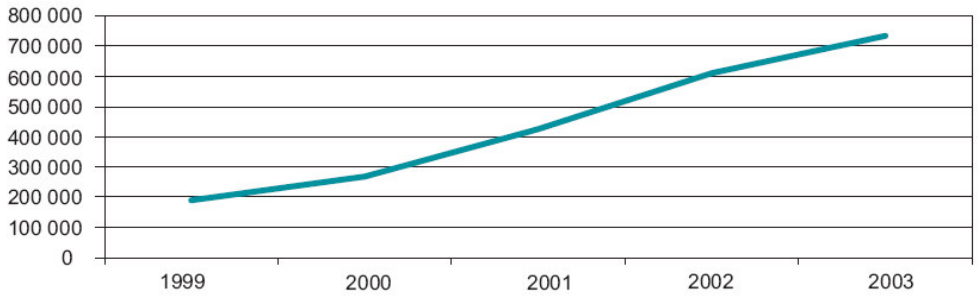


Figure 4.12 Changes in Purchasing Power Parity (PPP) of Turkey. Values showing the increase in Turkish Lira per USA dollar for years between 1999 and 2003 [40]

A foreign marketing consulting firm uses the PPP to estimate the use of diapers [42]. The study was briefly explained in this thesis in the section explaining worldwide baby diaper consumption. The figures for Turkey and the estimations made have been shown on Table 4.10. The study, takes the population about 68.9 million and indicating a birth rate of 17.2 per 1000 women. It divides the population into 4 sub-categories. These are: people below poverty, population at the lowest 10% of the purchasing power, 80% in the middle and the last 10% who has the highest purchasing power.

A model developed estimates the market share for all three segments that are above poverty [42]. While the lowest 10% has 0 market share, the middle 80% is estimated to have about 10% market share in year 2005. According to the model, the highest 10% has about 28% market share. It reaches a theoretical market share of 38% and an estimated market share of 35% for year 2005. With about 1.6 billion diapers sold locally while having about 4.5 billion diapers per year.

Table 4.10 Baby diaper market potential in Turkey [42]

Factors Effecting Baby Diaper Business and the Market Potential in Turkey (based on estimations made on 2003)	
Population	68.893.918
Birth rate per 1000 women	17.22
Number of Babies 0-30 months	2.965.883
% Below Poverty	18
% PPP Lowest 10% (PPP 1)	2.3
% PPP Highest 10% (PPP 2)	32
Per Capita PPP (USD)	6.700
Lowest 10 % PPP1 (USD)	1.541
Highest 10% PPP2 (USD)	21.641
Middle 80% PPP3 (USD)	5.477
Market Share 1 (Lowest 10%)	0
Market Share 2 (Highest 10%)	10
Market Share 3 (Middle 80 %)	28
Theoretical Market Share (%)	38
Estimated Market Share in 2005 (%)	35
Maximum Potential Use in 2005 (millions)	4.547
Estimated Diapers Sold in 2005 (millions)	1.591

According to a study made in year 2000 making a 5 year forecast, the baby diaper market has about 22% market penetration in year 2001 [43]. The results of forecasting figures by the study has been given at below Table 4.11

Table 4.11 Diaper consumption forecast 2001-2006

Estimated consumption for diapers and training pants (million diapers)				
Year 2000	Year 2001			Year 2006
estimated consumption	estimated consumption	potential market	market penetration	forecast consumption
1200	1170	5252	22%	1880

In addition to the consumption of diapers in Turkey, it is also exported to neighboring countries. The diaper import and export volumes have been obtained form Government Statistical Institute fore customs tariff code 481840910000 and 4818409900000. The values obtained starting from year 1996 till the first 9 months of 2005 has been extrapolated to cover till the end of year 2005.

Table 4.12 Import export volumes of baby diapers 1996-2005 USD [54]

Import Export of Baby Diapers (customs tariff code: 481840910000 and 481840990000)		
Years	**Import (USD)**	**Export (USD)**
1996	8.136.324	3.838.470
1997	5.249.514	11.133.270
1998	3.370.729	7.569.380
1999	5.394.006	13.217.063
2000	10.992.530	11.626.595
2001	5.386.182	34.835.166
2002	2.363.756	56.717.610
2003	1.611.351	71.525.805
2004	3.402.078	111.801.825
2005 9 months	3.469.284	98.751.151
2005 12 months (expected)	4.625.712	131.668.201

Figure 4.13 Baby diaper import export volumes 1996-2005 in USD [54]

4.5.1 Baby diaper manufacturers in Turkey, their capacity and market share

Below table shows diaper producers in Turkey, their locations, number of machines in operation and respective market shares. Figure 4.14 shows their locations on map.

Table 4.13 Diaper producers, number of production lines and market share in Turkey

Company #	Location	Region	Number of lines	Market Share
Company 1	Gebze	Marmara	6	30-35 %
Company 2	Gölcük / İzmit	Marmara	4 (+2)	20-25 %
Company 3	Bahçelievler / Istanbul	Marmara	5	10-15 %
Company 4	Tuzla / Gebze	Marmara	4 (+2)	10-15 %
Company 5	Istanbul	Marmara	3	10%
Company 6	İstanbul	Marmara	4	
Company 7	Adapazarı	Marmara	4	
Company 8	Kayseri	Central Anatolia	3	
Company 9	Çerkezkoy/ Tekirdağ	Marmara	3	
Company 10	Beylikduzu / Istanbul	Marmara	2	
Company 11	Adana	Mediterranean	2	10-15%
Company 12	Haramidere / Istanbul	Marmara	2	
Company 13	Istanbul	Marmara	2	
Company 14	Karaman / Konya	Central Anatolia	3	
Company 15	Adana-Mersin	Mediterranean	3	
Company 16	Gaziantep	Southeast Anatolia	2	
Company 17	Haramidere / Istanbul	Marmara	2	
Company 18	Ceyhan / Adana	Marmara	(+2)	
Company 19	Yenibosna / Istanbul	Marmara	3	
Company 20	Uşak	Aegean region	1	
Company 21	Yeniköy / Antalya	Mediterranean	1	
Company 22	Mersin	Mediterranean	1	
Company 23	Gaziantep	Southeast Anatolia	1	
Company 24	Gaziantep	Southeast Anatolia	1	
Company 25	Istanbul	Marmara	1	

The Company names have been masked because; it is possible that some of the information provided herein may be confidential for some of the companies. The information provided in terms of the number of lines and the respective market shares has been obtained during face to face communications made people involved in the industry as well as the digital and printed media. There are about 26 baby diaper producers in Turkey and new companies are entering to market. Location, geographic region they operate at, number of baby diaper manufacturing lines in operation. The numbers mentioned in parenthesis are the lines either at installation phase or it has been purchased but not yet delivered. The capacity among regions is provided in Table 4.14. Producers in Turkey are mostly located at Marmara Region, especially the companies with higher production capacities [50,52,53].

Table 4.14 Baby diaper capacity among geographic regions of Turkey

Capacity Among Regions (diapers only)	
Marmara Region	85 - 90 %
Southern Anatolia Region	Less than 5 %
Mediterranean Region	Less than 4 %
Central Anatolia Region	Less than 3 %
Aegean Region	Less than 1%
Black Sea Region	Less than 1%
Eastern Anatolia Region	Less than 1%

Figure 4.14 Locations of baby diaper producers in Turkey

Along with the lower machinery costs, freight costs for diapers with lighter weights will also lead to lower transportation costs. Additionally, as diapers with increased absorbency levels lessen the need for frequent diaper changes, packages would contain fewer diapers. So, a thinner, lighter diaper would mean less overall package weight, which translates into lower transportation fees. About 30 years from today, one could get only about 500 cases of 4 bags each onto a trailer, a total of maybe 7500 kilograms. With the trailers and products of today, it can get 2000 or more 6-bag cases onto a truck so that the shipping cost per bag is minimized [55,56]. Both the diapers and the incoming materials are high volume materials, therefore the transportation costs is an important factor in diaper business.

4.5.2 Disposable diaper market prices in Turkey

The study to determine the sales prices revolves around three main information sources. First one is obtained by making a supermarket survey. First, prices have been obtained from Real Supermarket which is one of the biggest supermarkets of the city. Then prices available at Yimpas Supermarket, a district market and finally from the Gaziantep wholesaler's market house has been noted. Minimum prices for the same diaper size and pack size has been taken as reference price and the summarized pricing table has been provided at Table 4.15. Detailed pricing has been provided at Appendix 1.

The second information source for pricing is a baby diaper producer who does export some part of their production to Middle East. The price obtained from this source is 17.5 USD for 240 diapers. Details have been given at Table 4.17.

As a third source of pricing information; this comes from a producer, wholesaler who sells diapers under "Bundies" brand name. Mondial International, located in United States of America, claim to manufacture high quality diaper for a price conscious segment of the market place. It is a diaper producer company and only sells diapers to the diaper trade. It sells only container load and sells only to wholesale distributors or brokers. Detailed price information has been provided on Table 4.16 When the information obtained is analyzed, it can be concluded that a medium size diaper can be sold at a minimum price of 0.07292 USD and it has been decided to take this number as reference minimum sales price per diaper.

Table 4.15 Companies diaper end user prices available in the supermarkets

Manufacturer	Brand name	Average End User Market Prices for Major Sizes (USD/diaper), (VAT discounted)				
		New born	Mini	Midi	Maxi	Junior
P&G	Pampers	0,2282	0,1525	0,1744	0,1844	0,5336
KC	Huggies		0,1704	0,1883	0,2294	0,2773
Hayat Kimya	Molfix		0,1345	0,1569	0,1765	0,2354
Ontex	Canbebe		0,1255	0,1464	0,1690	0,2197
Evyap	Evybaby	0,1997	0,1345	0,1300	0,1811	0,2302
Rozi	Love Baby		0,1108	0,1255	0,1448	0,1883
Paksel	Bebiko		0,0986	0,1151	0,1381	
KC-Ovisan	Pedo		0,1098	0,1047	0,1098	0,1883
Melita	Pupe		0,0897	0,1047	0,1255	
Hazel	Ninni Bebe		0,0819	0,0942	0,1280	
Eruslu	Sleepy		0,0897	0,0942	0,1130	
No Name	No Name		0,0725	0,0785	0,0856	
Pakten	Onlem/Joyful		0,0762	0,0889	0,1067	0,1883
No Name	Bello		0,0807	0,0942		
Berke	Pufy				0,1381	
	Average Price:	0,2140	0,1091	0,1211	0,1450	0,2576
	Max. Price:	0,2282	0,1704	0,1883	0,2294	0,5336
	Min. Price:	0,1997	0,0725	**0,0785**	0,0856	0,1883

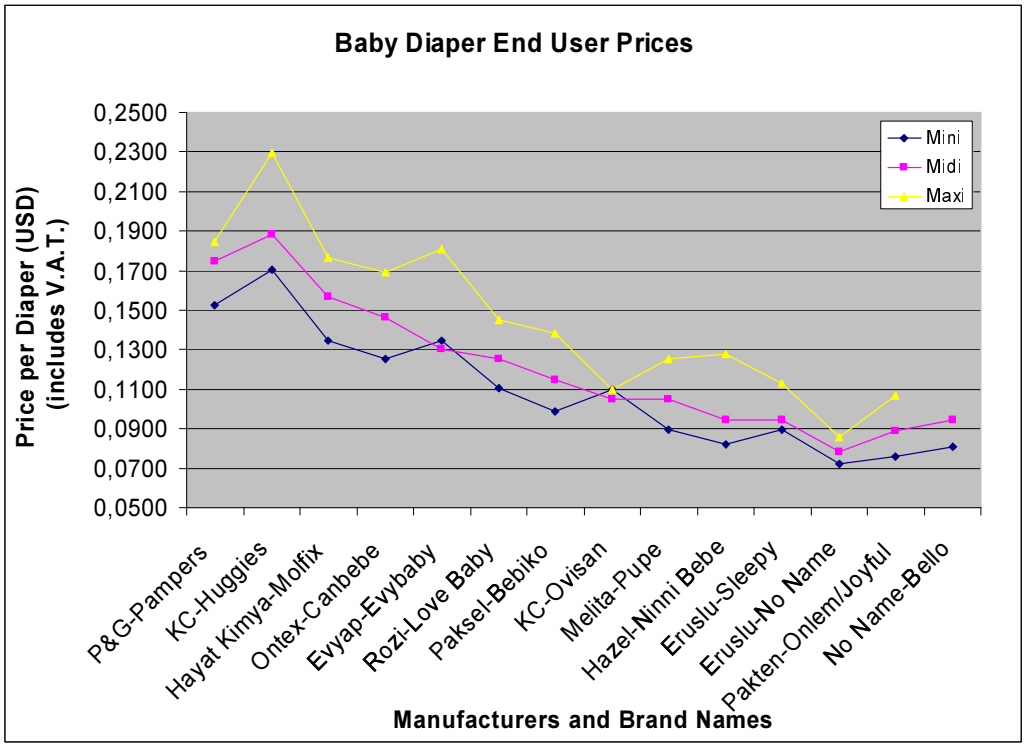


Figure 4.15 Diaper end user average prices depending on the brand name

Table 4.16 A baby diaper wholesaler prices available in USA

Bundies Baby Diapers	Sizes and prices per diaper (USD)			
	Small	Medium	Large	X-Large
	(3-6 kgs)	(5-9 kgs)	(8-18 kgs)	(12-25 kgs)
Gold Baby	- - -	0,1063	0,1083	0,1083
Silver Brand Baby Diapers	- - -	0,0938	0,0958	0,0958
Platinium Brand Velcro Diapers	0,0792	0,0875	0,1083	0,1250
Ultra Bundies	0,0813	0,0900	0,0938	0,0950
Economy Standard	- - -	0,0800	0,0800	0,0800
Economy Standard 4010 upgrade	- - -	0,0900	0,0900	0,0900
Panda Kids Diapers	0,0875	0,0958		0,0979
2nd quality (per diaper)	0,73 to 0,85 USD/piece			
Pricing Notes: Add 0.01 USD for Elastic Stretch Waist on Silver standard diapers. Add 0.01 for Premium Features upgrade to Economy Diapers standard. For diapers without waistband the price is 0.005 USD less per unit. Diapers have cotton-like non woven back sheet. Polyetylene is also available and price is 0.0025 USD less each unit.				
Packing: 30 diapers per pack, 8 packs per case. All our bags are marked "Made in the USA"				
Sales Terms: Prices are ex- works door warehouse or factory. Min. order quantity: 1 20ft container				
All above diapers are ultra-slim, full feature and have elastic legs and elastic waist-bands, Diapers are with SAP (Super Absorbent Polymer)				
Economy Standart can be upgraded to Premium #4010. Features i.e. includes Soft Elastic Stretch Waist, better absorbency. Upgrade same price all sizes.				
Private Label and Control label Contract Manufacturing available.				

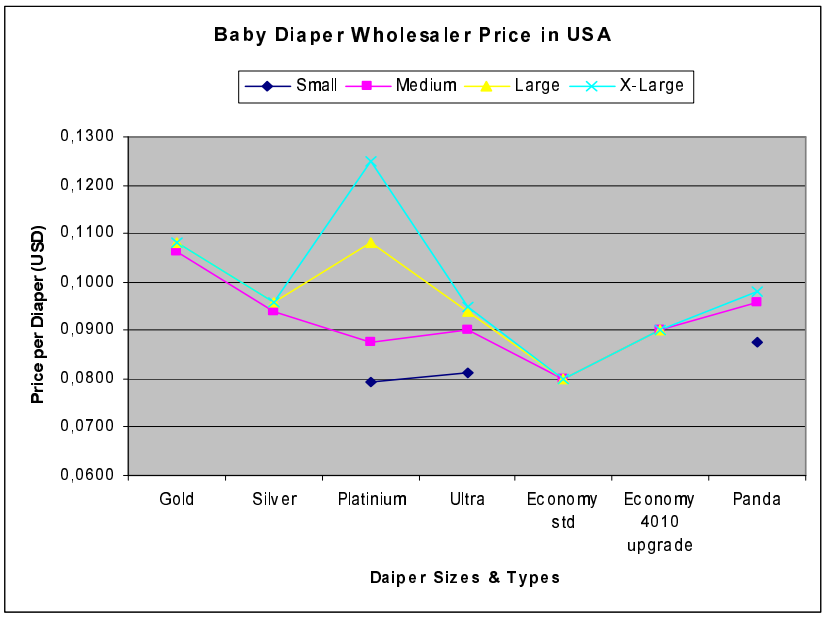


Figure 4.16 A baby diaper wholesaler's prices in USA

Table 4.17 Baby diaper sales price to Middle East market

Sales Price				
Packs per stack	**Diapers per pack**	**Total number of diapers per stack**	**Sales price per stack (USD)**	**Unit price (USD/diaper)**
8	30	240	17,5	**0,07292**

4.5.3 Disposable diaper market trend in Turkey

The primary objective of today's consumer is to purchase a diaper that will absorb repeated insults without leaking while staying dry enough to ensure the child's comfort. It is believed that the diaper market will remain competitive in the future, but the demographics of the market will change. While the U.S. market comes to a slowdown, Asia, Eastern Europe and the Middle East will see more growth, and for this growth to continue individual communication is the key. To achieve maximum market penetration, there is a need for regional product ranges and regional marketing strategies rather then one global strategy [55].

The hygiene market is dominated by a few key players: Procter & Gamble, Kimberly-Clark and Hayat Kimya. Ontex, Evyap and Rozi follow up very closely. Beyond these branded companies are a number of small and large private label players. Hygiene market is quite fragmented with a number of smaller scale companies serving regional markets.

Times are tough for suppliers to the hygiene market. Pricing pressures, skyrocketing raw material prices and inability to pass these costs to consumers have created a grave situation for the manufacturers of materials that comprise baby diapers and other disposable hygiene products.

Some private label manufacturers credit the segment's success to the commodity situation occurring in many nonwovens based consumer markets. Products like

diapers and feminine hygiene products have long been considered commodity and are largely price driven. In United States, Wal-Mart's possession of a high quality private label brand is consistent with a trend among major retailers of creating a brand presence by establishing an identity within their stores through private label products. While commodity food products, namely milk, bread and cheese, continue to represent the largest markets for private label products, growth in non-food markets has been more consistent in recent years [57]. Big supermarkets in Turkey, like Migros, Real and similar others are offering products at their own brand names and it has been foreseen that this will happen to diapers as well.

In USA, major retailers are no longer satisfied to offer private label products that are lower cost but mediocre quality imitations of the "A Brands". They now strive to build enduring brand equity in their store brand names by offering products with consistently high quality and supporting these products with advertising and promotional programs. Their store brands have features that match or exceed the leading brands but are sold at a lower price that delivers excellent value to consumers. Consumers are learning to trust the quality and value of certain store brands and are becoming loyal buyers [58]. Turkey is expected to follow up this trend as well. It should be noted that the cost per unit of a diaper is going up, but the overall price of diaper is not. It is therefore very essential to have a good diaper design to maximize the product performance. A good supply chain management and marketing strategy is also important in this respect.

4.6 SWOT Analysis to the Baby Diaper Market Segment in Turkey

A SWOT analysis has been done to the baby diaper market segment in Turkey. The methodology in doing the analysis is that; a group of industrialist has been formed. In the case of this thesis the analysis is been done interactively by a group of 4 persons. The main criterion in the selection of the participants is the closeness of the participant to the baby diaper business. While one of them was operating a baby diaper business already, the other 3 persons were executive managers of industrial enterprises [59].

Strengths

1- It is a growing market. The annual growth rate is about 2% and has a market penetration of 22% [43].
2- Consumers are very important for the customers.
3- The rate of birth and ratio of young population is much higher than highly developed markets like European Countries and USA.
4- Due to the location (country) where this market study is being conducted the future looks promising for exporting of diapers. The neighborhood countries have a growing demand to diapers as well.
5- There is an incredible rate of return from reusable diapers to disposable diapers. When looked at the developed countries of Europe and USA; it can clearly be seen that the cloth diapers lost its market and almost 95% of the diapers used are replaced by disposables. This would be the same case when the country subject to this study is considered as well.
6- All of the investments made up to now has been successful in marketing their products and keep being operational. This is a good show that the market accepts both the top quality and relatively poor quality.
7- The change in people's consumption. In other words, the diapers are not only for high income level society of the population but also for people who relatively has less income. Even there are people squeezing their budget to use the disposables only at nights for less interrupted sleep.
8- Mostly, diapers are helping mother's daily work in such a positive way that they strongly insist on using disposables instead of cloth diapers. The main positives is because disposable diapers are much convenient, no need for cleaning and laundering, baby's cloths stay dry and allows longer nursing periods.
9- The market segment served cannot be classified as luxury by each passing day; it is becoming more and more a part of a daily life. The market penetration is increasing rapidly.
10- There are no foreseen shortages for any of the raw materials that are being used at diapers of today.

Weaknesses

1- The market is price sensitive.
2- If the product would cause skin irritation, that customer is lost forever. Even in some cases more than 1 consumer is lost.
3- The cost of a mistake in terms of hygiene, something that may cause dermatitis and skin irritation can be very high. This is critical especially if the product is serving to the top level segment.
4- The equipment used in manufacturing and people in charge shall be open to new market developments, changes in the product structure and customer feedbacks. For instance: use of SAP (super absorbent polymers), use of breathable backsheet, use of textile like backsheet, use of cream at top sheet, detachable hooks etc.
5- Customers are not willing to pay more for the improvements made on the product.

Opportunities

1- The product is not considered to be a product for higher income level people anymore.
2- The rate of medium income level is much higher than high income level society. Meaning; the penetration rate would increase by the launch of low cost products performing as good as the expensive ones. The need for low cost yet high performance is very high.
3- Pull-on diapers (training pants) can be an opportunity but is shall be of high quality.

Threats

1- Possible local waste disposal regulations in the future might be a challenging job. However it should be noted that even at highly developed countries there is no any yet.
2- Low cost disposable diapers imported from countries that can produce really at very low costs. Like diapers that may be imported from China.
3- Rumors made by people who are supporting the use of cloth diapers. (i.e.: Diapers causing cancer, infertility, polluting environment)

4- People's resistance to change. Time may be necessary for people who got used to use cloth diapers.
5- Increasing number of entrepreneurs investing in baby diapers production machineries.

4.7 Business Portfolio Analysis for Baby Diaper Market

It has been decided to use a strategy development tool as an organizational strategy formulation technique. For baby diaper market GE Multifactor Portfolio Matrix has been used to help developing organization strategy that is based primarily on market attractiveness and business strengths. In this case, the strategic business unit (SBU) has been taken as the baby diaper manufacturing business covering the complete organization and has been plotted on a two-dimension matrix as industry attractiveness and business position. Each of these two dimensions actually consists of a variety of factors.

Factors for market attractiveness have been determined as follows:

- The annual growth rate of the industry in Turkey
- The rate of market penetration in Turkey
- The number of new born per year (young population) in Turkey
- The rate of market penetration and new born per year in neighboring countries,

Factors for business position (strengths) have been determined as follows:

- High production capacity for low-cost products.
- Being able to supply low to medium income level consumers.
- Located at the "growth phase" of the product life cycle diagram. This diagram has been shown on Figure 4.17
- Good financial position.

The rate of industry growth in Turkey is about 2% per annum, and has a market penetration of 22% [43] with 2.700.000 new born per year [51]. The rate of industry growth and market penetration in North Africa countries has about 16% with an average annual birth of 2.970.000 per year. Whereas for other Middle East Countries (Lebanon, Syria, Iran, Iraq, Yemen, Jordan) these values are about 20% market

penetration and 3.201.000 births per year. It can be concluded that the market attractiveness is “high” for an investment in diaper market

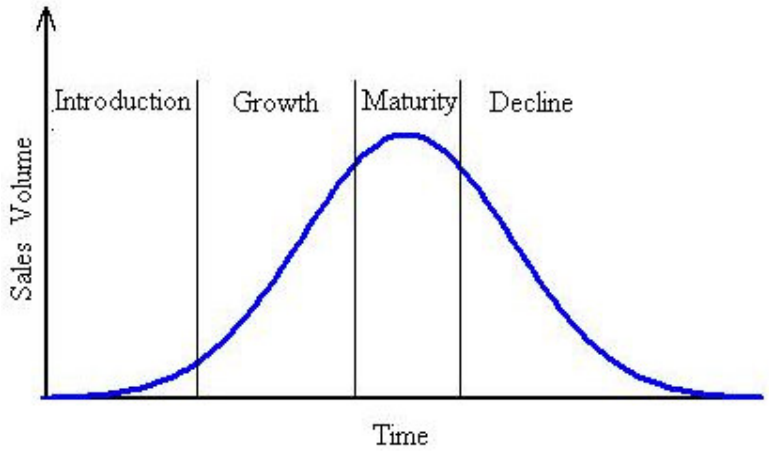


Figure 4.17 Product life cycle graph

As for the factors for business strengths; to serve product at a low cost it is unavoidable that there will be some compromises on the product performance which would lead a relatively less complex product. Due to the less complexity of the product, the machinery technology depended on would give about 300 to 500 diapers per minute and a continuous run would generate a high number of absorbent hygiene products bringing a good cash flow to the company.

The high-performance brings high prices. When looked at the Turkey market especially at the city suburbs, it can clearly be observed that the no-name diapers are sold out of an open bag one by one.

As for the product life cycle, it can clearly be stated the absorbent hygiene products, more specifically, the diapers are at the growth stage of its product life cycle. This supports the position of the business. Taking all into consideration, it can be concluded that the business position (strength) can be defined as “medium”. When this is shown on a GE multifactor Business Portfolio Matrix, the baby diaper business falls at the “invest/grow” section of the matrix.

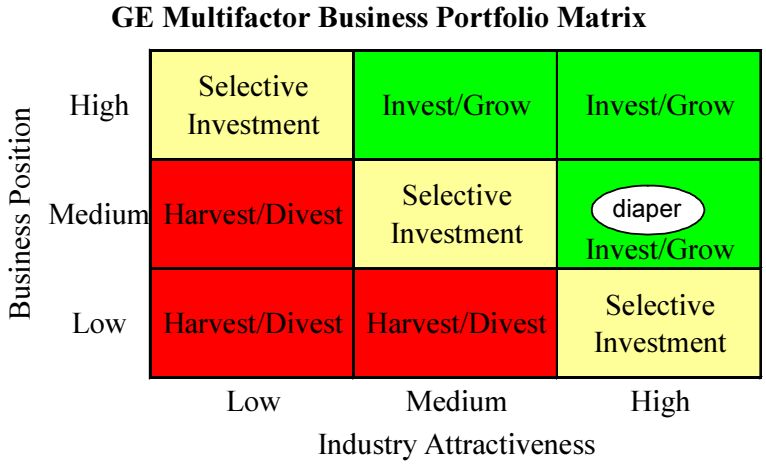


Figure 4.18 GE multifactor business portfolio analysis [60]

Similarly, to locate the diaper manufacturing investment on a Small Business Unit Model Matrix; the maturity of the industry and the competitive position of the company has to be defined. As it is mentioned above, the baby diaper market is currently at the beginning of the "growth" phase of its product life cycle. Since the company has a strategy to produce diapers of low cost to sell low to medium income level families and developing neighboring countries, it can be defined that the competitive position of the company would have a favorable even a strong competitive position. On Figure 4.19, the "diaper circle" locates on the "build" section of the matrix which supports an investment to be made according to the corporate strategy made.

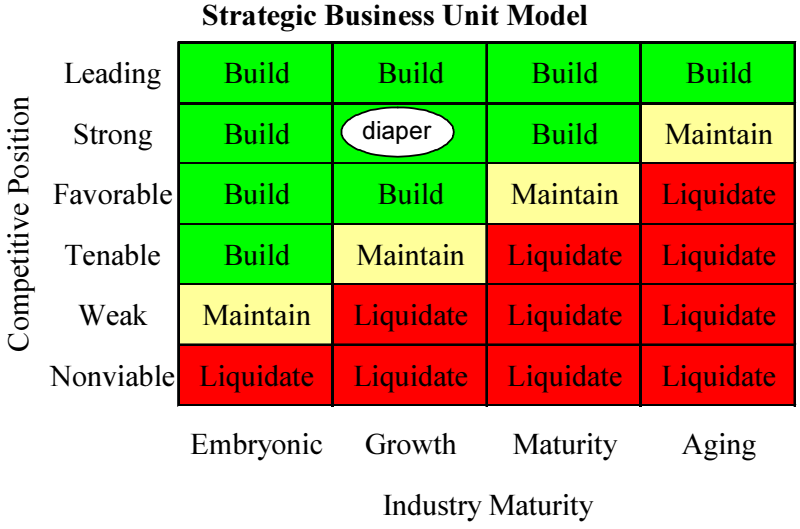


Figure 4.19 Small business unit model matrix [60]

4.8 Selection of the Market Segment to be Served

In this study, a qualitative marketing research has been done by means of focus groups, interviews and literature survey. The study revolves around observing competitors, reviewing the market structure and understanding economic trends that make up the business environment. All magazines and journals regarding the baby diaper business have been reviewed.

The personal interviews are conducted one-on-one and lasted between 30 and 60 minutes. The rich dept of information proved that it is the best method for in-depth probing of personal opinions, beliefs and values. Another advantage this method brought is that there was no social pressure on respondents to conform and there were no group dynamics. As for the focus group; a group of 4 people had an interactive group discussion. It took about 1 hour and 30 minutes; it has been observed that group dynamics are useful in developing new streams of though and covering an issue thoroughly.

In developed countries, parent of young children now have good disposable diapers that are soft, fit well, look good, have cartoon characters depicted on them and may even help prevent diaper rash. This all comes at a cost of about 26 US cents per diaper for the standard (size 3) branded diaper. Premium diapers (size 3) run about 30 U.S. Cents per diaper. If one assumes that five standard size diapers are used per day; that translates into 475 USD per year [61]. When looked at the prices in Turkey; for a similar quality baby diaper in sale at the market shelves are sold at a price of about 18 U.S. cents and are considered to be very high price in the Turkey market place. A key target for the company shall be to be able to answer retail partners' requests for products that imitate the leading brands.

While commodity food products, namely milk, bread and cheese, continue to represent the largest markets for private label products, growth in non-food markets has been more consistent in recent years. This would be a good market to sell big volumes of supermarket branded diapers. Turkey market is still limited by low incomes and the availability of products particularly in rural areas. Therefore this can provide a good opportunity for sales.

Also the neighboring countries can be a very good market. MENA countries comprise 325 million people. MENA markets for diapers are put at an annual 4.4 billion pieces with penetration rates averaging 25% [37].

By taking all these into consideration, it has been decided to make a production that would serve to low to medium income level population of the country, while making business cooperation with leading supermarket brands of Turkey to supply diapers under their brand name so that increase the volume. For this purpose, the Anatolian side of Turkey seems to provide better opportunities. As for the exportation, it has been foreseen that after starting production; the biggest potential market that would require diapers are to be the southeast neighbors of Turkey.

4.9 Vision and Mission Statements

According to the selection made; it has been decided to define a vision and mission statement. These are as follows:

Vision Statement: Be a global supplier of baby diapers producing absorbent hygiene products to all from high-end users to low-end users.

Mission statement: Produce absorbent hygiene products to promote absorbent hygiene products usage at low and medium income level segments at local and progressively export neighboring countries and grow business to cover all performance level products starting from low to top performance products.

4.10 Conclusion

Marketing research techniques has been reviewed and strategic management process has been explained. SWOT analysis has also been explained. A literature survey has been made on worldwide disposable diaper market and baby diaper market in Turkey has been studied. Diaper consumption, market position, and growth rate has been determined and the trend in diaper business has been followed. Diaper producers in Turkey, their locations, estimated market shares and market prices of their products have been identified. Then a SWOT analysis has been made to the baby diaper market segment in Turkey and business portfolio analysis has been made. According to the results, selection of the market segment to be served is made and vision and mission statements have been formed according to the business strategy made.

CHAPTER 5
TECHNICAL & OPERATIONAL FEASIBILITY: TECHNOLOGY SELECTION

5.1 Introduction

In this chapter, an introduction to technical feasibility is made and the questions that need to be replied to make a technical feasibility for real life environments will be given. Strategic technology management, technology portfolio and integrating technology and business portfolios will be explained. The technology for baby diaper manufacturing is selected in this chapter. Cost benefit analysis is used for technology selection. The flowchart of the work done is given in below figure.

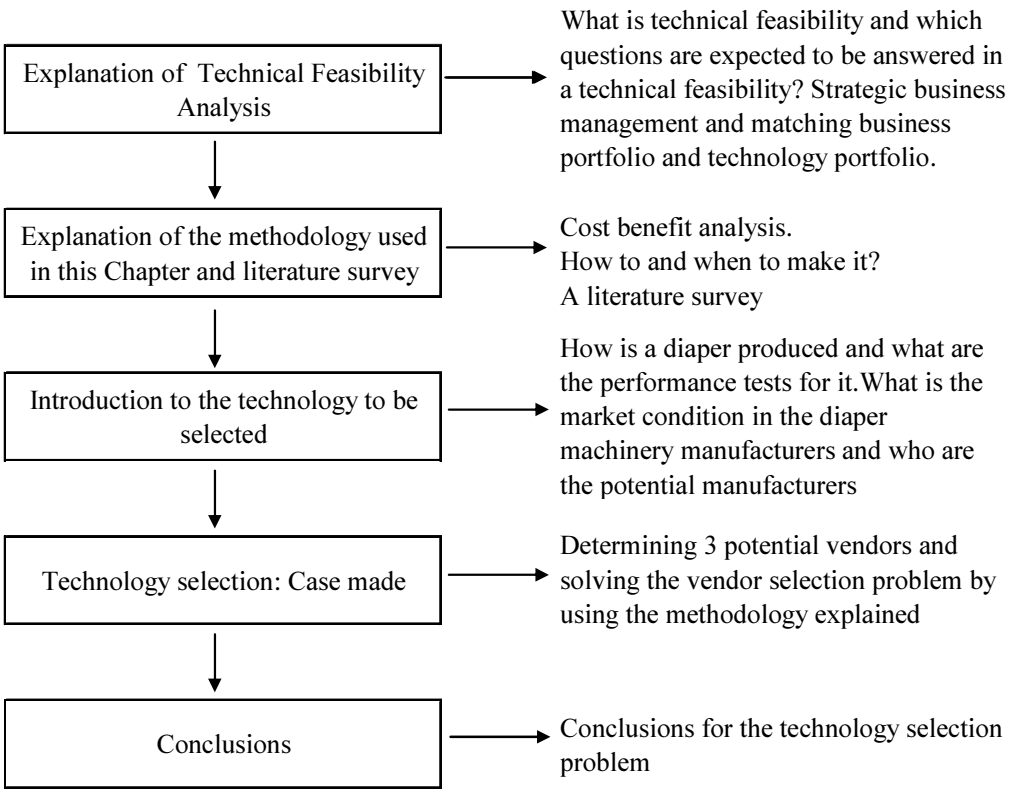


Figure 5.1 Framework of Chapter 5

5.2 Technical Feasibility

The technical feasibility analysis is critical to each feasibility study. This analysis involves a review of all factors that makes the product happen, right up until it leaves the original owner's control, or until someone else takes financial responsibility for it. Technical feasibility should be based on verifiable data and contain sufficient information and analysis so that an evaluation may be made on the technical feasibility of achieving the levels of income or production that would be projected in financial statements. There are several questions that need to be answered and several decisions to be given during the process of a technical and operational feasibility. Depending on the venture, you may need to answer the following questions [2]. These questions has been used to bring up ideas and to evaluate the conditions more accurately during the faces to face communications and the group discussions made in the phase of this case study.

5.2.1 Questions related to production / processing site

- Can our product or service be offered or produced in the selected (or at each alternative) location?
- What minimum size facility is required?
- Does the production site have the desired characteristics and available utilities, transportation facilities, etc. for the proposed production facility?
- What are utilities requirements, i.e. use and availability, costs, local competition, water, sewage, power and fuel?
- What are the transportation requirements, i.e. road service to the site, rail and air service necessity and availability; transportation rate; distance to primary markets; special handling requirements (temperature/humidity control, delivery deadlines)?
- What the labor requirements, i.e. availability, skills (assess the specific quantity and type of labor required)? What are the expected wage rates?
- What is the climate, soil type, acreage needed [2]?

5.2.2 Questions related to supply chain

- What are the required inputs available?

- What about quality, timing and price?
- How far away are the inputs?
- Do alternative inputs exist?
- How dependable are the input suppliers?
- What alternatives exist for input suppliers?
- Do long-term agreements exist [2]?

5.2.3 Questions related to technology, equipment and building

- What machinery and equipment is needed?
- What are the technology needs for the proposed business?
- When and where can the technology and equipment be obtained?
- What does the technology and equipment cost?
- Will the technology achieve intended income and production levels?
- What technical know-how is available?
- What are the requirements for the storage area for finished product, raw material and inventory?
- What are the maintenance requirements, i.e. required tools and equipment, required space for operation etc [2] ?

5.2.4 Questions related to operational assessment

- What is the production cycle?
- Which production method is required in terms of automation, semi-automation and traditional production?
- How assets should be allocated and interacted, i.e. human resources, financial resources, know-how, etc.
- What is the specific location of each asset? How are they going to interact?
- What are the logistics requirements?
- Who are you suppliers? Are they reliable? Evaluate terms and conditions.
- What is the organizational chart to be adopted?
- Where will the accounting and administration process take place? Who is going to manage these responsibilities? Is it internally or externally?

- What are the risk management tools? Consider one or a combination of the following tools: insurance, product diversification, process standardization, etc [2].

5.3 Strategic Technology Management

One key task of the general manager is to acquire develop and allocate an organization's resources. Technology is a resource of paramount important to many organizations; managing this resource for competitive advantage entails integrating it with the firm's strategy [62,63].

5.3.1 Integrating technology and strategy

The perspective on strategy can be positive versus normative views or product-market versus resource-based views. These are briefly explained below.

The positive view of strategy is concerned with the firm's actual strategy and how it comes to be. The normative view, on the other hand, is concerned with what the firm's strategy should be.

As for the product-market versus resource-based perspective on strategy; The Product market view of strategy is primarily concerned with how the firm competes with is products and services. The resource based view of strategy is concerned primarily with how the firm can secure the factors needed to create the core competencies and capabilities that form the basis for establishing and sustaining competitive advantage. Strategy is inherently a function of the quantity and quality of a film's capabilities. Strategy without capabilities has no force. On the other hand, capabilities without strategy remain aimless. Strategy asks the questions. How do competencies and capabilities help create and sustain competitive advantage? Strategy thus articulates the ways in which the opportunities that are created by the firm's capabilities can be exploited [62,63].

5.3.2 Connecting technology and strategy

Technology is an important element of business definition and competitive strategy. Technology is among the most prominent factors that determine the rules of competition [62].

5.3.2.1 Technology and competitive strategy

Porter's [64] "generic strategies" concept is a widely used frame work for classifying competitive strategies. The generic strategies are industry wide differentiation, focused differentiation; industry wide cost leadership, and focused cost leadership. Companies pursuing industry wide differentiation seek sustainable competitive advantage in a broad range of industry segments through offering products or services that are better than those of competitors in terms of quality, performance, features delivery, support and so on. Companies pursing focused differentiation attempt to achieve similar sustainable competitive advantage in a narrow set of industry segments. One objective indication of having achieved differentiation is customers' willingness to pay a premium price. Companies pursing industry wide cost leadership seek sustainable competitive advantage in a broad range of industry segments through offering at lower prices products or services that are comparable to those of competitors on the relevant set of dimension that of concern to customers. Companies pursing focused cost leadership attempt to achieve similar sustainable competitive advantage in a narrow set of industry segments. To be viable, a company's cost leadership strategy must be based on possessing a lower delivered cost infrastructure [62].

5.3.2.2 Technology and product-market strategy

A firm's strategy is expressed in the products and services it brings to market. One way to get at the integration of a firms technology and product market strategy is to decompose each product or service into its constituting technologies and assess the relative strength -the degree of distinctive competence- the firm has with respect to technology.

5.3.2.3 Technology portfolio

Harris, Shaw, and Somers [65] suggest that once the various technologies have been identified, they can be classified in terms of their importance for competitive advantage. Next, the firm's position relative to its competitors can be assessed. Technology importance needs to be expressed in terms of the value added it brings to a particular class of products and the value added it could potentially bring to other products classes for the customer/user the importance of a particular technology is

strongly affected by where its situated in the technology life cycle. Relative technology position should be expressed in reference to competitors in term of, for example: patent position, know how and trade secrets learning curve effects and key talent. Relative technology position is strongly affected by the firm's historical and future levels of investment. Figure 5.2 presents a framework based on these two dimensions. It is proposed that technologies in the 'bet' quadrant warrant the firm's full commitment. That is, the firm should be willing to engage in frontier R&D, push limits of its product development process and invest in the newest equipment [65].

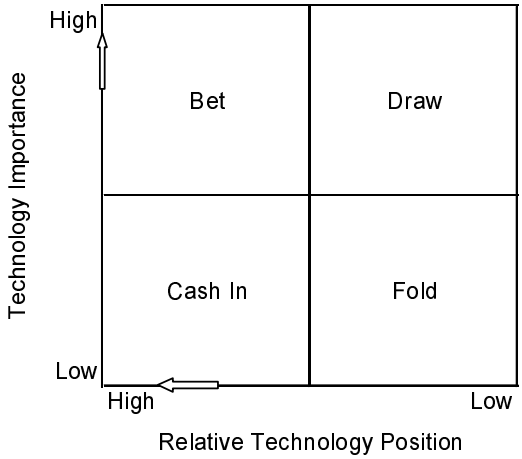


Figure 5.2 Developing the technology portfolio [65]

Technologies in the "cash in" quadrant should be examined carefully. These technologies may have been very important at one time, but changes in the basis of competition in the industry may have reduced their relative importance. Understanding these changes and why they came about often leads to insight into the firm's strategic situation. Also, while "cash in" might suggest that no further investment in these technologies is warranted. Such a move may be premature or misguided. Sometimes parts of these technologies continue to be linked in subtle ways with other technologies judged to be relatively more important.

Technologies in the "draw" quadrant are also positioned ambiguously. A technology may be placed here because of changes in the basis of industry competition. At this point, the firm must decide whether to invest probably heavily, in the technology so as to reach (at least) parity with its parity with its competitors or to disengage from a particular product or business. Again it is extremely important to ask why and how this change came about.

Technologies in the “fold” quadrant require that the firm reconsider its investment in R&D beyond the level where reasonable returns can be expected. Regular reviews of investment patterns may indicate a need to disengage and redeploy resources [62].

5.3.2.4 Matching technology and business portfolio

Many companies have multiple businesses in their corporate portfolio, each with its own technologies. Corporate strategy development has been enhanced by portfolio planning techniques, but most have failed to pay explicit attention to technology. One such portfolio planning tool is McKinsey’s framework based on industry attractiveness and competitive position dimensions. Harris, Shaw and Somers suggest examining the relationship between the traditional portfolio planning matrix and the technology portfolio matrix. This is presented in Figure 5.3.

Such analysis offers the possibility of investigating the match (or mismatch) of a firm’s business and technology investment portfolios and its resulting .technology investment priorities. For instance, standard strategic analysis made indicate that a particular business in a strong competitive position in and an attractive industry .How ever, technological analysis may indicate that the technologies supporting this business. While important for competitive advantage, are actually in a relatively weak position. This would indicate the need to increase investment in technology development [65].

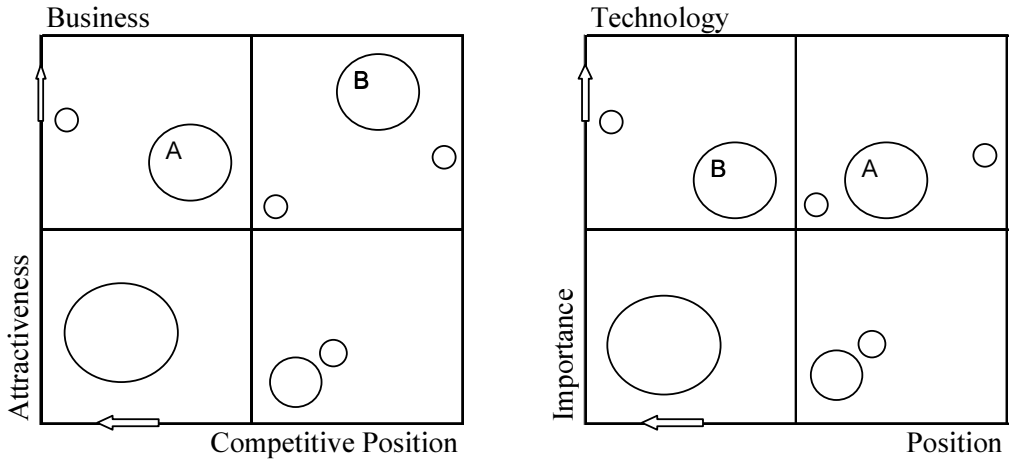


Figure 5.3 Matching business and technology portfolios [65]

5.4 Cost Benefit Analysis

The Cost Benefit Analysis methodology has evolved over the years with increased acceptance by numerous disciplines and government agencies [66].

Cost-benefit analysis is a set of procedures for defining and comparing benefits and costs. In this sense it is a way of organizing and analyzing data as an aid to thinking. This concept of benefit analysis leads to what we regard as a fundamental rule of cost-benefit analysis: Decisions are made by decision makers, and cost-benefit analysis is properly regarded as an aid to decision making and not the decision itself.

The well-informed cost-benefit analyst is aware that cost-benefit analysis cannot perfectly capture the thinking of the decision maker. The informed decision maker and analyst are aware the data area always imperfect, that the very process of qualification imposes limitations on the conceptual frame embedded in the analysis. In fact, cost-benefit analysis is intrinsically dependent on the political process for the specification of rights on which to calculate benefits and costs [66,67,68].

5.4.1 When should cost-benefit analysis be used

Viewing cost-benefit analysis broadly, rational decision makers can be said to always use cost-benefit analysis in the sense that decisions arise from a weighing of benefits and costs. Cost- benefit analysis is similar to profit and loss accounting used, in private business. Traditionally, cost-benefit analysis is associated with government intervention and with the evaluation of government action and government projects [68].

Cost-benefit analysis is used in the technology selection problem of the feasibility analysis. The reason for using a benefit to cost ratio is ease of implementation to the problem. Since it would allow the decision givers decide what their benefit criterions are and how important they are, it gives a straight-forward result by taking into consideration the costing of each potential candidate. Below the basics of a baby diaper manufacturing is explained. It is important to know what the basic steps of production are so that when comparing different machinery alternatives, it would be easier to understand what the machinery components actually do and what their role in production are.

5.4.2 The steps of analysis

At a general level, cost-benefit analysis is indistinguishable from policy analysis. The procedures for analysis are then those for any policy analysis. The following framework may be a useful starting point:

1. Who is the client? This question should be asked regardless of whether or not the analyst is being paid, or has been explicitly hired. An analysis requires a perspective, and the purpose of this question is to make the perspective clear to the analyst. Only when this is done can the next questions be asked.

2. What are the goals of analysis? This question is one of defining the problem.

3. What is the objective? The answer to this lays out how the problem is to be treated as a practical matter. Here you specify the objective that gives operational definition to the goal.

4. What are the alternatives? This step is crucial to a successful analysis. The analyst should use his or her imagination and lay out as many alternatives as feasibly possible. Some of these alternatives can often be dismissed easily but a review reduces the chances of ignoring a superior alternative.

5. What are the consequences of each of the alternatives? Answering this question involves a choice of techniques for predicting physical consequences.

6. How are the physical consequences to be valued? A technique must be chosen for valuing outcomes. This, of course, is part of the heart of cost-benefit analysis.

7. How certain are the predicted consequences? Outcomes are always uncertain and this issue should, therefore, always be explicitly addressed.

8. What is the choice? This step draws together the results of the cost-benefit analysis and the predictions that underlie it, along with other, perhaps political, considerations, relevant to the choice. This step is for the analyst who recommends a choice to the decision maker.

9. What is the decision? This step is for the decision maker who may be someone different from the analyst. But this step precedes the next step which ideally should be performed by the analyst.

10. How do the outcomes compare with the predictions? The analyst should monitor the outcomes, compare the actual results with those predicted, and consider why the results are different. This is a step whose importance is seldom recognized [68].

5.5 Literature Survey on Technology Selection

Technology selection includes complex decision making problems. With different available alternatives and various criteria for technology evaluation, multi-criteria decision making methods can be used to support this selection process. In the technology selection problems for baby diapers a structured assessment methodology that still lets the decision givers make the technical comparison of the alternatives as the way they would like to do. Determination of benefit's priorities would be very critical in this respect. It directly affects the outcome of the analysis. The benefits divided by the actual normalized costs of the machines has provided a ratio to depend on in technology selection problem. Multi-criteria, multi-attribute selection processes are being used in the literature with different ways.

A study made by Graham et. al. discusses an improved multi-criteria decision making model (MCDM) data envelopment analysis (DEA) model for technology selection [70]. A model in order to evaluate the best efficient decision making units in advanced manufacturing technology. The model developed ranks the next most efficient decision making unit after removing the previous best one.

Jain and Nag [71] developed a decision support model to identify successful new ventures. The model integrates the qualitative and quantitative variables through the use of AHP along with the robustness required for the decision-making.

To achieve rapid product development, Kengpol and O Brien [72] presents a decision tool for the selection of advanced technology. In their proposed model, they integrate cost–benefit analysis model, decision-making effectiveness model, and a common

criteria model to choose from Time Compression Technologies (TCT). TCT are the technologies that improve a design and manufacturing process to achieve better quality in short time-period, e.g., rapid prototyping. In the first stage, sensitivity analysis and neutral line profitability model is worked out. Neutral line profitability model is the anticipated cash flow using the illustrative data for current technology and business practice. This is done considering the fact that companies need to adjust to their own specific data to obtain accurate results for the specific product. This analysis becomes a part of cost–benefit analysis model. In the second stage, decision-making effectiveness model is framed to investigate to what extent it may be possible to calculate the probability of product success based on the analysis of previous data. In the third stage of the common criteria model, a common criteria and sub-criteria are prepared. All these criteria need to be prioritized based on the company's requirements. There are about three basic line criteria, which are to be prioritized. This was done by AHP and using the Expert Choice software. The proposed model thus helps to monitor the effectiveness of a decision and the decision model helps in consolidating quantitative and qualitative variables using AHP.

5.6 A Brief Explanation How a Disposable Baby Diaper is Produced.

Disposable diapers are produced in a continuous process. A baby diaper machine is typically between 20 to 45 meters long, depending on the speed and the complexity of the product to be produced. The process starts at the mill, where a sheet of pulp is fed to a rotary mill and converted into fibers. These fibers are transported into a forming pocket using a vacuum generator. As the fibers are produced, they are also mixed with a super-absorbent within the drum former. (The drum former usually holds 6 to 20 pockets depending on diaper size). Once the pad is formed, it is transported using a layer of tissue. This can be on the top, bottom or around the pad. The pad is compressed using a de-bulking roll, and later cut into individual pieces of pad. Next step, poly or cloth-like material is added at the bottom of the pad (or laminated on line), and non-woven at the top. Frontal tape was previously added to the poly film or cloth-like backsheet using a cut and place applicator. In order to glue all these materials, hot melt is used in the form of multi-lines or spray. Elastomerics are also added at this point to add stretch to the waist and the leg area and glued with hot melts [73].

The non-woven top sheet can be made of one or more pieces, depending on the features to be added to the diaper, for example, a diaper with or without leg cuffs. The next step in the manufacturing process, is the addition of the lateral tapes, they are applied using another cut and place applicator. Tapes can be the standard adhesive type or mechanical tapes, like hook and loop (Velcro). After the tapes are added, then a die cutting system trims the leg area of the diaper and discards it using a vacuum system. The diaper continues to a folding process, and then it is cut into individual diaper pieces inspected and finally stacked into a bag for its final sealing and boxing [73]. Below figure gives an overview of a diaper machinery.

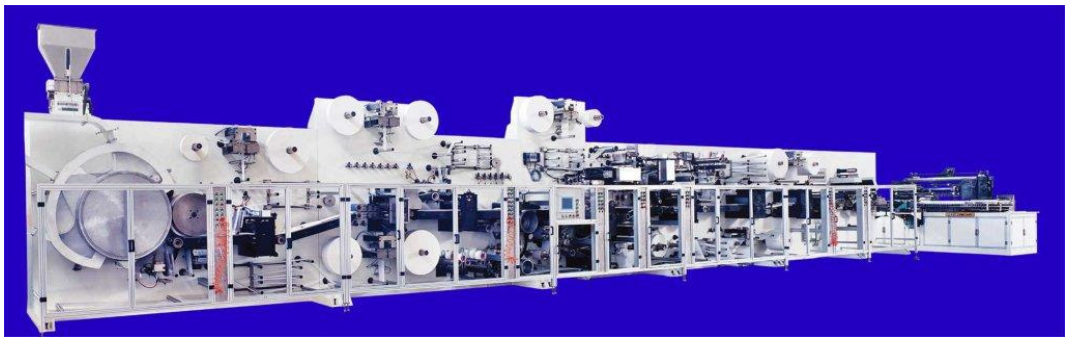


Figure 5.4 A view from a baby diaper machine

It has been decided to give a brief explanation on what are the performance measures in a diaper manufacturing. The performance of a diaper depends on the quality of the materials used, the design of the diaper and how it is constructed. It is highly recommended to define the parameters and make a test run on the laboratory scale pilot machine of the machinery manufacturer using a similar diaper construction that will be used in actual production.

5.7 Diaper Performance Test Methods

There are several tests to measure the performance of diapers and the main components of diapers. The main test being used and are widely accepted in the industry are explained below [74,75,76]. It has been decided to explain these, because design of a baby diaper has a strong contribution on how baby diaper performs.

1. Acquisition Test: This is a test that evaluates in real time how well liquid gets into the absorbent core at any flow rate.

2. Absorption Test: This is a measure of how much liquid a core can absorb at various flow rates, how much is retained when pressure is applied and how much collapse occurs.

3. Mannequin Test: In this test a complete collection of styles of baby, child, and adult size mannequins are used to assess fitting characteristics, elastic systems and overall leakage performance in various body positions simulating both sexes.

4. Slant Tester: Known as run-off test as well. This test is used for testing surface qualities of coverstocks as well as the penetration of liquid into finished products.

5. Retention / Rewet Test: This test is used for determining the rewet and surface dryness of final products or new materials and for improving coverstock performance for better skin care.

6. Wetability Test: Useful for assessing liquid take-up properties of pads made of various fibers, fluff pulps, and super absorbents.

7. Strike-through Test: This is used to determine how quick the liquid passes through the coverstock media to the core.

8. Wetback Test: This is used to determine how well the coverstock media is in terms of letting the liquid pass from the core to the baby's skin.

9. Spreading and Wicking Tests: Horizontal and vertical liquid spreading testers use electronics to measure how well the pad accepts and moves liquid. Both spreading speed and total amount of liquid actually moved would be determined. The horizontal tester is used for testing variable density diaper design whereas the vertical wicking is use to measure quality of fluff pulp.

10. Leakage Test: Used for studying liquid penetration performance and failure capacity of various pad shapes and sizes.

5.8 Disposable Baby Diapers Production Machinery Manufacturers.

As everywhere in the world, intense competition continues for baby diaper machinery suppliers. Margins are tighter than ever in the baby diaper machinery sector. Meanwhile, manufacturers worldwide are struggling to increase line speeds and flexibility to keep up with demands of customers in hygiene segments. When it comes to competition and cost, stakes remain high for producers, with a tough war still being waged to offer the lowest priced machines to a limited number of customers [81].

If there is one feature that every piece of machinery in the hygiene industry should have today, it is modularity. The rapidly changing design features of such hygiene materials as disposable baby diapers, feminine hygiene products and adult incontinence items have made flexibility paramount in importance among hygiene producers, who want to be able to rebound quickly in the face of changing market requirements [78]. In addition to modularity and flexibility, hygiene manufactures are demanding other features from their machines including speed, competitiveness, standardization, transportability, ergonomics, simplicity, process optimization, improved product performance, reduced raw material consumption and product cost savings [78,79,80].

Multinational companies with their own branded products are challenging the machinery manufacturers to produce machinery that guarantees the highest process optimization and to reach high quality standards and maximum reliability. Other companies, such as private label manufacturers, must be quick when making investment decisions and need to be prompt in reacting to market changes. Therefore, they look for efficient and flexible machinery that can easily and quickly implement new features so they can plan investments in different steps [79,80].

Hygiene manufacturers want the option of adding and removing features such as leg cuffs, re-sealable tapes and cloth-like backsheets, but they don't want to invest in a new production line, which can cost millions of dollars, every time the market demands a new innovation [79]. As nearly two-thirds of the production costs of any hygiene product are raw materials, the reduction of waste is an important issue. In any commodity-driven market such as hygiene, end product manufactures are focus

on one thing - cost. This means that any cost-saving measure could be made overnight and, in some instances, this could change the entire way a diaper, and panty liner or sanitary napkin is produced. Fully aware of this, machinery manufactures are keeping their lines flexible and able to handle changes in the design of the absorbent material [78].

Similar to many commodity sectors, the baby diaper machinery business is described by producers as predominantly saturated in Western Europe and North America with some room for slow growth in less developed regions. The trend is that baby diaper machinery customers want machines with maximum efficiency and the possibility of running with low-cost raw materials. Machines from china arriving at incredible prices affect almost all machinery manufacturers. Demand for low-cost machinery is prevalent in new emerging diaper markets such as Asia and South America, which are experiencing business growth as their economies begin to revive [77,80].

Baby diaper manufacturing machinery customers located in developing countries are looking for inexpensive machinery and start-up operations, which require a lower level machine with more basic functions and performance so that it is compatible with the facility and requirements of the market. Regardless of whether baby diaper machinery finds its place in all areas of the world, one thing which is certain is that; as long as there are babies, there will need to be diapers, so baby diaper machinery will play a very important role in the future [80]. Below, is a list that show the companies involved in the machinery/equipment side of the business.

Table 5.1 Baby diaper production machinery manufacturers

Machinery / Equipment Manufacturer	Web Site Address
Anqing Hengchang Machinery Co., Ltd.	www.aqhch.com.cn
Batson Group Inc.	www.lpbatson.com
BHT Bicma Hygiene-Technologie GmbH	www.bicma.com
Bikoma AG	www.bikoma.de
C.P.I.D. Conception Process Ing Development	www.cpid.fr
Caldiroli Srl	www.caldiroli.it
Cellulose Converting Equipments	www.cce.it
Convertex	www.convertex.com
Curt G. Joa, Inc.	www.joa.com
Delta SpA	info.deltaspa@viaglio.it
Diatec Srl	www.diatec.kpl.net
Fa-Ma Jersey SpA	www.famajersey.com

Table 5.1 Cont. Baby diaper production machinery manufacturers

Machinery / Equipment Manufacturer	Web Site Address
Fameccanica Data SpA	www.fameccanica.com
GDM S.p.A.	www.gdm-spa.com
Gevas Packaging & Converting Technologies	www.gevas.com
Gevas Verpackungsmaschinen GmbH)	www.gevas.com
Hes Makina	www.hesmakina.com
Investkonsult Sweden AB	www.ik.se
Kappa Tecnologies srl	www.kappatechnologies.it
Link Consultant & Engineering	www.linkce.com
Lynx Technic Ltd.	www.lynxtechnic.co.uk
Paper Converting Machine Company	www.pcmc.com
Quanzhou Hanwei Machinery Making	www.han-wei.com
Rainbow Fame Industrial	www.rainbowfame.com
RML Raynworth RML Services	www.raynworth.com
RHO Personal Products Machine Co.	www.eniplanmaq.com.br
Sanimac	www.sanimac.it
Schober USA Inc.	www.schoberusa.net
SSP Technology SpA	www.ssp.it
Tornado Textilmaschinen GmbH	www.tornado-tex.de
M.D.VIOLA Macchine Srl.	www.mdviola.com
Worldwide Rotary Die Systems	www.worldwiderds.com
Zuiko Corp.	www.zuiko.co.jp

5.9 Determination and Evaluation of Three Baby Diaper Production Machinery Manufacturers

The study made shows that the three big players always ranks at the first 3 and interchange the rankings each year depending on the order they get from the baby diaper industry giants like P&G or Kimberly-Clark Corp. These companies in alphabetical order are, Fammechanica SPA, Kurt G. Joa Inc. and Zuiko Corp. There is only one company in Turkey who is involved in the manufacturing of baby diaper lines: Hes Makina. China, as expected, is the competitor of the leading companies with very low prices.

As a part of the technical feasibility, it has been decided to take 3 machinery manufacturers as reference. One of them has been selected out of the three big players of the baby diaper machinery industry. One of them has been selected form the biggest baby diaper production machinery manufacturer of China. And the last one has been selected from Turkey, as a local vendor.

Technical specifications and quotations have been requested from these companies and evaluated. A candidate system Matrix has been formed to see similarities and differences between candidate systems. This matrix is shown on Table 5.2.

To develop the matrix, all 3 offers have been put together and the characteristics mentioned by each supplier have been analyzed. These include how the automation of the production line is handled, the design speed and the reliable speed figures provided by the each supplier. Other questions include but not limited to: What are the main components of the machinery, what is the expected efficiency level, what kind of and how many hot melt application system is included in the price, weather or not the line has a counting and stacking unit at the end of the line, Availability of CE certificate, lead time of the line and the project price. These are determined to be used as the comparison characteristics on the candidate system matrix that has been shown on Table 5.2. The names of the candidates are not disclosed, because of commercial restrictions.

The evaluation of the machineries has been made on the major factors that are listed on the technical specifications like: automation level of the machine, product sizes the machine can produce, main machinery components, design speed, reliable speed defined by each company, running efficiency provided by each company and availability of counting, stacking and packing system. These factors have been listed on the comparison Table 5.3 given below. All three Candidates has been studied and a brainstorming has been done to understand the suitability of each candidate and to locate understand their position in the market more clearly. This study has been made by brainstorming and by means of a group discussion. The group was formed by 4 professional industrialists one of which is already a producer. The rest of the members have necessary knowledge and experience to extend their opinions in a professional manner as an investor, who may consider spending resources in the selected direction. Each of the group members had reviewed the quotations of the candidates before the meeting date. The brainstorming meeting has been made as a group discussion that took about three hours. During this discussion each member, so called decision giver, has freely extended his opinions to the audience and the referred subject has been discussed in detail.

Table 5.2 Candidate system matrix

Characteristics	Candidate 1	Candidate 2	Candidate 3
Automation of the machine	Full Servo	Full Servo	Semi-Servo
Product Size(s)	4 sizes, Designed for 1 size. Comes with adaptors for 3 other sizes at additional cost. These are included in the price.	4 Sizes - Small, Medium, Large, X-Large	3 Sizes - Small, Medium, Large
Main Machine Components	Cellulose pulp fiberizing and S.A.P preperation + Top sheet + SAP applicator + aquisition Layer + barrier leg cuffs + elastics feeding + polyethylene backsheet + frontal tape + leg elastics + fastening tapes applicaiton system + cutting folding ans stacking	Pulp preperation + SAP applicator + acquisition layer + elastic feeding + leg cuff apllicator + elastic waistband + polyethylene film backsheet applicator + side tapes + frontal tapes + cutting and folding	Cellulose pulp preperation + SAP applicator + top sheet + acquuisition layer + elastic band + barrier leg cuff + tape application system + frontal tape + polyethylene laminated backsheet + cutting, folding and stacking
Design Speed, max	500 pieces/minute	500 pieces/minute	450 pieces/minute
Reliable Speed	500 pieces/minute OR 250 m/min line speed whicever comes first. Size dependant	500 pieces/minute (medium size)	No info available. Expected reliable speed :350 pieces/minute medium size
Product Structure Complexity (acc. to sample drawings supplied)	Complex	Average complexity	Average complexity
Efficiency Given	Efficiency>85%, Scrap<3%	Efficiency>90% (expected to be less)	N/A. Expected to be >85%
Hot Melt Application System	Yes (10 sets)	Yes (4 sets total, USA made)	Yes (1 for PE+nonwoven lamination and 1 set for elastic bands)
Counting and Stacking	Yes, Automatic, works in coordiantion with automatic packing system	Yes, 2 exits, Automatic	Yes, 2 exits, Automatic
Packing System	Yes, full servo, minimum 300pieces/min packing. Up to 65 packages/min.	Not quoted. N/A	Not quoted. N/A
CE certification	Yes	Yes	No
Lead Time	9 months	5 months	7 months
Project Price (incl. spare parts and stacking counting system)	USD 3.350.000,-	USD 650.000,-	USD 1.000.000,-

Table 5.3 Brainstorm comparison of the three candidates

Candidate 1	**Candidate 2**	**Candidate 3**
High production capacity	Medium production capacity	Medium production capacity
Higher productivity	Acceptable productivity	Acceptable productivity.
Proven Technology, preferred vendor	Sold several machines, worldwide	Sold a few machines
The market leaders use equipment very similar to this alternative studied.	Private label manufactureres as well as store-brand manufacturers would use	Private label manufactureres as well as store-brand manufacturers would use
Changing from one size to the other is quicker	To switch from one size to other relatively takes more time than Candidate1. Similar to Candidate 3.	To switch from one size to other relatively takes more time than Candidate1. Similar to Candidate 3.
With correct product structure and design, the machinery can produce very high quality products that can compete with market leaders.	It is a challanging job to produce highly complex products similar to what P&G produces.	It is a challanging job to produce highly complex products similar to what P&G produces.
Machinery manufacturer is closer than China, however still a foreigner machinery vendor.	China is very far. It would take several days to receive a small spare part.	Machinery manufacturer is in the same country. In case assitance is required, a technician can pay a visit next day.
Customer service is (expected to be) better and more responsive. Technical support would be more professional	There might be difficulty in communication if a technical support is required. Relatively less professional support is expected	Talking to someone at mother language is always much convenient.
Good for producing relatively high cost products that are sellable at higher market prices	Good for producing different size simple structure, low cost diapers	Good for producing different size simple structure, low cost diapers
Long lead time of the machinery	Relatively better lead time. However the time required for transportation shall be considered at least 1 month	Relatively better lead time. No need to involve in customs procedures.
Higher energy consumption	Relatively lower energy consumption	Relatively lower energy consumption
First investment cost is almost 4 times more than the nearest alternative studied.	Low first investment cost	Medium first investment cost
Relatively high cost to adopt a new product feature or develop a new product	It is easier and cheaper to adopt a new product feature or develop a new product	It is easier and cheaper to adopt a new product feature or develop a new product

5.10 Baby Diaper Machinery Technology Selection: Which Candidate?

Technology selection is s complex problem that need several points to be studied and analyzed. In this study the technology selection is made by using a benefit/cost analysis. While the cost is directly obtained from the quotations provided by each candidate, the benefits have been obtained by analyzing the candidate system matrix and the brainstorm comparison of the three candidates. The technology and business portfolio analysis has also been shared with the people who involved in the evaluation process of the benefits used at cost/benefit analysis. As a part of the group discussion, it has been decided to use the following benefit factors for obtaining the benefits value of the analysis: production capacity, productivity, set-up time, proximity to supplier, customer service, lead time and suitability to the business strategy developed in earlier sections of the study.

5.10.1 Determination of benefit factors to be used at benefit/cost ratio

As a first step of implementing a cost/benefit analysis, the benefits have to be determined. The benefits have been determined depending on the technical specifications that have been provided by the baby diaper machinery manufacturers. The determination of benefits has been done at the same group discussion made during forming the candidate system matrix and comparison of candidates.

These are: production capacity, productivity, set-up time, proximity to machinery supplier, customer service, lead time of the machinery and the suitability of the machinery to the business strategy made. These are described below.

1. Production capacity of a medium size diaper has been taken as one of the criteria. The capacity values given on the technical documents of the machineries of Candidate 1, 2 and 3 are given as 500, 500 and 350 pieces/minute respectively.

2. The productivity is another critical criterion that has to be taken into consideration. However it has been decided that the technical specifications provided within the specifications may not reflect realistic values. Another respect was that even tough the up-time is high, the scrap product percent may be high Therefore, during the discussion, it has been requested from the decision-givers to extend opinion on the expected productivity of each candidate as well.

Even tough the technical documents of candidate 1, 2 and 3 state that the productivity of their equipment is higher than 90, 85 and 85% respectively; the opinion of the decision givers were to take these numbers as 85, 80 and 80 percent.

3. Set-up time is an important factor that shall be taken into consideration. Reduction in set-up time would provide shorter lead time, lower inventories, on-time delivery, and ability to change quickly and therefore being more flexible and cost effective. In diaper business, size change is a challenging decision in the production environment. The time required to make the change, loss in production, loss in material during fine tuning is costly. Therefore the time needed for size change has also been taken as a criterion in technology selection. Time necessary to change from one size to other may take almost an 8 hour shift. A size change from medium size to small size has been taken into consideration. Candidate 1,2 and 3 has a time frame of 6,7 and 7 hours respectively. The longer the time the worse, therefore the numbers has been taken as negative values.

4. Proximity to machinery supplier might be a critical factor for technology selection. This is not off essence in diaper manufacturing as it may be at some other technologies, but still it has been decided to take as criteria. In this respect; the average time required to receive a spare part from the machinery supplier has been taken as reference. Since Candidate 1 and 2 is foreigner, the parts would come by airfreight and there should be a customs clearance procedure. It has been foreseen that this would be 5 days for Candidate 1 and 8 days for Candidate 2. Since Candidate 3 is a local machinery builder, the time needed for a spare part is considered as next day delivery.

5. Customer service and support is an important factor. Especially the support might be necessary for machine breakdowns or when a problem that cannot be resolved by internal resources occurs. Obtaining know-how is also considered as the customer service and support. Since the machineries are sold as turnkey systems, there would be a part of know-how that will be transferred during the start-up of the machine as well. As expected; the more experience a machinery manufacturer have the more know-how or techniques of diaper production will be transferred. Apart from this; communication is a big part of the service taken. It will be

difficult to talk with someone talking at Chinese accent English than talking to someone speaking English without an accent. Of course talking to mother language is the best of all. The professional approach to the inquiries and issues is also been considered as a part of this criteria. Taking all of the above mentioned subjects into consideration; it has been requested from the decisions givers to rate the candidates out of 5 star scale. 5 is the highest (best) value used the rating. The outcome is that Candidate 1 has received 5 stars, Candidate 2 received 1 star and finally Candidate 3 received 3 stars. It has been observed that out of what has been discussed above know-how has been taken as priority and then the communication possibilities came.

6. The lead time of the machine is not of essence in this study; however it would be important for the investor. Therefore it has been decided to have this criterion in the technology selection process. In addition to the lead time of each manufacturer given on their offer for machine readiness for shipment there would be an addition of time for delivery of the equipment as well. When this is calculated, the delivery time would be 9 months for Candidate 1, 5 months for Candidate 2 and 7 months for Candidate 3. These have also been taken as negative values.

7. A technology may be most up to date, but may not be the best that fits into the company's need. The technology selected shall be in parallel with the company's requirements to fulfill the market expectations of the subject company. Therefore it has been decided to have another criterion to test the candidates' suitability of the company's business portfolio and the strategy made. Knowing the company's market profile and strategy and after reviewing the technical specifications and the outcome of the brainstorming made; the decision givers are asked to rate the Candidates out of a 10 star scale. Where 10 has been considered as exact fit; 5 is in the middle meaning would work fine but can be better. And 1 star meaning this is certainly not the equipment that the company is looking for. From this perspective the Candidates got the following ratings. Candidate1:5, Candidate2:8 and Candiate3:8.

The benefits part of the cost benefit analysis, consisting of 7 criteria has been listed at below Table5.4. The table shows the values for each criterion as explained above. These are comparable numbers in between themselves. As explained above, negative values reflect values for negative criteria where smaller value is better. After the values for each criterion is put on the table, they have been normalized. The procedure fallowed to normalize each criterion is as fallows: The sum of value for each candidate obtained and it is shown as total in below table. Then the value for each candidate is divided by the total and the normalized values have been obtained. Normalized values are shown on the last three columns of Table 5.4. By doing so, the criterions became comparable with each other.

Table 5.4 Technology selection criterions and the comparison of the candidates

Benefits	Values			Total	Normalized Values		
	Candidate 1	Candidate 2	Candidate 3		Candidate 1	Candidate 2	Candidate 3
Production capacity (diapers/hour)	500	500	350	1350	0,37	0,37	0,26
Productivity (%)	85	80	80	245	0,35	0,33	0,33
Time needed for size change in hours (set-up time) related to the same complexity of the product. (Reverse)	-6	-7	-7	20	-0,30	-0,35	-0,35
Proximity to machinery supplier (days for a spare part arrival) (reverse)	-5	-8	-1	14	-0,36	-0,57	-0,07
Customer service/support	5	1	3	9	0,40	0,25	0,35
Lead time of the machinery (months)	-9	-5	-7	21	0,43	0,24	0,33
Suitability of the equipment to business strategy made.	5	8	8	21	0,24	0,38	0,38

5.10.2 Forming benefit/cost matrixes

It has been asked to decision givers to rate the importance level of the benefits at a 10 point scale. Where, “10” is defined as the most important factor. The rating of the decision givers has been taken at equal importance and arithmetical average has been obtained. This has been used as the factor to give the weight to each of the benefits. So that it can easily be determined which benefit has the most importance for the final decision and which is less important. The normalized values of each benefit listed at Table5.4 have been multiplied by this weighting factor. These values have been listed on Table 5.5

Table 5.5 Weighted values of the benefits rated by decision givers in the brainstorming group.

Benefits	Weight Factor (1-10)	Weighted Values		
		Candidate 1	Candidate 2	Candidate 3
Production capacity (diapers/hour)	10	3,704	3,704	2,593
Productivity (%)	9	3,122	2,939	2,939
Time needed for size change in hours (set-up time) related to the same complexity of the product. (Reverse)	7	-2,100	-2,450	-2,450
Proximity to machinery supplier (days for a spare part arrival) (reverse)	3	-1,071	-1,714	-0,214
Customer service/support	8	3,200	2,000	2,800
Lead time of the machinery (months)	3	1,287	0,714	0,999
Suitability of the equipment to business strategy made.	10	2,381	3,810	3,810
	Total:	10,523	9,002	10,476
	Normalized Results:	**0,351**	**0,300**	**0,349**

With the formation of Table 5.5; the benefit section of the benefit/cost analysis has been completed. The cost section has been formed by using the price offers that has been given by the Candidates. It has been decided only to use the cost of the machinery to be taken into consideration. The costs shown in million US Dollars and their normalized values have been listed at below Table5.6.

Table 5.6 Normalized cost of candidates.

Costs	Values (million USD)			Total	Normalized Values		
	Candidate 1	Candidate 2	Candidate 3		Candidate 1	Candidate 2	Candidate 3
Machinery Cost	3,35	0,65	1	5	0,67	0,13	0,20

With the completion of Table 5.5 and Table 5.6, the benefit / cost ratio can be calculated. By using a benefit to cost ratio, it has been aimed to find which candidate gives the best value to the investor. The calculation is made at below section.

5.10.3 Vendor selection: calculation of benefit/cost ratio.

To calculate the benefit cost ratio, the weighted values of the benefit for each Candidate shall be divided by the normalized cost value of respective candidate.

However, it should be kept in mind that this methodology may gloss over the requirement for the benefit and cost priorities to be in commensurable units. In some specific cases, it may be possible that one candidate have a much higher level of benefit which is leading the best benefit/cost ratio while it is far away from the decision givers projected budget. To overcome this situation, a magnitude adjustment method [82] may be necessary to be used. It was not necessary to apply a magnitude adjustment in this case.

The normalized benefit values obtained on Table 5.5 and the normalized cost values obtained on Table 5.6 has been used to calculate the ratio of benefits to costs for each candidate. These are shown on below Table 5.7. For Candidate 1, the benefits value (0,351) divided by the costs value (0,670) gives a benefit cost ratio of 0,524. Similarly, the benefit cost ratio for Candidate 2 is 2,308 and it is 1,746 for Candidate 3.

Table 5.7 Calculation of weighted benefit/cost ratio and selection of technology.

Normalized Values Weighted with the Main Factor			
	Candidate 1	**Candidate 2**	**Candidate 3**
Benefits	0,351	0,300	0,349
Costs	0,670	0,130	0,200
Benefit / Cost ratio	**0,524**	**2,308**	**1,746**

The computation has been given at Table 5.7. From the ratios, it has been advised that Candidate 2 has to be selected for producing baby diapers.

5.11 Conclusion

The technology is growing very rapid. Due to this quick change, decision makers to face great uncertainty and complexity regarding the selection of which technology to

depend on. At SME's, even tough the comparison of the technologies are made quite good, mostly the decisions are made intuitively.

In this chapter, as a first part of technical feasibility analysis, technology selection has been studied. After explaining strategic technology management and technology portfolio, Cost benefit analysis has been introduced. To give information about the production cycle; how baby diaper production is made has been explained and brief information about the diaper performance test methods has been given. Information about baby diaper manufacturing equipment has been given and three candidates have been identified.

With different available alternatives and various criteria for technology evaluation, multi-criteria decision making methods seem to be appropriate to support this selection process. In the technology selection problems for baby diapers a structured assessment methodology that still lets the decision givers make the technical comparison of the alternatives as the way they would like to do. However, by putting the outcome of the consensus in a matrix format let them see exactly what are the advantages and disadvantages of each alternative with respect to the criteria discussed on. Understanding which criterions are more important and the pair-wise comparisons of the importance levels of criterions is obtained by defining the criterions and assigning them the weight factors. The benefits divided by the actual normalized costs of the machines has provided a ratio to depend on in technology selection problem.

To determine with which candidate the investor should move forward, it has been decided to make a cost benefit analysis. Benefits and costs matrixes have been formed and weighted cost benefit analysis has been made to make a vendor selection.

The proposed methodology should improve the technology selection process and the quality of the decision given as it also allows consideration for multiple decision givers to express their personal preferences in selection process.

CHAPTER 6
TECHNICAL & OPERATIONAL FEASIBILITY: FACILITY LOCATION SELECTION

6.1 Introduction

In this Chapter, as a part of the technical feasibility, a facility location selection problem will be studied. After explaining basics of facility location selection and analytical hierarchy process (AHP), a hierarchy tree is formed and the location selection factors are explained. Three alternative sites are determined. A qualitative, multi criteria decision support model has been formed and AHP has been implemented to the location selection problem by utilizing computer software. The location for baby diaper production plant has been determined. Below table shows the framework of this Chapter.

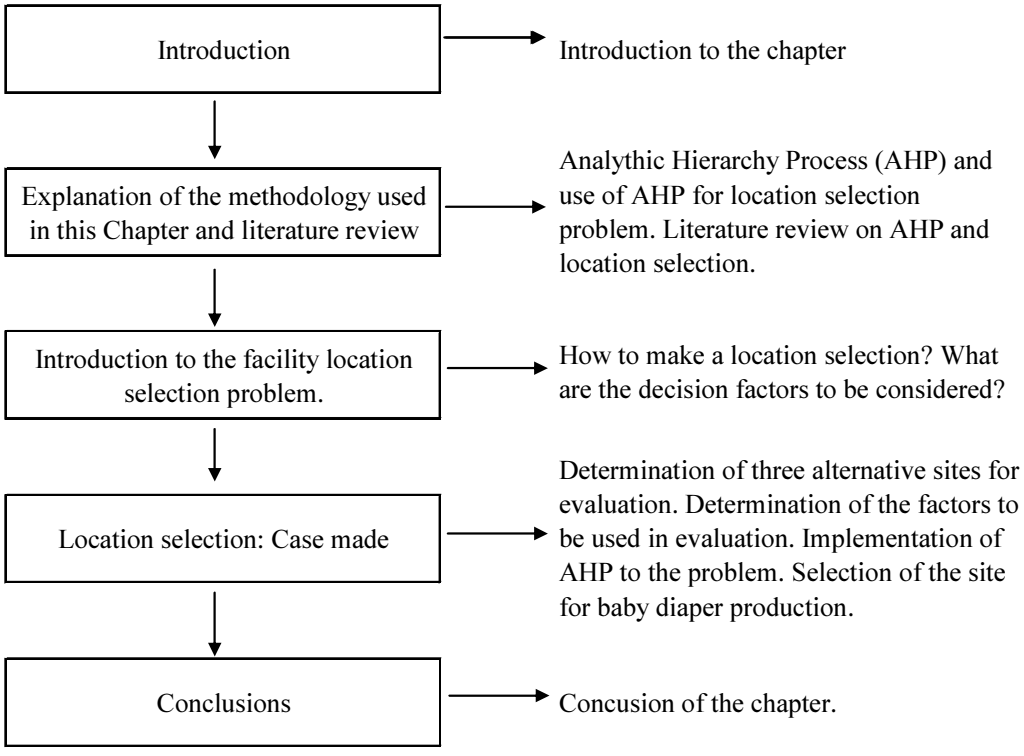


Figure 6.1 Framework of Chapter 6

6.2 Analytic Hierarchy Process (AHP) Methodology and Literature Review

6.2.1 Analytic Hierarchy Process (AHP)

The analytic hierarchy process (AHP) developed by Thomas Saaty is a method for ranking decision alternatives and selecting the best one when the decision maker has multiple objectives, or criteria, on which to base the decision. Thus, it answers the question, "which one?" A decision maker usually has several alternatives from which to choose when making a decision [83].

AHP is a very useful technique in solving complex decision problems. By applying this methodology, we can several qualitative and quantitative criteria can be identified, the competing and conflicting objectives among them can be examined, and their relative importance in order to make trade-offs and to determine priorities among them for making good decisions can be assessed [84, 85].

The application of AHP methodology involves four phases, namely:

Phase 1: Structuring the problem and building the AHP model.
Phase 2: Collecting data through pair wise comparisons by expert interviews.
Phase 3: Determining normalized priority weights of individual factors.
Phase 4: Analyzing the priority weights and deriving a solution to the problem [86].
In Phase 2 pair wise comparisons is done by using a nine-point scale as suggested by Saaty [87]. The nine-point scale is shown in Table 6.1.

Table 6.1 The nine-point scale [87]

1	Equal importance	Two activities contribute equally to the objective
3	Weak importance of one over other	Experience and judgment slightly favor one activity over another
5	Essential or strong important	Experience and judgment favor one activity over another
7	Demonstrated importance	An activity is strongly favored and its dominance is demonstrated in practice
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between the two adjacent judgments	When compromise is needed

The pair wise comparison judgment matrixes obtained from the expert interviews were translated into the largest Eigen value problems that can be solved to obtain the normalized and unique priority vectors of weights to criteria or sub-criteria, benefits or costs, and alternatives used in each level of the hierarchy. It is possible to obtain a software support for calculations.

The analytic hierarchy process (AHP) has been proposed in literature as an emerging solution approach to large, dynamic, and complex real world multi-criteria decision-making problems. The AHP has been used in a wide variety of complex decision-making problems, such as the strategic planning of organizational resources, the evaluation of strategic alternatives, or the justification of new manufacturing technology [88]. Up to date successful applications of the AHP have been reported in marketing, finance, education, public policy, economics, medicine and sports [89].

Three major steps in the AHP solution approach are:

1. Problem decomposition: The problem is decomposed into elements (which are grouped on different levels to form a chain of hierarchy) and each element is further decomposed into sub-elements until the lowest level of the hierarchy.
2. Comparative analysis: The relative importance of each element at a particular level will be measured by a procedure of pair wise comparison. The decision makers provide numerical values for the priority of each element using a rating scale.
3. Synthesis of priorities: The priority weights of elements at each level will be computed using eigenvector or least square analysis. The process is repeated for each level of the hierarchy until a decision is finally reached by overall composite weights [90].

The typical AHP model should include Objective, Criteria and Alternatives shown in below figure.

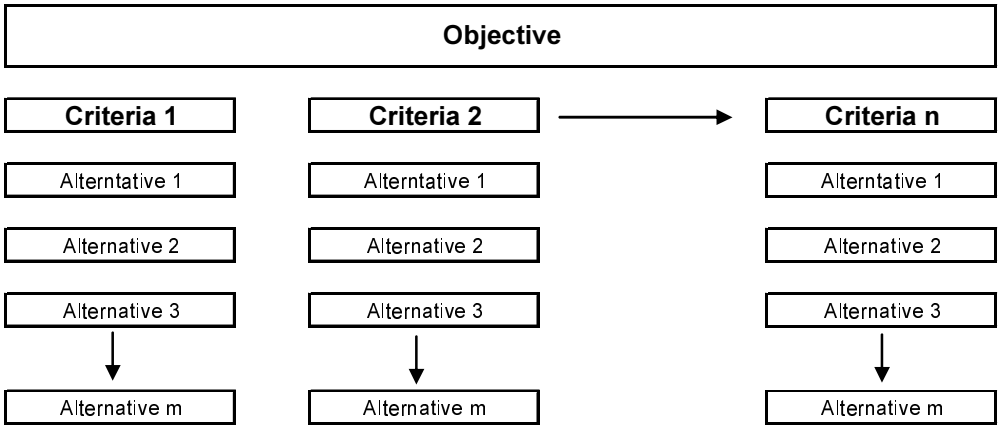


Figure 6.2 Typical AHP model

Mathematically, the objective is to determine the non-negative weights w_i of the criterion C_i for i=1 to n, where n is the number of criteria. If the weights w=(w_1,……,w_n) were known, then the relative importance of the criteri c_i as compared to c_j would be the ratio w_i/w_j. The basic idea of AHP is precisely to proceed from a pair wise comparison of the criteria and to evaluate the weights through a special procedure.

In an empirical study of preference, one might in principle be content to make comparisons of all criteria with only the first criteria for instance. In this way one would find empirical weight ratios w_i/w_1 for i=1 to n. These values only define the weight w up to an overall factor, and it is therefore always possible to represent the vector w by a normalized vector, e.g by imposing:

$$\sum_i w_i = 1 \tag{6.1}$$

Clearly there is no particular reason to choose the criterion c1 as a reference, any of the criteria could form the basis for a comparison with the others because of the underlying permutation symmetry of the criteria. Combining all n possible column vectors into a matrix A in the following way:

$$A=\begin{bmatrix} w_1/w_1 & w_1/w_2 & \dots & \dots & w_1/w_n \\ w_2/w_1 & & & & \\ w_3/w_1 & & & & \\ \cdot & & & & \\ \cdot & & & & \\ w_n/w_1 & & & & w_n/w_n \end{bmatrix} \quad (6.2)$$

One arrives at the starting point of the Saaty analysis. The elements of the matrix A have the special property

$a_{ij}=1/a_{ji}$ for all i and j, (6.3)

from which follows that the diagonal elements are unity and the upper-right and lower-left triangular blocks are reciprocal. It is easy to see that w is a right Eigen vector of the matrix A with eigen value n:

$A_W=n_w$ (6.4)

The matrix A/n is simply a projection operator on the one dimensional space defined by the vector w. In fact, the column vectors of A are proportional as a consequence of representing n perfectly consistent comparisons with reference to each of the criteria [91].

In the most common Saaty approach, a linear scale 1,2,3…,9 for the pair wise comparisons is used to quantify how much more important a criterion is compared to another one. The value 1 for instance means equally important and 9 means much more important. If the criterion is less important than another one, then the inverse preferences 1, 1/2, 1/3….,1/9 are used as can be seen in Table 6.1.

Clearly the choice of a linear scale and the maximum value is somewhat arbitrary but this is simply a reflection of the general problem of quantifying preferences in multi-attribute decision models. It is quite reasonable to use a bounded positive evaluation scale, i.e. no infinite preferences are allowed. Therefore all the elements of the matrix A are finite and positive.

However, the use of a linear scale creates an immediate inconsistency in the AHP approach. The standard AHP approach proceeds by remarking that the empirical matrix A most likely will have inconsistencies in the sense of its columns not

necessary being proportional. Saaty proposed to find the weight vector w as an Eigen vector solution of the equation:

$$A_W=\lambda_{max}w \tag{6.5}$$

λ_{max} is the minimal Eigen value of A. It may be shown that $\lambda_{max}\geq n$. The deviation of the maximal Eigen value from n in the perfectly consistent situation is used to define a consistency ratio

$$CR = CI / RI \tag{6.6}$$

Where the consistency index CI is defined by;

$$\mathrm{CI} = (\lambda_{\max} - n)/(n-1) \tag{6.7}$$

And RI is a number found by averaging CI over a large number of random A matrixes. A consistency ratio CR which is smaller than 0,1 is normally considered to be acceptable since this is "close" to the situation $\lambda_{max}=n$ when then pair wise comparison matrix A is totally consistent. A standard consistency cut-off of 0,1 is often applied by only retaining empirical data which feature a consistency ratios below 0,1. Below table shows n-RI values.

Table 6.2 n-RI values

n	3	4	5	6	7	8
RI	0,58	0,9	1,12	1,24	1,32	1,41

6.2.2 AHP and Facility Location Selection Literature Review

The AHP is a structured method to elicit preference opinion from decision makers. Its methodological procedure can easily be incorporated into multiple objective programming formulations with interactive solution process. The AHP approach involves decomposing a complex and unstructured problem into a set of components organized in a multilevel hierarchic form [84].

A salient feature of the AHP is to quantify decision makers' subjective judgments by assigning corresponding numerical values based on the relative importance of factors

under consideration. A conclusion can be reached by synthesizing the judgments to determine the overall priorities of variables [90].

Korpela and Tuominen [92], presented an integrated approach to warehouse site selection process, where both quantitative and qualitative aspects were considered. The main objective of the warehouse site selection was to optimize the inventory policies, enable smooth and efficient transportation facilities, and decide on various aspects such as location and size of stocking points etc., as related to logistics system design. The algorithm constitutes of four phases. The first and the second phase define the problem to set goals for the decision-making and identifies the sites and gather sufficient information to evaluate them respectively. Third phase consists of analysis wherein AHP is used for qualitative analysis, and to compare the alternatives based on intangible criteria. Cost analysis is also done in this phase to evaluate the impact of each alternative on the total logistic cost. Fourth phase combines the outcomes of both analyses to calculate and choose the site based on benefit/cost ratios. The authors described a case wherein a warehouse is selected.

Al Harbi [93], applied AHP in the field of project management to select the best contractor. He constructed a hierarchical structure for the pre-qualification criteria, and the contractors who wish to qualify for the project. In all, five contractors were considered in the case study. They were evaluated based on the criteria of experience, financial stability, quality performance, manpower resources, equipment resources, and current workload. Each of the contractors was compared pair-wise with the other for the different criteria mentioned above. Ranking among the different criteria was also done to find out the overall priority of each contractor. Based on this overall priority, the best contractor was selected. The contractor so selected had a highest overall priority value.

Lai et al. [94] used AHP for software selection called Multi-media Authorizing System (MAS). They used the group decision-making technique, which included six software engineers. Three products of MAS were evaluated. The hierarchy of the pair-wise comparison was formed that consisted of four levels. The criteria in the level three were evaluated. These criteria were: development interface, graphics support, multi-media support, data file support, cost effectiveness, and vendor

support. The six software engineers were trained about the use of AHP, and then asked to pair-wise compare the different criteria. Expert Choice software was used to felicitate ease in computation. To arrive at a selection consensus, the geometric mean methodology was preferred. The production software, which had a large geometric mean value, was selected. In the post AHP session, a questionnaire was prepared for the software engineers. This questionnaire was used to determine the contributions of AHP to decision quality, indirect benefits, practical user satisfaction, and economy. Some *t*-test analysis was also done in order to compare the applicability of AHP over conventional Delphi technique. The participants (software engineers) agreed that AHP would be more acceptable over Delphi method. This paper provides an insight for the use of AHP in the group decision-making.

Angels and Lee [95] presented a methodology using AHP that ties investment decisions to activity based costing. Both the monetary and the non-monetary benefits are included in the analysis. The relationships between goal, activities benefit and cost is also developed. These models are evaluated based on the costs and the performances. The final result is interpreted based on the performance versus cost graph that is plotted. The procedure involved six steps. The first three steps comprehensively make use of AHP. First step determines the relationship between the activities and goals, the second step finds the relationship between the costs and activities, and the third step seeks the different performance measures. Based on this information a model for cost and performance is framed out, these form the fourth and the fifth steps. Finally a graph is plotted to arrive at a decision consensus. The procedure used is explained with an example in the paper. Some minor modifications are done in the conventional AHP model, like some of the priority weights are negative because the savings allocation is being made. The priority weights are not normalized because they tend to loose the true cost effect. The paper, apart from its extension in the cost performance/cost benefit framework, can be extended for using in ranking considerations.

Badri [96] used AHP as an aid in making location allocation decisions. He claimed that the methodology could help the facility planning personnel to formulate the location strategies in the volatile complex decision environment. The author presented the methodology, by incorporating AHP alone and extended the same with

the use of GP. In the stand-alone AHP methodology, a three level hierarchy is defined. This hierarchy is used to select the best location that forms the goal of the hierarchy as the first level. The second level is the criteria, and the third level is the locations. As an example, the author considered a petrochemical company, which is evaluating its plant locations in six Middle-East countries. They are to serve their six distribution centers in six countries. The decision maker's interest is to determine the location site and the quantity of the products to be transported to each location from different sites. In the AHP hierarchy, the second level criteria are the political situations in the countries, global competition and survival, government regulations, and economy related factors. The third level in AHP is formed by the countries as UAE, Saudi Arabia, Bahrain, Qatar and Oman. In order to check whether the results are consistent, Expert Choice software was used, which incorporated composite view of analysis. This was done by a test of performance sensitivity. The author further pointed out the drawbacks of using AHP alone. To cover the limitations, AHP and GP are combined. Some more objectives were identified apart from the one used in AHP. Some of these are: minimizing the positive deviation, locating where quality of life is satisfactory, minimizing the positive deviation of the total cost above the budgeted amount, minimizing the transportation costs, etc. AHP has permitted flexibility in the use of available data in location allocation, whereas GP model is used so as to consider resource limitations, which are faced during recourse allocations.

Facility location selection is a typical multi-criteria decision-making problem in which managerial preference among performance criteria plays a key role in the final decision. To assess the decision-maker's preference explicitly with a preference model, many efforts have been made to develop the theory and methodology for preference assessment. In the current literature, the most preferred approaches are multi-attribute utility theory and analytic hierarchy process (AHP) [88]. It is observed that AHP is being predominantly used in the theme area of selection and evaluation [97].

6.3 Facility Location Selection

6.3.1 Basics of facility location selection

Facility location decision involves organizations seeking to locate, relocate or expand their operations. The facility location decision process encompasses the identification, analysis, evaluation and selection among alternatives. Plants, warehouses, retail outlets, terminals, and storage yards are typical facilities to be located. Site selection starts normally with the recognition of a need for additional capacity. A decision is then made to start the search for the "best" location.

It has been well recognized that facility location selection has important strategic implications for the operations to be located, because a location decision normally will involve long-term commitment of resources and be irreversible in nature. Specifically, the location choice for a manufacturing facility may have a significant impact on the firm's strategic competitive position in terms of operating cost, delivery speed performance, and firm's flexibility to compete in the marketplace. For example, selecting a production facility location that will allow the company to achieve proximity to suppliers has become a critical strategic advantage in the recent marketplace, since proximity to suppliers is important to JIT (Just-In-Time) production systems and flexible distribution systems for reduced inventories and improved delivery performance. Therefore, the final selection of a facility location must contribute to the success of corporate strategic plans for financing, marketing, human resource, and production objectives [98].

In the private sector, for instance, location decisions concern many stakeholders including venture capitalists, financial investors, industrial site developers, as well as hotel and convention centre managers. In contrast, the primary public interest about location decisions is from local governments or their economic development agencies, who view attracting new business as a key to the economic wellbeing of their region and communities.

6.3.2 How to make a facility location selection

Steps of making a location decision can be summarized as follows:

1. Decide on the criteria
2. Identify the important factors
3. Develop location alternatives
4. Evaluate the alternatives
5. Make selection

Most location decisions are made by using a transportation model, factor rating or by using center of gravity method. Transportation model is a model based on movement of costs of raw materials or finished goods. Factor rating method make a decision based on quantitative and qualitative inputs. And Center Of Gravity Method gives a decision based on minimum distribution costs [99].

6.3.3 Location decision factors

Location decision factors can be classified under four main considerations [99].

1. Regional Factors, (i.e.: Location of raw materials, location of markets, labor factors, climate and taxes)
2. Community Considerations (i.e.: Quality of life, services, attitudes, taxes, environmental regulations, utilities, developer support.)
3. Multiple Plant Strategies (Product plant strategy, market area plant strategy, process plant strategy)
4. Site Related Factors (i.e.: Land, transportation, environmental, legal issues)

Determination of factors depends on the type of the facility and the decision givers priorities and expectations from a facility location. The major facility location factors have been listed below [88].

1. Site Related Factors (i.e.: Land, transportation, environmental, legal issues)
2. Access to markets/distribution centers
   - ❖ Cost of serving markets
   - ❖ Trends in sales by areas
   - ❖ Ability to penetrate local market by plant presence

3. Access to markets/distribution centers
    - ❖ Transportation costs
    - ❖ Trends in supplier by area
4. Community/government access
    - ❖ Ambience/cost of living
    - ❖ Co-operation with established local industry
    - ❖ Community pride
    - ❖ Housing/churches
    - ❖ Schools and colleges
5. Competitive considerations
    - ❖ Location of competitors
    - ❖ Likely reaction to the new site
6. Environmental factors
    - ❖ Community attitude
    - ❖ State/local governmental regulations
7. Labor related considerations
    - ❖ Prevailing wage rates
    - ❖ Extent and militancy of unions in the area
    - ❖ Productivity
    - ❖ Availability
    - ❖ Skill levels available
8. Taxes and financing
    - ❖ State income tax/local property and income taxes
    - ❖ Unemployment and compensation premiums
    - ❖ Tax incentive concessions
    - ❖ Industrial pollution control revenue bonds
9. Transportation
    - ❖ Trucking service
    - ❖ Rail service
    - ❖ Air freight service
10. Utilities services
    - ❖ Quality and price of water and sewerage
    - ❖ Availability and price of electric and natural gas
    - ❖ Quality of police, fire, medical services

6.4 Factors to be used at Location Selection and Forming the Hierarchy Tree

The primary goal of this Chapter is to make a decision for location selection for a baby diaper production investment. Many factors influence location decisions. However, it often happens that one or a few factors are so important that they dominate the decision. In this study the most important factors has been determined and 3 site alternatives are identified. The detailed information on the alternative site selection is given in the following section. The main aim of this part of the study is to evaluate the alternatives and make a selection.

The phase of evaluation has been made by inputs from 4 people who have the necessary experience and can evaluate both factors and site alternatives as far as an industrial location selection is concerned.

The factors to be used for location selection problem for baby diaper production investment has been determined and briefly explained as follows [100]:

1. Factor 1: Market

When all the necessary inputs have been assembled and the manufacturing begins then the product has to be sold. This raises the related question of how much to produce, what price to charge and how and where to market the output. These are all matters that have an important bearing on the location decision, since different scale of operation and different pricing policies may require different locations and for many firms today access to the market is regarded as the dominant consideration in choosing a site for a factory. In the case of this study, as it has been clarified by the business strategy made, the diapers produced will be aiming the medium to low-end users in Turkey and mainly to Middle East Market. It can be said that the market is the users whose primary focus is not the performance but the price.

2. Factor 1.1: Proximity to the market

Some firms must locate close to their markets because of the perishability of their products. (i.e. flower shops) For other types of firms, distribution costs are the main factor in closeness to market. Still other firms require close customer contact, so they tend to locate within the area they expect to serve.

When the bulkiness of the product is considered for a baby diaper manufacturer the most critical one can be taken as the transportation costs as well as being able to deliver the orders much quicker. Therefore it is not only the cost of transportation but also the time required for transportation shall be considered as a major factor. The customers may need the producer to keep a minimum stock level. The more close the distance the less quantity can be inventoried for guaranteed on-time delivery.

3. Factor 1.2: Competition at the market segment served

Profit-oriented firms frequently locate near the markets they intend to serve as part of their competitive strategy, whereas the nonprofit organizations choose locations relative to the needs of the users of their services. Other factors include distribution costs or the perishability of a finished product.

Competitive pressures for some operations can be extremely vital factors so that a search for potential locations tends to concentrate on locations without (or less) competitors. When the Middle East Market is concerned, the competition on price would be higher than anything else related to the diaper production and marketing.

4. Factor 2: Labor Related Factors

Labor is needed to operate any industrial plant, but the amount and type required varies from industry to industry and from firm to firm. The distinctive labor requirements of particular industries make some places more suitable locations than others. Primary labor considerations are the cost and availability of labor, wage rates in an area, labor productivity and attitudes towards work and whether the unions are a serious potential problem.

5. Factor 2.1: Availability of qualified and skilled personnel

Skill of potential employees is another factor that effects the location decisions. Some companies prefer to train new employees rather than rely solely on previous experience. Increasing specialization in many industries makes this possibility even more likely than in the past. A firm needing a big labor force with a large range of skills obviously will find this easier to obtain in a major metropolitan area than in a small town. If workers with specific skills are needed, a location in one region or city might suggest itself on the grounds of an existing concentration on a particular

activity; traditional familiarity with industries can be an advantage to a firm seeking a particular kind of labor. For baby diaper manufacturing, the need for qualified personnel is necessary, because they are the ones who will set-up the machine, keep the machine running and make fine tunings and decrease the waste percent. However, on the other side, it the machinery itself who makes the production and does not require the operator to be involved as long as it has been set correctly to a certain size product and maintained in good conditions.

6. Factor 2.2: Cost of labor

Labor costs are very important for labor-intensive organizations. Variations from place to place in labor costs can assume critical importance in the modern industrial system, where the level of wages paid and the supply of labor may be beyond the control of the individual firm. As far as diaper production concerned, the cost of labor does not get the highest share at the unit cost of a baby diaper. However it is still in the first three major costs of production. It should also be noted that the cost of labor per unit mostly depends on the number of diapers produced at a certain period, say a day. Therefore this is also something that depends on the management's strategy on how often they make size changes and how much they know about running the machine with fever stops.

7. Factor 3: Supply/Support Related

Supply is the backbone of manufacturing. Success of all other manufacturing and marketing activities depends on the performance of purchasing. It is clear that purchasing cheaper is more important than selling higher. Therefore proximity to raw material sources and a location that would allow less transportation expenditures would be preferred.

8. Factor 3.1: Proximity to raw materials

Firms locate near or at the source of raw materials for three primary reasons: Necessity, Perishability and Transportation Costs. Farming, mining, fishing operations fall under necessity. Companies making canning, freezing of fresh fruits etc. must consider perishability when considering location. Transportation costs are important in industries where processing or producing bulk materials.

In baby diaper case, the transportation costs are believed to the most important of the three primary reasons. Because there are several materials are used in producing a diaper and most of the material is bulky.

9. Factor 3.2: Availability of transportation possibilities

The transportation possibilities and cost may be a major factor for determining location for companies who processes bulky materials or whose products are bulky. Even tough it has been pressed occupy a minimum size; the baby diaper itself is bulky as well. Also for firms with executives who travel frequently the ease of travel connections can be important. When a diaper is considered, there are several raw materials required to produce a diaper and if one of them is missing the production stops. Therefore a very good supply chain management is required. Roads, rails, airports, availability of transportation and freight forwarder companies are of essence in selecting a manufacturing location.

10. Factor 3.3: Availability of supporting and outsource services

It may be necessary for a decision giver to analyze the availability of outsourcers and supporting services before make a decision for a location. Industrial zone infrastructure, availability of machine shops and shops that sells spare parts and pieces may be important. Training & consulting possibilities, availability of universities and engineering companies to co-operate with...etc. may also be important. The baby diaper machineries operate includes several sensors, proximity switches, encoders, pneumatic cylinders and other parts. For a baby diaper manufacturer, it is not a must but it would be preferred to be located at a location that these types of parts and pieces can easily be obtained.

11. Factor 4: Incentives and Tax exemptions

Taxes play an important role in investment decisions. The income taxes applicable at some alternatives may increase or decrease the attractiveness of these locations. Many companies have been attached by the cities that has investment incentive certificate provided by the government for the improvement of a specific region of the country. Low taxes, even no-taxes for several years, low-cost energy and labor and monetary incentives are major factors in attracting or keeping the investors in a

location. Table 6.3 lists the cities and gives information about the situation of the city with respect to the investment incentives [101].

Table 6.3 Developed and normal cities and cities that has incentives

Developed Cities	Normal Cities	Cities that Have Priority for Development	
ADANA (city center)	ADANA (outskirts)	ADIYAMAN	MALATYA
ANKARA (city center)	ANKARA (outskirts)	AGRI	MARDIN
ANTALYA (city center)	ANTALYA (outskirts)	AKSARAY	MUS
BURSA (city center)	BOLU	AMASYA	NEVSEHIR
ISTANBUL (city center)	BURDUR	ARDAHAN	NIGDE
IZMIR (city center)	BURSA (outskirts)	ARTVIN	ORDU
KOCAELİ (city center)	CANAKKALE	BARTIN	OSMANIYE
	ESKISEHIR	BATMAN	RIZE
	GAZIANTEP	BAYBURT	SAMSUN
	ICEL	BINGOL	SIIRT
	IZMIR (outskirts)	BITLIS	SINOP
	AFYON	CANAKKALE (Bozcaada ,Gokceada)	SIVAS
	AYDIN	CANKIRI	SANLIURFA
	BALIKESIR	CORUM	SIRNAK
	BILECIK	DIYARBAKIR	TOKAT
	DENIZLI	ELAZIG	TRABZON
	DUZCE	ERZINCAN	TUNCELI
	EDIRNE	ERZURUM	VAN
	HATAY	GIRESUN	YOZGAT
	ISPARTA	GUMUSHANE	ZONGULDAK
	KAYSERİ	HAKKARI	
	KIRKLARELİ	IGDIR	
	KONYA	K.MARAS	
	KUTAHYA	KARABUK	
	MANISA	KARAMAN	
	MUGLA	KARS	
	SAKARYA	KASTAMONU	
	TEKIRDAG	KILIS	
	USAK	KIRIKKALE	
	YALOVA	KIRSEHIR	

12. Factor 5: Others

These are factors that potentially effect the decision for a location but have relatively less priority. These to include the land and construction constraints, the climate conditions, local limitations and possibilities, consistency, stability, reliability, availability and costing of utilities and environmental regulations.

13. Factor 5.1: Land and construction

The need for land goes far beyond simply requiring ground on which to put the factory. The land occupied by the physical plant is of course important but land is also needed for such purposes as the storage of the materials and finished goods. Few firms now put up a factory without making sure they have enough room to expand. Some firms may require a particular kind of site with certain physical attributes. The cost of land varies considerably from place to place. Although the cost of land is often a major item in the initial expenditure involved in setting up a factory, it is insignificant in most industries when costed over a long period, or when rent is expressed as a proportion to total production costs. Even if the cost of the land is relatively insignificant as a determinant of plant location among a number of possible sites, there may be somewhere the price that other users are prepared to pay will effectively exclude any form of manufacturing.

14. Factor 5.2: Climate Conditions

Climate sometimes play a role in location decisions. For example, severe winters may cause firms to consider milder climate, especially if delayed deliveries and work disruptions caused by inability of employees to get to work. When the diaper business is concerned, an alternative that has the humidity levels less than the other alternatives might have an advantage avoiding some potential issues that may arise due to the nature of the materials used in manufacturing baby diapers. For instance the super absorbent polymer, SAP, would be in the aim of absorbing humidity in the air if diaper manufacturing is done at an un-conditioned production environment.

15 Factor 5.3: Local limitations and possibilities

Many communities try to attract new businesses because they are viewed as potential sources of future tax revenues and new job opportunities. However communities do

not, as a rule, want firms that will create pollution problems or otherwise lessen the quality of life in the community.

From a company standpoint, a number of factors determine the desirability of a community as a place for its workers and managers to live. They include facilities for education, shopping, recreation, transportation, religious worship, entertainment, quality of police and medical services, local attitudes towards the company and the size of the community.

16. Factor 5.4: Consistency, stability, reliability, availability and costing of utilities

The consistency, stability, reliability and availability of sources like energy, gas, communication and water are critical factors for almost all industrial location selections. Some firms may have considerable losses due to lack of energy or the fluctuation at the quality of the energy supplied. Electricity is the main source of motive power in most industries including baby diaper production and just a small power blink would potentially cause several hours of downtime.

17. Factor 5.5: Environmental Regulations

The environmental regulations might change from one location alternative to the other. The attitude of the community as well may change from site to site. While some industrial zones, as the group of companies active in the zone, has its own waste water treatment, recycling, waste disposal activities, some may not have any and the firm might need to install these by him self to comply with the environmental rules and regulations. Also, it may be a location that is protected by law due to the nature. Baby diaper manufacturing is not produce waste harmful to environment and the waste products are either sold or recycled.

Above listed facility location selection factors has been put in a hierarchy tree view. These factors would be evaluated by using analytical hierarchy process, AHP. Figure 6.2 shows the location selection model for baby diaper production in AHP framework.

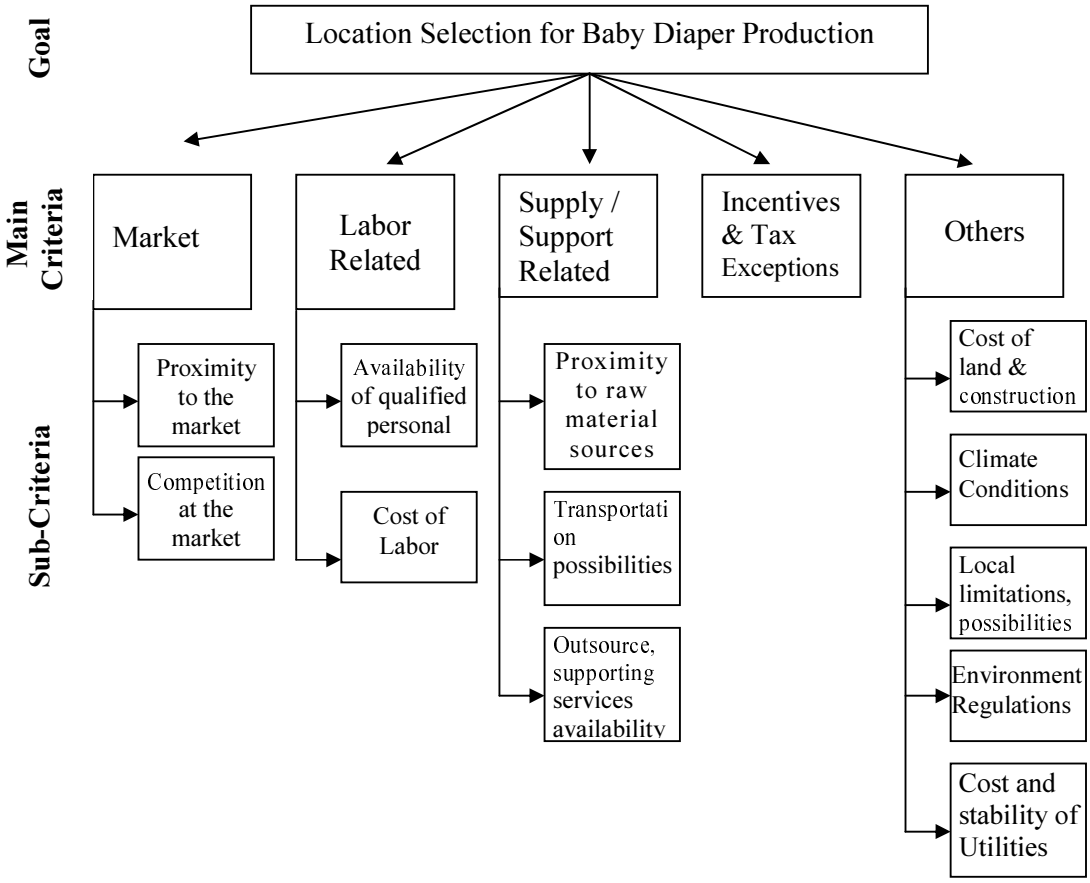


Figure 6.2 Location selection model in AHP framework

6.5 Location Selection Using AHP

6.5.1 Software used for the problem

When an organization is confronted with choosing the best vendor to deliver a good or service, the decision can often be very complex. Many decisions are too complex or too important for decision-makers to make choices based solely on instinct. For example, today's typical budget decision involves a variety of tangible and intangible strategic goals, conflicting stakeholders, dozens or hundreds of alternative initiatives to be pursued and limited resources. No single decision-maker can meaningfully combine all of this information and make informed decisions.

AHP applications in complex situations may demand the use of professional computer application software. Badri [96], who used AHP as an aid in making

location allocation decisions stated that the decisions related to multi-location problems and the problems that involved insufficient resources to support the selected locations etc., cannot be executed with the aid of AHP alone. The authors, in order to overcome the complexity of the situations, have used Expert Choice software.

It is possible to use software to enable decision-makers to develop consensus about what is really important in selecting the best product or service. When procuring complex goods and services, organizations often encounter gridlock in determining what is really needed. Some decision-makers may already favor a vendor or may have their own ideas of what constitutes best-value. While traditional management processes and collaboration tools employ good information gathering methods – such as brainstorming sessions and surveys, they provide no accurate or thorough way to bring information together. By using software; decision-makers weight criteria using a process for developing priorities and building consensus.

Expert Choice is intuitive, graphically based and structured in a user-friendly fashion so as to be valuable for conceptual and analytical thinkers, novices and category experts. Because the criteria are presented in a hierarchical structure, decision makers are able to drill down to their level of expertise, and apply judgments to the objectives deemed important to achieving their goals. At the end of the process, decision makers are fully cognizant of how and why the decision was made, with results that are meaningful, easy to communicate, and actionable. Based on the Analytic Hierarchy Process (AHP), Expert Choice software provides a mathematically rigorous application and a process for prioritization and decision-making. By reducing complex decisions to a series of pair wise comparisons, then synthesizing the results, Expert Choice not only helps decision-makers arrive at the best decision, but also provides a clear rationale for the decision. Powerful sensitivity graphs enable the purchaser to graphically display the relative strengths and weaknesses of vendors against the evaluation criteria. The analytical tools are extremely effective for rolling up vendor scores and comparing costs to truly measure best-value. It dramatically reduce the amount of time it takes to select the best vendor, then justify the selection against protest using the advanced reporting capabilities of the software. The user can save and iterate the results. Sensitivity

analysis can easily be performed. Expert Choice prints graphs and tables. Expert Choice is used to overcome the complexity of the situations in this study. The data gathered were analyzed by using the software package. However, to show how the manual calculation can be done, it has been decided to show one calculation for an evaluation made for reference.

6.5.2 Determination of three alternative sites

By the time, baby diapers are introduced to the market it has started as a replacement to re-usable diapers. Today, it is possible to find at the markets in districts that are selling diapers one by one from an open box. It has been decided to determine three alternative sites and implement the methodology of location selection to these three locations. To do so, it has been decided to take the following factors into consideration: 1- Baby diaper producers' locations. 2- Diaper producers' capacity. 3- Governmental investment incentives. 4-Business strategy made previously.

By taking all above into consideration and to have a starting point of the study, three alternatives has been intuitively determined. These are: Istanbul, Kocaeli and Kilis. During the phase of discussion, it has been asked the decision givers opinions on the alternatives determined and the general opinion was towards that the three sites selected are agreeable. In real life environment, the selection of alternatives is as important as the selection one of the alternatives. For this thesis, the three sites named above have been assumed to be the best 3 alternatives available.

6.5.3 Methodology and implementation of AHP to location selection problem

The AHP model provides a framework to assist decision givers in analyzing various location factors, evaluating location site alternatives, and making final location selections. The primary principle of the AHP model is to match decision-makers' preferences with location site characteristics. The model requires that a number of potential sites have been proposed. Alternatives are then evaluated and compared under both quantitative and qualitative factors to allow managers to incorporate managerial experience and judgment in the solution process.

Every decision giver has been asked to make pair wise verbal comparisons to prioritize each of the location selection factors between themselves. After that, it has

been asked to evaluate these factors for each of the alternatives. This also has been made by pair wise comparison. Below is an explanation to show how it has been made.

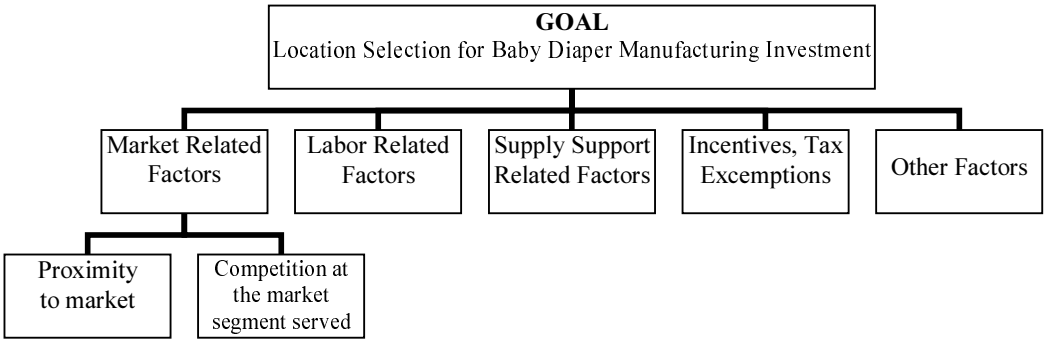


Figure 6.3 Hierarchy view of "market" only with respect to goal

First one of the decision-giver has been asked to make pair wise comparison between the "market" and the other main facility location selection factors with respect the goal of the analysis. Here are his opinions:

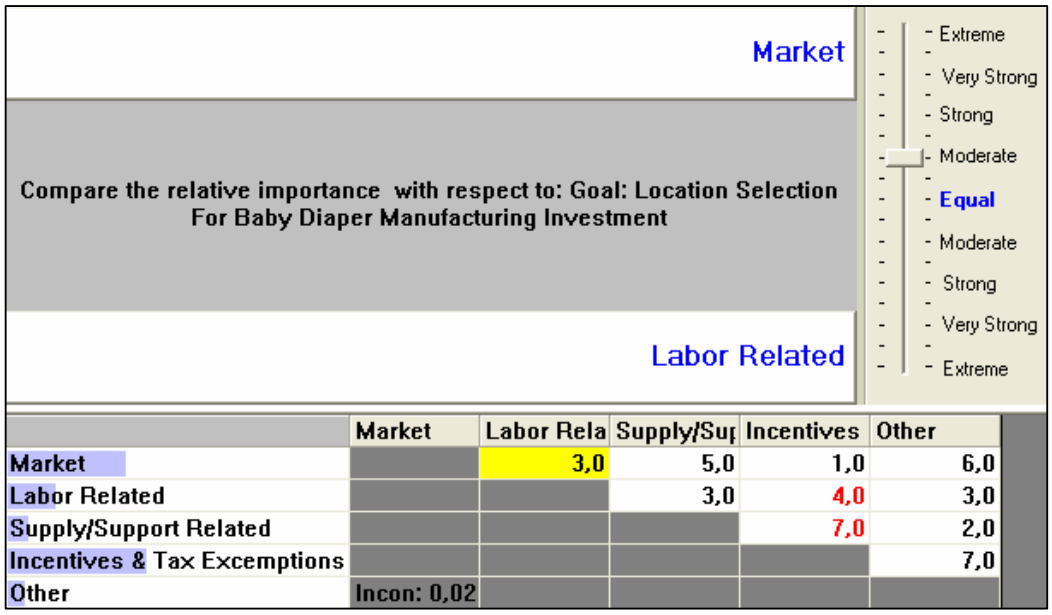
"Market" has moderate (3) relative importance than "labor related factors" with respect to the goal.

"Market" has strong (5) relative importance than "supply support related factors" with respect to the goal.

"Market" has equal (1) relative importance with "government incentives and tax exceptions" with respect to the goal.

"Market" has very strong (6) relative importance than "other factors" with respect to the goal.

These comparisons are put in the computer using the Expert Choice software. Below is a screen-shot showing the results of a decision-giver making pair-wise comparison.

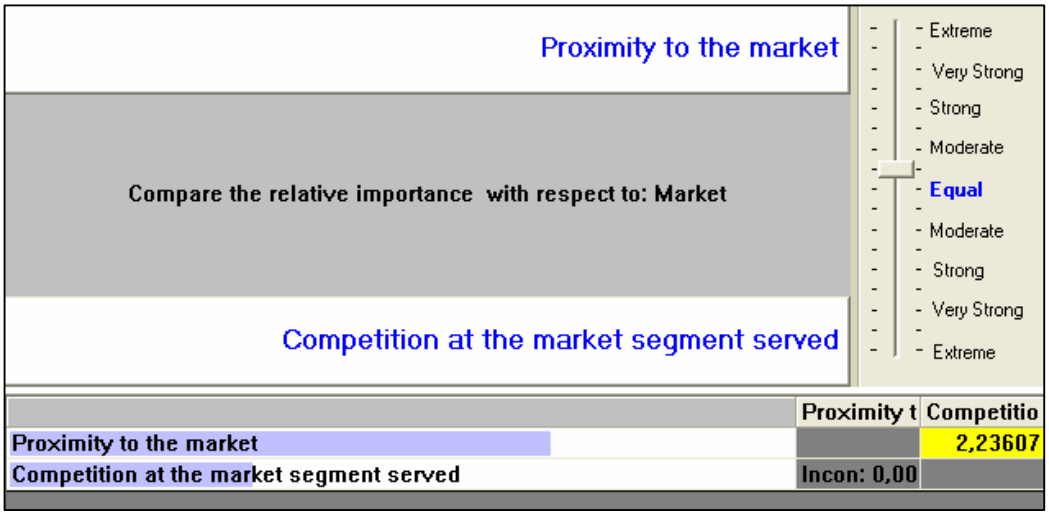


	Market	Labor Rela	Supply/Sup	Incentives	Other
Market		3,0	5,0	1,0	6,0
Labor Related			3,0	4,0	3,0
Supply/Support Related				7,0	2,0
Incentives & Tax Exemptions					7,0
Other	Incon: 0,02				

Figure 6.4 Pair-wise comparison of location selection factors.

Similar comparison is also made between the two sub-factors of the market: "proximity to the market" and "competition at the market segment served" factors. As it can be seen from Figure 6.4, this specific decision giver has rated that both has equal (1) importance.

After all comparisons are completed; decision-giver is asked to compare the alternative sites with respect to each of the facility location selection factors.



	Proximity t	Competitio
Proximity to the market		2,23607
Competition at the market segment served	Incon: 0,00	

Figure 6.5 Pair-wise comparison of sub-factors under main factor: "Market".

Below Figure 6.6 shows a result from one of the decision-givers opinion on sub-factor “proximity to the market”.

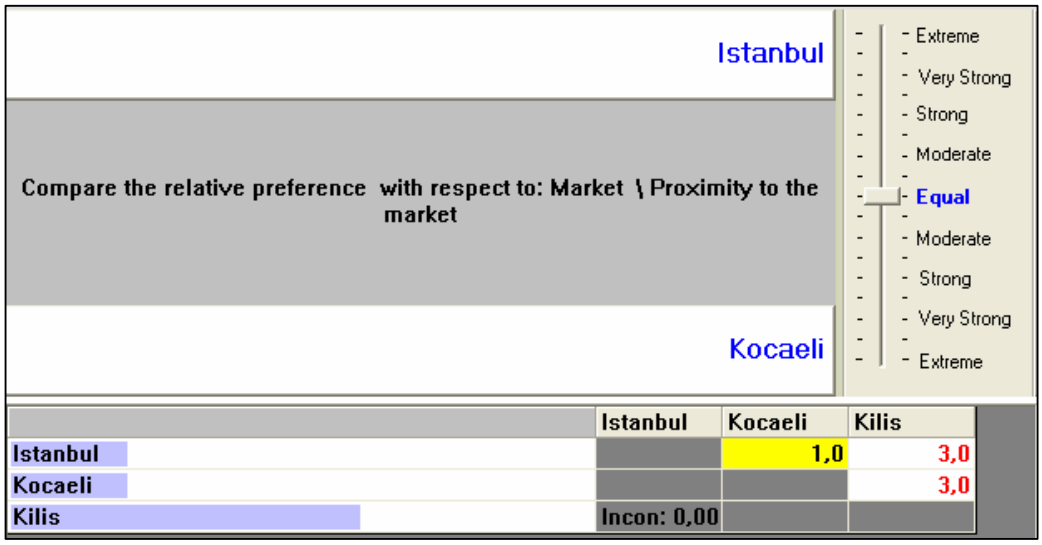


Figure 6.6 Pair-wise comparison for relative preference of the alternative locations with respect to “Proximity to the market”

Once all of the comparisons are complete, the collected data can easily be analyzed by the software and give the outcome of the preferences.

Figure 6.7 shows the results of only one decision giver. According to this person; the plant shall be to Kilis.

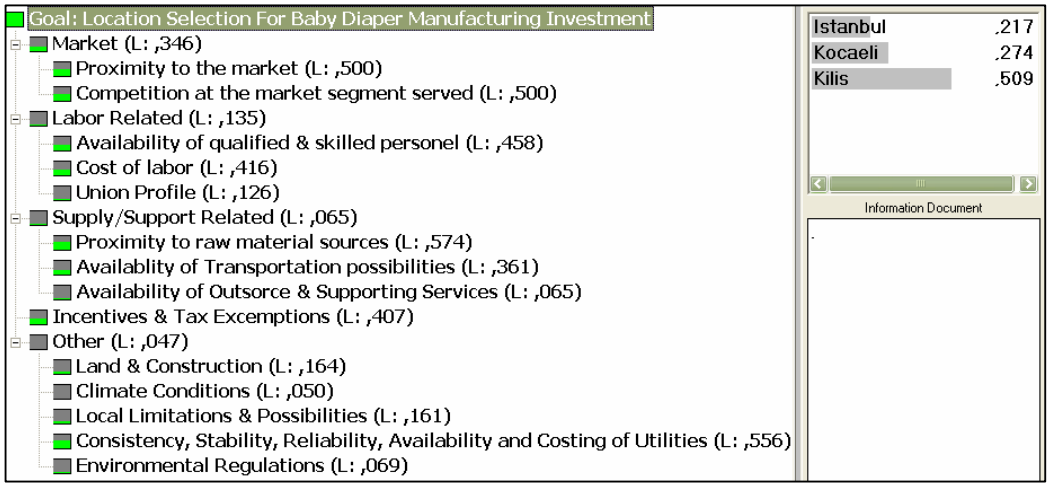


Figure 6.7 Results for only one decision-giver.

As Expert Choice is a software package used for evaluation; it has been decided to show how this calculation can be made manually. Manual solution has been made only for one comparison matrix. One of the decision giver's evaluations has been taken as starting point. The evaluation of criterions with respect to goal is taken as example in manual solution. As step 1, the comparisons made as shown on Figure 6.4 are put into a matrix form. And steps described in the beginning of this chapter are followed to find the Eigen vector and test the consistency of this specific evaluation. The manual calculation can be followed in 5 steps with an addition of consistency step.

Step 1: In order to make the calculations, the variables / criteria names are removed and fractions are converted to decimals;

$$\begin{bmatrix} 1 & 3 & 5 & 1 & 6 \\ 0{,}33 & 1 & 3 & 0{,}25 & 3 \\ 0{,}20 & 0{,}33 & 1 & 0{,}143 & 2 \\ 1 & 4 & 7 & 1 & 7 \\ 0{,}167 & 0{,}33 & 0{,}5 & 0{,}143 & 1 \end{bmatrix}$$

Step 2: Squaring the matrix

$$\begin{bmatrix} 1 & 3 & 5 & 1 & 6 \\ 0{,}33 & 1 & 3 & 0{,}25 & 3 \\ 0{,}20 & 0{,}33 & 1 & 0{,}143 & 2 \\ 1 & 4 & 7 & 1 & 7 \\ 0{,}167 & 0{,}33 & 0{,}5 & 0{,}143 & 1 \end{bmatrix} \text{x} \begin{bmatrix} 1 & 3 & 5 & 1 & 6 \\ 0{,}33 & 1 & 3 & 0{,}25 & 3 \\ 0{,}20 & 0{,}33 & 1 & 0{,}143 & 2 \\ 1 & 4 & 7 & 1 & 7 \\ 0{,}167 & 0{,}33 & 0{,}5 & 0{,}143 & 1 \end{bmatrix} =$$

$$\begin{bmatrix} 4{,}9920 & 13{,}6300 & 29{,}0000 & 4{,}3230 & 38{,}0000 \\ 2{,}0110 & 4{,}9700 & 10{,}9000 & 1{,}6880 & 15{,}7300 \\ 0{,}9859 & 2{,}4920 & 4{,}9910 & 0{,}8545 & 7{,}1910 \\ 5{,}8890 & 15{,}6200 & 34{,}5000 & 5{,}0020 & 46{,}0000 \\ 0{,}6859 & 1{,}8980 & 3{,}8260 & 0{,}6070 & 4{,}9930 \end{bmatrix}$$

Step 3: Computing the first eigenvector (to four decimal places). The rows are summed and total of the rows are taken;

$$\begin{bmatrix} 4,9920 & 13,6300 & 29,0000 & 4,3230 & 38,0000 \\ 2,0110 & 4,9700 & 10,9000 & 1,6880 & 15,7300 \\ 0,9859 & 2,4920 & 4,9910 & 0,8545 & 7,1910 \\ 5,8890 & 15,6200 & 34,5000 & 5,0020 & 46,0000 \\ 0,6859 & 1,8980 & 3,8260 & 0,6070 & 4,9930 \end{bmatrix} = \begin{bmatrix} 89,9450 \\ 35,2990 \\ 16,5144 \\ 107,0110 \\ 12,0090 \end{bmatrix}$$

89,9450 + 35,2990 + 16,5144 + 107,0110 + 12,0099 = 260,7793

$$\begin{bmatrix} 89,9450 \\ 35,2990 \\ 16,5144 \\ 107,0110 \\ 12,0090 \end{bmatrix} \div \begin{bmatrix} 260,7793 \\ 260,7793 \\ 260,7793 \\ 260,7793 \\ 260,7793 \end{bmatrix} = \begin{bmatrix} 0,3449 \\ 0,1354 \\ 0,0633 \\ 0,4104 \\ 0,0461 \end{bmatrix} \rightarrow \text{The Eigen vector}$$

0,3449 + 0,1354 + 0,0633 + 0,4104 + 0,0461 = 1

Step 4: This process must be iterated until the eigenvector does not change from the previous iteration. Then this step is squaring the matrix found in Step2.

$$\begin{bmatrix} 4,9920 & 13,6300 & 29,0000 & 4,3230 & 38,0000 \\ 2,0110 & 4,9700 & 10,9000 & 1,6880 & 15,7300 \\ 0,9859 & 2,4920 & 4,9910 & 0,8545 & 7,1910 \\ 5,8890 & 15,6200 & 34,5000 & 5,0020 & 46,0000 \\ 0,6859 & 1,8980 & 3,8260 & 0,6070 & 4,9930 \end{bmatrix} \text{x} \begin{bmatrix} 4,9920 & 13,6300 & 29,0000 & 4,3230 & 38,0000 \\ 2,0110 & 4,9700 & 10,9000 & 1,6880 & 15,7300 \\ 0,9859 & 2,4920 & 4,9910 & 0,8545 & 7,1910 \\ 5,8890 & 15,6200 & 34,5000 & 5,0020 & 46,0000 \\ 0,6859 & 1,8980 & 3,8260 & 0,6070 & 4,9930 \end{bmatrix} =$$

The calculations are made as done on step 2 and 3 and the Eigen vector is calculated.

$$\begin{bmatrix} 0,3461 \\ 0,1347 \\ 0,0650 \\ 0,4071 \\ 0,0471 \end{bmatrix} \rightarrow 2^{nd} \text{ Eigen vector}$$

Step 5: The difference of the first eigenvector to the second eigenvector is computed.

$$\begin{bmatrix} 0,3449 \\ 0,1354 \\ 0,0633 \\ 0,4104 \\ 0,0461 \end{bmatrix} - \begin{bmatrix} 0,3461 \\ 0,1347 \\ 0,0650 \\ 0,4071 \\ 0,0471 \end{bmatrix} = \begin{bmatrix} -0,0012 \\ 0,0007 \\ -0,0017 \\ 0,0033 \\ -0,0010 \end{bmatrix}$$

When the Eigen vectors are compared, the difference is quite high. So, the iteration process should be continued until no difference is found. When steps fallowed the 3rd Eigen vector is found as follows:

$$\begin{bmatrix} 0{,}3461 \\ 0{,}1347 \\ 0{,}0649 \\ 0{,}4072 \\ 0{,}0471 \end{bmatrix} \rightarrow 3^{rd} \text{ Eigen vector}$$

$$\begin{bmatrix} 0{,}3461 \\ 0{,}1347 \\ 0{,}0649 \\ 0{,}4072 \\ 0{,}0471 \end{bmatrix} - \begin{bmatrix} 0{,}3461 \\ 0{,}1347 \\ 0{,}0650 \\ 0{,}4071 \\ 0{,}0471 \end{bmatrix} = \begin{bmatrix} 0{,}0012 \\ -0{,}0007 \\ 0{,}0016 \\ -0{,}0032 \\ 0{,}001 \end{bmatrix}$$

The results are still not acceptable. So another (4^{th}) iteration shall be done. When calculations are made, the 4^{th} Eigen vector is found as follows.

$$\begin{bmatrix} 0{,}3461 \\ 0{,}1347 \\ 0{,}0649 \\ 0{,}4072 \\ 0{,}0471 \end{bmatrix} \rightarrow 4^{th} \text{ Eigen vector}$$

$$\begin{bmatrix} 0{,}3461 \\ 0{,}1347 \\ 0{,}0649 \\ 0{,}4072 \\ 0{,}0471 \end{bmatrix} - \begin{bmatrix} 0{,}3461 \\ 0{,}1347 \\ 0{,}0649 \\ 0{,}4072 \\ 0{,}0471 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

When looked at the result comparison there is no difference. As a result the Eigen vector for these criteria is defined as follows:

$$\begin{bmatrix} 0{,}3461 \\ 0{,}1347 \\ 0{,}0649 \\ 0{,}4072 \\ 0{,}0471 \end{bmatrix} \text{ Eigen vector}$$

After determination of the Eigen vector, the consistency shall be tested.

Step 6 : Consistency

$$\begin{bmatrix} 1 & 3 & 5 & 1 & 6 \\ 0,33 & 1 & 3 & 0,25 & 3 \\ 0,20 & 0,33 & 1 & 0,143 & 2 \\ 1 & 4 & 7 & 1 & 7 \\ 0,167 & 0,33 & 0,5 & 0,143 & 1 \end{bmatrix} \text{x} \begin{bmatrix} 0,3461 \\ 0,1347 \\ 0,0649 \\ 0,4072 \\ 0,0471 \end{bmatrix}$$

$$= \begin{bmatrix} 0,3461 & 0,4041 & 0,3246 & 0,4072 & 0,2825 \\ 0,1142 & 0,1347 & 0,1948 & 0,1018 & 0,1412 \\ 0,0692 & 0,0444 & 0,0649 & 0,0582 & 0,0942 \\ 0,3461 & 0,5388 & 0,4544 & 0,4072 & 0,3295 \\ 0,0578 & 0,0444 & 0,0325 & 0,0582 & 0,0471 \end{bmatrix}$$

The weighted sum of each row calculated is $\begin{bmatrix} 1,7645 \\ 0,6867 \\ 0,3310 \\ 2,0761 \\ 0,2400 \end{bmatrix}$

Then each row of weighted sum vector is divided by each row of Eigen vector as fallows:

$$\begin{bmatrix} 1,7645 \\ 0,6867 \\ 0,3310 \\ 2,0761 \\ 0,2400 \end{bmatrix} \div \begin{bmatrix} 0,3461 \\ 0,1347 \\ 0,0649 \\ 0,4072 \\ 0,0471 \end{bmatrix} = \begin{bmatrix} 5,0982 \\ 5,0982 \\ 5,0982 \\ 5,0982 \\ 5,0982 \end{bmatrix}$$

The result vector's rows summed and divided by numbers or rows in order to calculate λmax.

$\lambda max = (5,0982+5,0982+5,0982+5,0982+5,0982)/5$

$\lambda max=5,0982$

In order to calculate CI (consistency index) the following equation is used.

$$CI = (\lambda max - n)/(n - 1) \quad (6.8)$$

$$CI = (5{,}0982 - 5)/(5 - 1)$$

$$CI = 0{,}025$$

The Consistency Ratio is calculated as fallows

$$CR = CI/RI \quad \text{(For n=5, RI is give as 1,12)} \quad (6.9)$$

$$CR = 0{,}025/1{,}12 = 0{,}022$$

$0{,}022 < 0{,}10$ so the pair wise comparison matrix is consistent.

6.5.4 Location Selection for baby diaper manufacturing investment

After completion of the data by all decision givers; the software combines all judgments made by each person. It is possible to assign a weighing factor to one person over other; however, in this study all decision-givers have been taken at equal level. Therefore their judgments have been evaluated by equal weights. Table 6.4 lists detailed priorities for each factor and alternative.

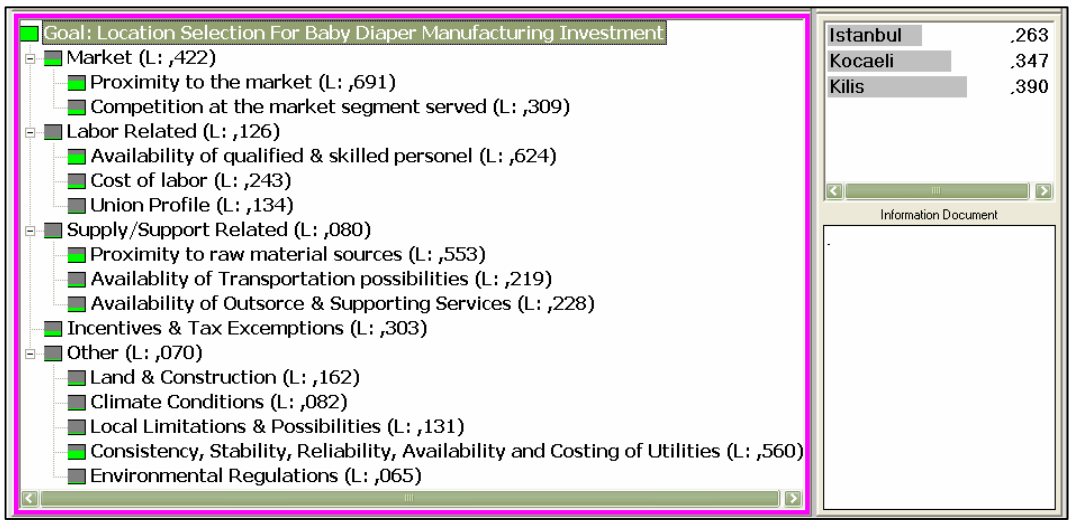


Figure 6.8 Combined judgments for location selection

Table 6.4 Priorities for each selection factor and alternative site

Level 1	Level 2	Alternatives	Priority
Market (L: ,422)	Proximity to the market (L: ,691)	Istanbul	0,106
Market (L: ,422)	Proximity to the market (L: ,691)	Kocaeli	0,153
Market (L: ,422)	Proximity to the market (L: ,691)	Kilis	0,084
Market (L: ,422)	Competition at the market segment served (L: ,309)	Istanbul	0,009
Market (L: ,422)	Competition at the market segment served (L: ,309)	Kocaeli	0,019
Market (L: ,422)	Competition at the market segment served (L: ,309)	Kilis	0,069
Labor Related (L: ,126)	Availability of qualified & skilled personel (L: ,624)	Istanbul	0,041
Labor Related (L: ,126)	Availability of qualified & skilled personel (L: ,624)	Kocaeli	0,041
Labor Related (L: ,126)	Availability of qualified & skilled personel (L: ,624)	Kilis	0,008
Labor Related (L: ,126)	Cost of labor (L: ,243)	Istanbul	0,003
Labor Related (L: ,126)	Cost of labor (L: ,243)	Kocaeli	0,006
Labor Related (L: ,126)	Cost of labor (L: ,243)	Kilis	0,016
Labor Related (L: ,126)	Union Profile (L: ,134)	Istanbul	0,001
Labor Related (L: ,126)	Union Profile (L: ,134)	Kocaeli	0,003
Labor Related (L: ,126)	Union Profile (L: ,134)	Kilis	0,009
Supply/Support Related (L: ,080)	Proximity to raw material sources (L: ,553)	Istanbul	0,023
Supply/Support Related (L: ,080)	Proximity to raw material sources (L: ,553)	Kocaeli	0,018
Supply/Support Related (L: ,080)	Proximity to raw material sources (L: ,553)	Kilis	0,011
Supply/Support Related (L: ,080)	Availablity of Transportation possibilities (L: ,219)	Istanbul	0,009
Supply/Support Related (L: ,080)	Availablity of Transportation possibilities (L: ,219)	Kocaeli	0,007
Supply/Support Related (L: ,080)	Availablity of Transportation possibilities (L: ,219)	Kilis	0,002
Supply/Support Related (L: ,080)	Availability of Outsorce & Supporting Services (L: ,228)	Istanbul	0,01
Supply/Support Related (L: ,080)	Availability of Outsorce & Supporting Services (L: ,228)	Kocaeli	0,005
Supply/Support Related (L: ,080)	Availability of Outsorce & Supporting Services (L: ,228)	Kilis	0,002
Incentives & Tax Exceptions (L: ,303)		Istanbul	0,032
Incentives & Tax Exceptions (L: ,303)		Kocaeli	0,071
Incentives & Tax Exceptions (L: ,303)		Kilis	0,159
Other (L: ,070)	Land & Construction (L: ,162)	Istanbul	0,001
Other (L: ,070)	Land & Construction (L: ,162)	Kocaeli	0,002
Other (L: ,070)	Land & Construction (L: ,162)	Kilis	0,006
Other (L: ,070)	Climate Conditions (L: ,082)	Istanbul	0,001
Other (L: ,070)	Climate Conditions (L: ,082)	Kocaeli	0,001
Other (L: ,070)	Climate Conditions (L: ,082)	Kilis	0,003
Other (L: ,070)	Local Limitations & Possibilities (L: ,131)	Istanbul	0,005
Other (L: ,070)	Local Limitations & Possibilities (L: ,131)	Kocaeli	0,002
Other (L: ,070)	Local Limitations & Possibilities (L: ,131)	Kilis	0,001
Other (L: ,070)	Consistency, Stability, Reliability and Costing of Utilities (L: ,560)	Istanbul	0,021
Other (L: ,070)	Consistency, Stability, Reliability and Costing of Utilities (L: ,560)	Kocaeli	0,017
Other (L: ,070)	Consistency, Stability, Reliability and Costing of Utilities (L: ,560)	Kilis	0,021
Other (L: ,070)	Environmental Regulations (L: ,065)	Istanbul	0,002
Other (L: ,070)	Environmental Regulations (L: ,065)	Kocaeli	0,002
Other (L: ,070)	Environmental Regulations (L: ,065)	Kilis	0,001

Figure 6.9 show the performance graph for the selection factors for all three alternatives. Even tough Kilis is not first preference for some of the selection criteria, at the end, the overall performance of Kilis ranks the first. Figure 6.10 is the outcome of the location selection problem. The software has analyzed the preferences with respect to the goal, selection of location for baby diaper manufacturing investment, and the results that the investment shall be located at Kilis. Istanbul, Kocaeli and Kilis has obtained 26,3%, 34,7% and 39% respectively. Values are obtained when all

data gathered from the members and are put in the software package as an input. The software make an analysis of all comparisons made and gives the outcome.

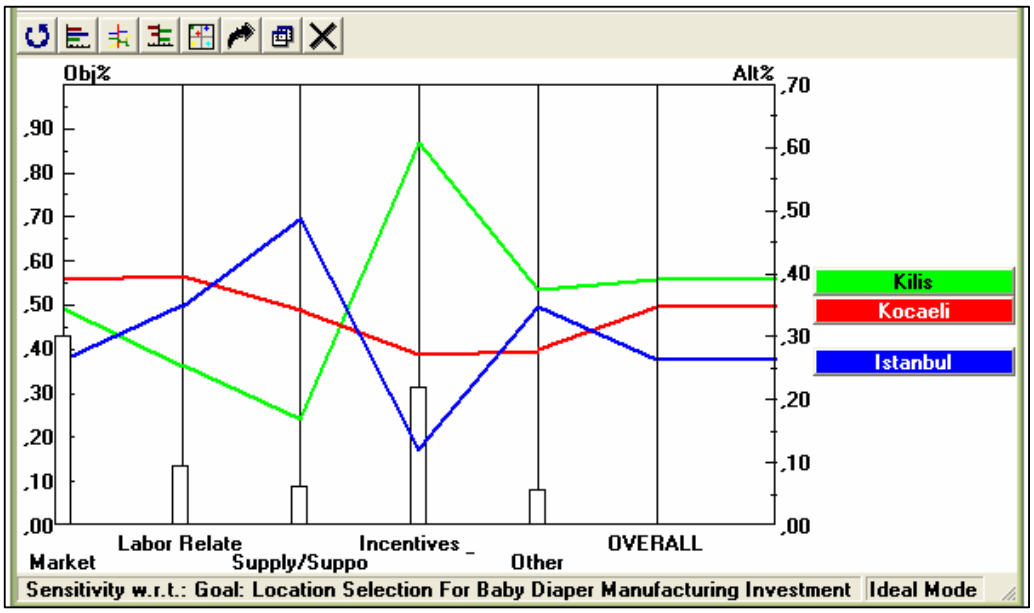


Figure 6.9 Performance graph for alternatives

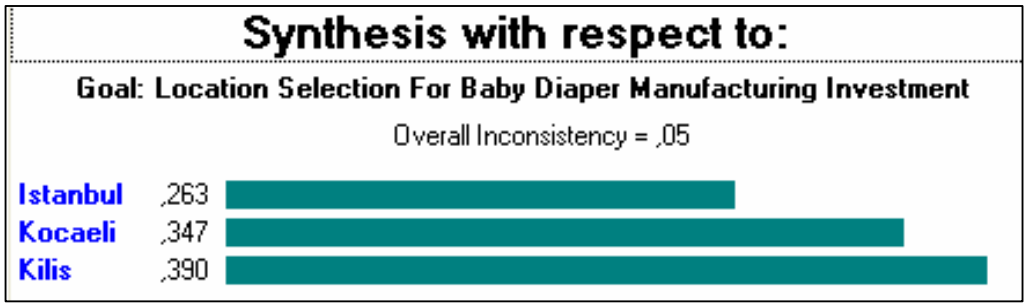


Figure 6.10 Synthesis of analysis with respect to goal

6.6 Conclusion

In this chapter a multi criteria, group decision model has been formed and the location selection problem has been solved by using an analytical hierarchy process (AHP) based software. As a part of the technical feasibility, the manufacturing investment has been decided to be located at one of the three alternative sites. It has been decided to consider Kilis as the facility location for this investment.

The proposed methodology should improve the location selection process and the quality of the decision given as it also allows consideration for multiple decision givers to express their personal preferences in selection process.

CHAPTER 7
TECHNICAL & OPERATIONAL FEASIBILITY: COSTING OF THE PRODUCT

7.1 Introduction

As a part of the technical feasibility, the cost of the product is calculated. The unit cost of a medium size diaper is taken as reference for calculation. The calculation include the cost of material, labor, depreciation, estimated direct production costs and estimated indirect costs. The aim of this chapter is both to make an outline of how the cost per unit can be calculated in the real life environment and to make a cost calculation and scenario to understand how much profit can be gained.

7.2 The Main Components of a Diaper

The main components of a diaper were explained in detail at Chapter 2. In this section the costs of the main components of a diaper will be calculated. In Figure 7.1 the average baby diaper composition can be seen. This graph represents the percents in terms of weight. Fluff pulp made out of wood and the super absorbent, a chemical composition, are used to absorb and hold the liquid. In recent years, especially due to the increasing SAP prices, the big players of the diaper industry started using treated cellulose together with regular fluff pulp to increase the liquid holding capacity of the diaper core. As it can be seen, these two are the two main components that makes the diapers weight. Polypropylene and polyethylene is used in production of topsheet, acquisition layer, leg cuff and backsheet.

Topsheet is the layer that is in contact with the baby skin. Acquisition layer is the layer right underneath the topsheet primarily aimed to distribute the liquid along with the diaper to increase performance of the absorbing layers. Leg cuff is a barrier fabric that has elastics attached to the sides so that it wraps the baby's leg and avoid the liquid to leak. Backsheet is the layer that is in touch with the mother's hand. It is the main carrier of the diaper components and is a barrier fabric to avoid leaks.

Backsheet can be made by using polyethylene only or a polyethylene layer laminated to a nonwoven layer forming a composite material. Elastics are used at the leg cuff areas for good fit. Adhesives are used to glue the elastics to the nonwoven layers or to laminate two layers to each other.

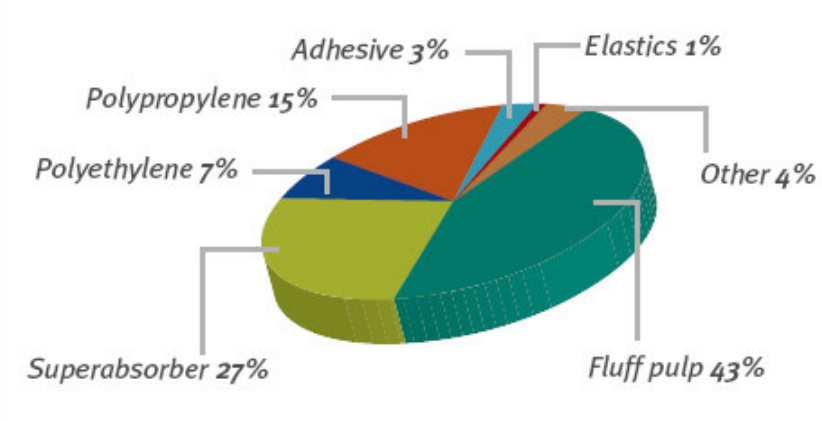


Figure 7.1 Average baby diaper composition [13]

Below, Table 7.1 provides an opinion towards the weight of the materials used per each diaper. The below table shows data only for the product of the first two biggest players of the diaper industry: Proctor & Gamble and Kimberly Clark Corp.

Table 7.1 Indication of the relative amounts of the principal components used in baby diapers (in grams) [102]

Diaper Type	Product Weight	SAP Weight	Fluff Pulp Weight	Treated Cellulose	Other Components
Pampers Baby dry (P&G)	44,0	11,7	10,3	4,7	16,0
Pampers Premium (P&G)	48,0	13,2	10,7	4,8	20,1
Pampers Sensitive (P&G)	44,0	13,1	11,1	5,5	14,3
Huggies Freedom (KC)	50,0	14,0	19,4	---	16,9
Huggies Adventures (KC)	57,0	17,3	17,9	---	16,4
Huggies Air Dry Baby (KC)	50,0	12,4	22,2	---	15,5

This table shows only the usage of materials used at the core of a diaper. Since these are the top performance diaper brands of the industry, they provide the best absorbency and dryness. An average diaper uses relatively less core material which allows them to offer lower price diapers.

7.3 Material Costing of a Diaper

A diaper consists of several materials that require a very good supply chain management. The main components of a diaper explained above forms the main cost elements. Below, Table7.2 shows these cost elements, their usage per a medium size diaper and unit material cost of a diaper. Calculation details are provided below.

Table 7.2 Material costing of a baby diaper

Cost Element	Use per Diaper	Estimated Market Price	Specs	Cost of material per Diaper	Cost percent of Materials Used	Reference Prices	Potential Vendors
Fluff pulp	21 g	680 USD /mton	N/A	0,0143	28,8%	680usd/ton [77]	Lenzing, SCA Forest Products.
Textile Backsheet, SMS. (Laminated film or polyethylene film can be alternative)	0,13 m2	2,7 USD / kg	20 g/m^2	0,0066	13,4%	2,50-2,65 usd/kg [77]	Gulsan, General Nonwovens, Pegas, Dunour, Avgol.
Topsheet (SS or SSS spunbond, or thermobond. hydrophilic surfactant treated)	0,1 m2	2,5 USD / kg	15 g/m^2	0,0038	7,6%	2,30-2,50 usd/kg [77]	Gulsan, General Nonwovens, Telasis, Pegas, Dunour, Avgol.
Leg Cuff Materiial (SMS nonwoven)	0,03 m2	2,7 USD / kg	20 g/m^2	0,00159	3,2%	2,50-2,65 usd/kg [77]	Gulsan, Pegas, Dunour, Avgol.
Acquisition Layer Material (High loft nonwoven)	0,04 m2	2,6 USD / kg	20 g/m^2	0,00182	3,7%	2,45-2,60 usd/kg [77]	Freudenberg, Lyocell, Telasis, Tradegar.
Elastics & Lycra	0,13 g	5,50 USD / kg	N/A	0,00069	1,4%	5,50 USD/kg lycra (price 10/2005)	Dupont, Freudenberg, Radici Spandex.
Frontal Tape	0,25 lm	2,00 USD / kg	45 g/m^2	0,00068	1,4%	25-50g/m2, 3cm width (market price)	Bento, 3M, Ko-Asia.
Super Absorbant Product (SAP)	7 g	2,35 USD / kg	N/A	0,01645	33,2%	2-2,35 usd/kg [77]	Amcol, Atafia, BASF, Bayer, Dow Chemical, Degussa, Lysac.
Glue (Hot Melt Application)	1,2 g	3,10 USD / kg	N/A	0,00372	7,50%	2,90-3,10 USD/kg (market price)	Bayer, Cognis.
			Total:	0,04960	100,0%		
			Unit Cost : (USD)	**0,05456**	(10% due to loss on material, due to efficiency, quality, set-up costs added)		

The usage per diaper shows approximate usage of that material in a medium size diaper. The source of information in this respect depends on the baby diapers that has been purchased from a supermarket and with analyze of each component. Material price shows the price that has been taken into consideration in the cost calculations. . The prices used in calculations are based on the bi-weekly published market data report. Some of them have been obtained from the manager of a diaper producer and also sole distributor of the material. Specifications are shown to define the type or performance value of that specific cost element. The usage information has been obtained from the samples and by interviews made. The table also shows the cost per diaper for each cost element as well as the percent over the total cost of the diaper. At the last column, the potential supplier of each element has also been provided. As seen on the table, most of the components of a diaper can easily be obtained from Turkey. However for the super absorbent material and high quality fluff pulp are the two major materials that still needed to be imported.

Table 7.2 gives the basic calculation elements of the diaper. The average usage per diaper calculated by the price gives the cost of that component in the diaper. These costs are then sum together to forming the material cost of a medium size diaper. A 10% increase has been added to the material cost of the diaper due to the loss of material, efficiency losses, and loss due to quality control and machine set-ups

7.4 Costing of a Diaper

Costing of a baby diaper is a difficult task. Because there are several variables and the projections made, may not fit to real life environments. It is the aim of this section to make a cost calculation as close as possible to real life production. To make calculations, there should be some assumptions made. To be able to make a cost calculation, the following factors has been defined: Production capacity, labor required to run the system, first investments costs, production costs, cost of packing material, transportation, purchasing and handling cost, cost of sales, marketing and promotion and other general expenses.

7.4.1 Production capacity

In addition to the material cost; the diaper carries other cost components that forms the overall cost of a diaper production. To calculate these values a scenario

production capacity has been identified. The diaper production capacity of the line selected is 500 diapers per minute. However this is the maximum output of the machine defined for small size diapers. The calculations made on this study base on a medium size product that has medium complexity. The capacity for this product ranges 350 to 400 diapers per minute. For calculation purposes; some certain figures has to be defined or assumed. The input of a diaper producer was taken as reference in making these assumptions and determinations. The capacity value has been taken as 380 diapers per minute. The efficiency has been taken as 85%. Working hours per day is 24 hours by 3 shifts running. However effective running of the line per day has been taken as 22 ½ hours given the fact that the machine has to stop for set-ups, size changes, cleaning, raw material feeding, roll changes, maintenance and similar purposes. When calculation is made according to these figures; the line reaches about 12 million diapers per month. Below Table7.3 gives shows the values taken for calculation of capacity.

Table 7.3 Capacity calculation of the baby diaper machine (for medium size diapers)

Capacity Calculation		
Production Capacity for medium size diaper production: (Installed Capacity of the machine:500 pieces/min)	380	pcs/min
Given Efficiency of the machine :	85%	%
Working days used for calculation :	330	days
Shift running the machine: (Covering 24 hours a day and 7 days a week)	3	shifts
Effective running hours per day :	22,5	hours
Annual Capacity	143.896.500	diapers/year
Monthly Capacity	11.991.375	diapers/month

7.4.2 Labor cost

The costing of labor in diaper production is also essential. This can be calculated based on the capacity figures obtained above. For a machinery with a capacity of 300 to 600 machine; there is a considerable amount of person is required to be able to run the system 24 hours continuously. One of the most important factors affecting the number of people required to run a diaper line has to do with the count on the package and weather or not automatic packaging equipment is used. The diaper

machinery will need 2 operators and 1 helper. For example, if manual packing is chosen; for a 20 count bag and running at 400 diapers per minute, two people just for stacking the diapers into the bag and sealing is required. A person to stack the sealed bags into the box, or an automatic case sealer is also needed. Depending on the number of bags inside the box; two people to do this job. It shall be considered to have some extra staff to be able to operate continuously without a stop during the lunch break. A typical machine with manual packaging will need about 8 people per shift; if automatic packaging is used, the need would be only about 5 per shift. All these people are just for the direct labor in-line, it is necessary to have more people to run the laboratory, the diaper inspections, the spare parts room, the instrumentation, the finished products warehouse, the raw material warehouse, in addition to the entire engineering infrastructure required to run an efficient factory. A typical diaper factory running only one diaper machine at 300 to 600 diapers per minute and three shifts per week (full capacity) with manual packaging and using a typical count of 20 diapers per bag, will require about 50 people [103].

Taking all these into consideration; together with the input of a diaper producer, the below table is formed. It shows the number of people that has been defined to run the baby diaper production plant smoothly.

Table 7.4 Personnel required running the diaper production line smoothly

Human Resources	**Number of Personnel**
1 General Manager	1
1 plant manager works day time	1
1 engineer works day time	1
1 chief of production X 3shifts	3
5 operator X 3shifts.(automatic packing)	15
1 lab technician X 3 shifts	3
1 Raw Material and finished product warehouse X 3 shifts	3
1 Mechanic for set-up & maintenance	1
1 sales manager and 1 sales assistant	2
1 assistant works day time	1
2 drivers work throughout the day	2
1 Accountant	1
Total :	**34**

Therefore for a smooth operation; 30 to 40 people shall be considered. The average total cost of personnel to a company has been taken as 1200 USD. This leads about

41.000 USD/month direct and indirect labor cost. Table 7.5 shows the basic calculation steps.

Table 7.5 Labor cost in diaper production.

Direct-Indirect Labor Cost		
Number of Employees (30 - 40 persons to be considered)	34	persons
The average total cost per person per month for a company employing a similar human resources:	1200	USD/ month/ person,average
Expected cost of labor/month including direct and indirect human resources	**40.800**	USD/month

7.4.3 First investment cost

The costs that are considered are basically the costs that fall under the calculation of amortization and depreciation. The cost of the machinery including its ancillary and auxiliary equipment, cost of the land and building in the selected location, Kilis is considered to be the first investment cost. In addition to these; the cost of installation and start-up, cost of furniture and fixtures has been taken into consideration. These are the values that depend on the investment made; however, to be bale to make a close cost calculation to real life environment these values has to be defined. The cost of the machinery, packing equipment and ancillary equipment has been obtained from the machinery builder that has been selected in Chapter 5. The cost of the land and the building providing 2000m^2 under roof; has been obtained from a company who has a similar size plant at Kilis. The size is from the recommendations of the machinery supplier as well. The cost of the forklift truck and the mini van for personnel service has been obtained from Gaziantep agent of the respective companies. Table 7.6 shows these figures.

Due to the technological advancements and improvements on both product design and machine design there will be an economical life for the equipment purchased. After certain point, production on the line would not be feasible. In general accounting principals this is taken as 10 years. By taking all these into consideration the economic life cycle of the machinery has been taken as 10 years. Therefore; the cost of amortization and depreciation would be calculated by dividing the total given on Table 7.6 by 10 years. And the cost per diaper can be calculated by dividing the annual cost by the projected number of production per year.

Table 7.6 First investment costs

First Investment Costs	Cost (USD)
Baby Diaper manufacturing equipment	650.000
Diaper packing equipment	200.000
Auxilary and ancillary equipment	85.000
Cost of land and building (in Kilis)	180.000
Forklift truck and a personnel service van	75.000
Other expenditures	85.000
Cost of Installation and start-up.	50.000
Total Cost (USD)	**1.325.000**

7.4.4 Production costs

The calculation of direct production costs includes the cost of labor, energy, set-up and maintenance. Labor cost has been calculated together with indirect labor costs; therefore, in this section the rest of the costs will be determined. The cost of the material will also be excluded because it has been studied as a separate costing element. To determine the energy cost; the machinery supplier has been asked to give a value of energy consumption. The line has an installed power capacity of 150 kW/h. With the addition of auxiliary and ancillary equipment; it has been decided to take the energy consumption as 200 kW/h. The installed power multiplied with 22.5 hours run time per day at an energy cost of 0,08USD/kW energy cost in industrial zone of Turkey gives a value of 10.000 USD/month.

The maintenance, set-up cost includes the cost of maintaining the line in operation in good conditions. Especially, the cost of the knives and sharpening them and time required to change the dull blades is both time consuming and costly. Knowing that only a sharpening job is done at a cost of about 500USD per each knife; the monthly cost of this purpose has been assumed to be 7.000USD. These values as has been shown in Table 7.7

Table 7.7 Production costs (excluding material and labor costs)

Production Costs		
Energy	10000	USD/month
Maintenance, set-up, size change	7000	USD/month
Total Cost	**17000**	**USD/month**

7.4.5 Other costs

Apart from the costs calculated above; there would be additional costs. For example cost of packing material, transportation, purchasing and procurement, cost of marketing, sales and promotion and other overhead and general expenses. It is difficult to forecast costs however to have the cost per unit as close as possible to the real cost; these cost elements has to be defined. The cost of packing material is directly related with the packing size of the diapers and how they are shipped to customer. The cost of transportation shall include the cost of incoming material and the cost of shipments to the customer. Cost of sales, marketing depends on the sales and marketing activities made. Also promotion is a necessary factor for consumers to try something new as well as to encourage the traders or super markets to sell the baby diaper brand produced. Apart form the costs that have been taken into consideration; there would be some overhead costs and expenses that are small in size but makes a total at the end of the month, so called general expenses. Table 7.8 provides the values that have been assumed and taken into cost calculations for the above mentioned cost elements.

Table 7.8 Major expenses necessary to be taken into account in diaper costing

Other Major Expenses	**Total Cost**	
Cost of packing material, transportation, purchasing & handling, customs…etc	30.000	USD/month
Cost of sales, marketing and promotion	25.000	USD/month
Other general expenses	10.000	USD/month

7.5 Cost Calculation of Diaper Production

By taking all of the cost elements and using the capacity figure given at Table 7.3, cost of a medium size single diaper can be calculated. The calculation details have been provided at below Table 7.4. According to this calculation the cost per diaper is 0,06572 USD. As it can be seen from the Figure 7.2, the biggest share of the cost is the material cost.

Table 7.9 Cost calculation of a medium size diaper

Cost Elements	USD/month	USD/diaper	Percents
Cost of the material only	654.216	0,05456	83%
Labor	40.800	0,00340	5%
Depreciation & amortization	11.042	0,00092	1%
Cost of production (others)	17000	0,00142	2%
Cost of packing material, transportation, purchasing & handling…etc	30.000	0,00250	4%
Cost of sales marketing and promotion	25.000	0,00208	3%
Other general expenses	10.000	0,00083	1%
Total Cost:	**909.516**	**0,06572**	**USD/diaper**

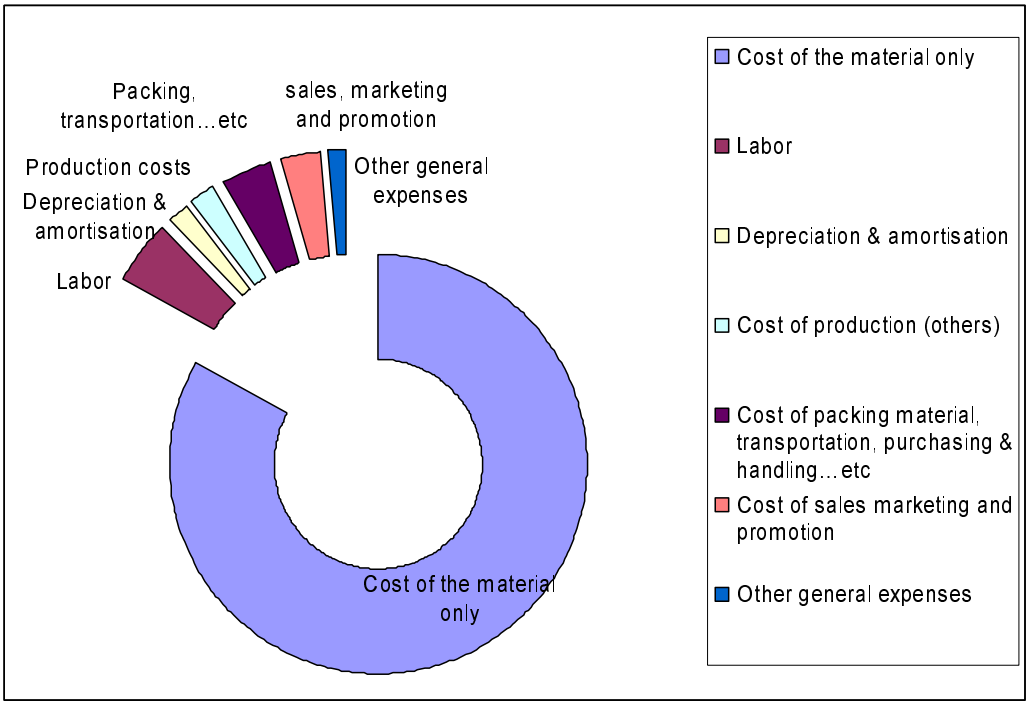


Figure 7.2 Cost elements and costing of a diaper

The purchasing consumer is unlikely to pay a higher price for basically the same product, so the only really tenable routes to improve the profitability positions are reducing material and production costs and making a major improvement in product performance at no added cost. And preferably do both at the same time. One way of reducing the material costs would be to reduce the weight of the diaper further.

7.6 Conclusion

In this chapter, the cost contribution elements of a baby diaper have been studied. As a part of the study, a medium size diaper has been selected to be a reference point and do all calculations according to this specific size. Materials used at a diaper have been studied and a material cost has been obtained by using an approximate consumption of each component and their respective market price. A capacity has been defined for the reference size and all calculations based on this capacity value.

For this scenario, the labor requirement, first investment costs, cost of production, marketing, sales, promotion and other overhead and general expenses has been defined and a cost per a single diaper calculated. From now on, depending on these calculations a scenario can be built and an economic analysis can be done.

CHAPTER 8
FINANCIAL FEASIBILTY

8.1 Introduction

In this chapter, all information gathered in previous segments would be channeled and used as input to assess the viability and the profitability of the new venture. Evaluation of all variable and fixed costs will be necessary to predict the profitability of the proposed venture. This step may require very detailed planning to get accurate values. Accuracy will depend on the reliability of the marketing predictions and production information. The sales price and cost of the diaper will be used to calculate the profit before tax. A scenario will be built and according to this scenario, most common economic feasibility analysis methods will be used. A 3 year production and sales forecast will be made. According to this forecast; a break even analysis, a payback analysis, a cash flow schedule, a return-on-investment analysis will be done.

8.2 Feasibility Assessment

Determining the feasibility of a business opportunity is the process of discovering whether a business idea is likely to succeed. To manage risks related to innovation investments that extend long into the future, managers must be willing to look ahead and consider uncertainties. It is a formal or informal process whereby it can be determined whether to proceed with, alter, or drop a plan of action. There is no right or wrong answers in feasibility study - only informed evidence that an idea will succeed or fail. In other words, it will answer the question that most business managers have in mind: Will the return generated from this new venture justifies the investment?

8.2.1 Scenario analysis and scenario planning

Scenario analysis is a process of analyzing possible future events by considering alternative possible outcomes (scenarios). The analysis is designed to allow improved decision-making by allowing more complete consideration of outcomes and their implications. It often employs “what if?” analysis in order to make better decisions, given the uncertain future. Scenario analysis involves looking at different outcomes for returns along with their associated probabilities of occurrence. Scenario planning is the process in which managers invent and then consider, in depth, several varied scenarios of equally plausible futures with the objective to bring forward surprises and unexpected leaps of understanding. These scenarios represent a tool for ordering the perceptions of a management team. The point is not to select one preferred future and hope for it to become true. Nor is the point to fund the most probable future and adapt to it. Rather, the point is to make strategic decisions that will be sound for all plausible futures. No matter what future takes place, a company and its management team is much more likely to be ready for it and influential in it, if it has seriously thought about scenarios. Scenario planning is about making choices today with an understanding of how they might turn out. Sales projections and forecasts is a part of a scenario planning [104].

8.2.2 Breakeven analysis

Breakeven analysis is defined as the amount of sales required in order to break even (revenues equal costs). It is important to establish breakeven point prior to proceeding too far into developing the business. It is suggested using the breakeven analysis only to estimate the minimum required sales volume and evaluate if they are achievable or not. If it appears the breakeven volume is not achievable, the new venture idea has limited potential for success and should not be pursued. Breakeven Point is calculated by using the below formulation [105].

$$Breakeven = fixed\ costs + depreciation / priceperunit - variable\ costperunit \qquad (8.1)$$

8.2.3 Payback period

This financial metric answers the question: "When does the action pay for itself?" That is, "When do the cumulative inflows equal the cumulative outflows?"

Payback period is a measure of time, usually given in decimal years, such as "Payback = 4.2 yrs." (or decimal months, or weeks). Other things being equal, the investment or action with the shorter payback is the better option. Payback is sometimes viewed as a measure of risk: the longer the payback, the higher the risk [106]. Also, payback periods are sometimes used as a way of comparing alternative investments with respect to risk: other things being equal, the investment with the shorter payback period is considered less risky.

As an example [107], consider a $150 software purchase that is expected to improve productivity valued at $60 per year for the next three years: Payback obviously occurs in Year 3, but where, precisely? The “formula” for payback period is a little cluttered, but it should be simple to follow. Table 8.1 shows the example. It should be noted that Year 3 is the final payback year.

Table 8.1 Example for calculating payback period

	Paid Out	Paid Back	Total Paid Back
Year 1	$100	$60	$60
Year 2	-	$60	$120
Year 3	-	$60	$180

Payback Period = 2 + ($150 - $120) / ($180 - $120)
Payback Period = 2 + 30/60 = 2.5 Years

8.2.4 Cash flow planning

When planning the short- or long-term funding requirements of a business, it is more important to forecast the likely cash requirements than to project profitability etc. Whilst profit, the difference between sales and costs within a specified period, is a vital indicator of the performance of a business, the generation of a profit does not necessarily guarantee its development, or even the survival.

Normally, the main sources of cash inflows to a business are receipts from sales, increases in bank loans, proceeds of share issues and asset disposals, and other income such as interest earned. Cash outflows include payments to suppliers and

staff, capital and interest repayments for loans, dividends, taxation and capital expenditure.

Net cash flow is the difference between the inflows and outflows within a given period. A projected cumulative positive net cash flow over several periods highlights the capacity of a business to generate surplus cash and, conversely, a cumulative negative cash flow indicates the amount of additional cash required to sustain the business.

Cash flow planning entails forecasting and tabulating all significant cash inflows relating to sales, new loans, interest received etc. and then analyzing in detail the timing of expected payments relating to suppliers, wages, other expenses, capital expenditure, loan repayments, dividends, tax, interest payments etc. The difference between the cash in- and out-flows within a given period indicates the net cash flow. When this net cash flow is added to or subtracted from opening bank balances, any likely short-term bank funding requirements can be ascertained [108].

Cash flow is defined as net dollars generated by the company's assets. It involves three components: Operating Cash Flow, Capital Expenditure, and addition to Net Working Capital (NWC). These can briefly be explained as follows:

"Operating Cash Flow" consists of net income and interest paid and the depreciation.

"Capital Expenditure" means money spent on fixed assets less money received from the sales of fixed assets. In other words, it is the ending fixed assets balance minus beginning fixed assets balance plus assets depreciation.

"Addition to NWC": NWC is defined as current assets less current liabilities. In this study only yearly change in NWC is interested.

By taking these into consideration the cash flow is can be calculated according to below formulation [105].

$$CashFlow = OperatingCashFlow - CapitalExpenditure - additiontoNWC \quad (8.2)$$

8.2.5 Net present value (NPV)

The NPV is the recommended approach to evaluate the financial decision to either consider or dismiss an investment. The NPV is defined as the value creation through the process of investment. It is the difference between the investment costs and the future cash flows that are going to be generated as a direct result of that investment. How much value has been created?

Below is the formula for calculating Net Present Value (NPV).

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_0 \tag{8.3}$$

Co: Investment cost
C_t: Cash flow at period t
T: Number of periods (years)
r: interest rate or discount rate

The difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyze the profitability of an investment or project. NPV analysis is sensitive to the reliability of future cash inflows that an investment or project will yield.

The investment project should be accepted if NPV is positive and rejected if NPV is negative. It should be indifferent to an investment project for which the NPV is nil, as the cost of the project equals the generated cash flow. No value has been created nor destroyed. Remember, when comparing several projects; always the one with highest NPV shall be chosen [105].

8.2.6 Rate of return, return on investment (ROI)

The required rate of return is defined as the minimum rate of return required by an investor in order to devote its assets (money) to an investment project. The required rate of return is estimation. It is a combination of investor's risk tolerance, cost of capital, opportunity cost and market circumstances. For example stock exchange

indexes can be used as a guide to estimate the required rate of return. It is suggested to use the weighted average cost of debt and equity. For example, assuming that company ABC acquired 70 percent and 30 percent of its debt at interest rates of 12 percent and 17 percent respectively, then the weighted average cost of debt is (0.70 x 0.12) + (0.3 x 0.17) = 13.5 percent.

Return on Investment (ROI) is a financial metric that answers the question: “How do the expected returns from an investment compare to the costs. ROI asks for a statement in relative terms; a ratio or percentage. Other things being equal, the investment with higher ROI is the better option [106].

8.2.7 Internal rate of return (IRR)

Three IRR definitions are given below. All really say the same thing:

1. “The IRR for an investment is the discount rate for which the total present value of future cash flows equals the cost of the investment."

2. "The IRR for an investment is the discount rate that produces a 0 NPV for the projected cash flow stream."

3. "IRR answers this question: How high do interest rates have to climb (the discount rate for NPV calculations) in order for the present Value (PV) of gains to just cover the PV of costs?

The answer in each case is an interest rate; the higher the interest rate (that is, the higher the IRR), the more robust the investment and the better the returns compare to the costs.

8.2.8 Sensitivity analysis

There may have doubts about the validity of the net income values calculated on the income statement. If you had trouble obtaining good data or are unsure of important projections; to measure the impact that changes in any factor (yields, prices, sales, etc.) will have on net income, a sensitivity analysis of the data shall be performed. It may be identified one factor that, if changed from the expected value, affects profitability the most. A sensitivity analysis will increase the confidence in

profitability projections. It is suggested to select at least three different values for these factors; a most likely to happen value, an optimistic value and a worst-case value. To complete the analysis, net income is recalculated. This analysis can be done quite easily with a computer and a spreadsheet software program. When the sensitivity analysis is complete, the revised income statement shall be evaluated [109].

8.3 Baby Diaper Production by Figures

This section is to make a calculation based on the full capacity for a medium size baby diaper production. The capacity, cost and sales price that will be considered is same as it has been defined at previous chapters. These were summarized at Table 7.3, Table 7.9 and Table 4.17.

Table 8.2 Annual profit capability assuming a full time run year-around.

Sales Price	0,0729167	USD/diaper
Cost	0,0657187	USD/diaper
Capacity (medium size)	11.991.375	Diapers/month
Profit	0,0071979	USD/diaper
Monthly profit	86.313	USD/month
Annual profit (theoretical)	1.035.756	USD/year

According to the figures given at the above Table 8.2, the line is almost paying its first investment cost in one year. However, this figure can only be correct that; the line runs continuously, the same single product with perfect supply chain management. In addition to this; looking form the sales side of the business, as a new comer, the company will be start selling their products in the first day it started production. This cannot be correct in real-life environments. To overcome this un-realistic situation; it has been decided to make a multi-year production and sales projection.

Below table show the costs occurred during starting from the phase of feasibility analysis to the end of installation and start-up of the machineries. These are the costs that are incurred before the plant gets in to production. These costs include the machinery cost, auxiliary and ancillary equipment cost, cost of the land and building,

cost of vehicles and cost of installation and start-up. Another cost element, so called other expenses, includes the cost of the feasibility analysis, cost of the transportation of the machineries and their customs clearance procedures, unexpected costs, tools necessary for installation. It also includes the cost of labor that are hired a smooth and successful start-up. The details of the explanations for each cost element were provided in Chapter 7, were the cost of a baby diaper is calculated. It is advised to refer Chapter 7 for any further details required.

Table 8.3 Fixed, first investment costs

Project Costing	**USD**
Baby diaper production machinery	650.000,-
Baby diaper automatic packing equipment	200.000,-
Auxiliary and ancillary equipment	85.000,-
Cost of the land and construction in Kilis. (2000m2)	180.000,-
Forklift truck and a personnel service van	75.000,-
Other expenditures (project analysis, equipment transportation and insurance, customs clearance and importation costs, unexpected costs, tools for installation)	85.000,-
Cost of Installation and start-up	50.000
Total :	**1.325.000,- USD**

8.4 A Sales Scenario and Feasibility Assessment.

Directing the investors with the profit projection at Table 8.2, would cause a big fail. Therefore it has been decided to make a 3-year production and sales projection and base all the financial assessments according to this specific case.

8.4.1 Calculation of break even point

To be able to make a breakeven analysis; the projected fixed and variable operating costs have to be identified. Fixed costs are the costs that remain constant regardless of the number of sales. Variable costs vary depending upon the volume of production and sales. Of course, to be able to make a projection, there should be some assumptions to be made. This case study makes the following assumptions:

Total fixed costs to include 100% of labor, all depreciation costs, 25% of the costs calculated under packing, transportation, purchasing and handling costs. In addition to this, 75% of marketing and sales costs and 90% of the general expenses has been taken to form the fixed costs.

Variable costs to include; cost of the material, cost of production and 75% of the packing material, transportation purchasing and handling costs, 25 % of the marketing and sales cost and finally 10% of other general expenses.

By taking these into consideration a break-even analysis is done. As seen on Table 8.4, the company has to produce 6 million diapers per month to be able to cover its expenses. Breakeven is calculated by fixed costs including depreciation divided by the difference between price per unit and variable costs per unit.

Table 8.4 Break-even analysis

Breakeven Analysis		
Total fixed costs =	87.092	USD/month
Variable Costs =	0,05846	USD/diaper
Sales Price =	0,07292	USD/diaper
Break Even =	6.022.611	pieces/month

8.4.2 A scenario of 3 years sales and production projection.

The projected net profit or loss is calculated as follows:

$$Net\,\mathrm{Pr}ofit/Loss = \mathrm{Pr}ojectedSales - CostofGoodsSold - Sales,General\,\&$$

$$Ad\,\mathrm{min}istrativeCosts + OtherIncomeorLoss - Taxes \quad (8.4)$$

In addition to the assumptions made for the calculation of variable and fixed cost; there will be a start-up phase of the business both in terms of production and also marketing. So that the capacity will relatively be smaller in the beginning and it will increase progressively. So an average monthly sale of 8.5 million diapers for the first year; 10,5million for the second year and 13 million diapers for the third year has been projected. In addition to this; it has been projected that after entering to business, the company would have chance to increase its average sales prices by 5%

at the first year and %8 at the second year. (About 2.3% increase between year 2 and 3). It has been foreseen that; with the increase in sales; there would be increase in the fixed costs as well. This has been reflected as 10% increase on fixed costs for the second year and 18% increase for the third year. (About 7% increase between year 2 and 3). It has been assumed that the there would be an increase in the raw material prices as well. This has been taken as 3% increase for the second year and 5% increase for the third year. (About 2% increase between year 2 and 3). The cost of amortization is fixed for all three years and it is one tenth of the total first investment costs. Since the location selected, Kilis, is under at investment incentive region, the company will be exempt from tax during the projected 3 year period. When the calculation is done net incomes for 3 years is obtained. It should be noted that even tough the economical life time is 10 years, the projection is mode only for 3 years. Another point that should be kept in mind is that this scenario and following analysis is made under certain conditions. Results have been given at below Table 8.5 According to this projection; the company would make an approximate net profit of 0.5 million in year-1, 1 million in year-2 and 1.5 million in year-3. It should be noted that the investment period, by the time feasibility starts to the start-up of the machine, is taken as 1 year.

Table 8.5 3-year production and sales projection

3 –Year Projection			
	Year 1	**Year 2**	**Year 3**
Price per unit	0,07292	0,07656	0,07875
Unit Sales (month)	8.500.000	10.500.000	13.000.000
Revenues (month)	619.792	803.906	1.023.750
Fixed Costs (per month)	-76.050	-83.655	-89.739
Variable Costs per unit	-0,05846	-0,06021	-0,06138
Depreciation (month)	-11.042	-11.042	-11.042
Taxes (tax incentive)	0	0	0
NET INCOME (month)	35.825	77.009	125.046
NET INCOME (year)	429.900	924.110	1.500.558

8.4.3 Operating Term Costs

Another view of the above provided table is the operation term expenses. Below table shows the expenses incurred during the projected 3 year period. The assumptions made in forming the below table were described in the previous section.

Together with them, the following assumptions and determinations are made as a part of developing the business scenario. The figures are obtained from Chapter 7. The raw material cost is increased 3% in the 2nd year and 5% in the 3rd year. The ancillary raw materials are directly related with the production capacity. The energy cost has USD 20.000,- fixed and the rest are assigned depending on the production capacity. Similarly the maintenance cost has USD 40.000,- fixed and rest distributed according to the capacity. The labor cost has %5 increase in the 2nd year and 12% increase in the 3rd year. It has been assumed that there would be USD 20.000,- per year increase on the general expenses. While the cost of depreciation and amortization is fixed for each year, the cost of sales increases with the products sold. As it has been defined previously the sales price also increases each year. 2nd year an addition of 5%, and 3rd year an addition of 8% is foreseen. The following tables has been formed according to the assumptions above and the scenario built.

Table 8.6: Projected operating term costs

	Year 1	**Year 2**	**Year 3**
Raw materials	5.565.120	7.080.797	8.936.928
Ancillary raw materials	286.875	354.375	438.750
Energy	99.688	118.438	141.875
Labor	489.600	514.080	548.352
Maintenance	75.063	83.313	93.625
General Expenses	100.000	120.000	140.000
Amortisation	132.500	132.500	132.500
Cost of sales and marketing	259.092	318.945	352.410
Yearly operating expenses total (USD)	7.007.937	8.722.447	10.784.440

Table 8.7: Projected term income table

	Year 1	Year 2	Year 3
Unit sold per year	102.000.000	126.000.000	156.000.000
Unit sales price (USD/diaper)	0,07292	0,07656	0,07875
Yearly Income (USD)	7.437.840	9.646.560	12.285.000
Yearly Operating Expenses	7.007.937	8.722.447	10.784.440
Net Income (USD/month)	35.825	77.009	125.047
Net Income (USD/year)	429.903	924.113	1.500.560

8.4.4 Payback analysis

Payback analysis shows when the baby diaper production investment would pay for itself. The amount payable has been taken as USD 1.325.000,- and a calculation has been made. It has been calculated as follows.

Table 8.8 Payback analysis according to 3-year projection

Payback Analysis	1.325.000	first investment cost
	1.6	Years (in decimals)
	20	months

8.4.5 Cash flow schedule

According to the 3-year projection made; below a cash flow schedule has been prepared. To be able to make the cash flow schedule it has been assumed that at the beginning, company requires a $250,000 injection of working capital (WC). Subsequently, working capital would be about 15 % of sales. Table shows the operating sash flows, networking capitals and the capital spending for the first 3 years. It should be noted that, the investment is considered to be made from the company capital. In case a loan would be involved, the principal payments and interests shall also be included in the cash flow schedule. Another point is that since the location for the investment is in Kilis and this city is in the governmental investment incentive region. Therefore, as it can bee seen from below table there is

no taxes discounted from the net income. Below table shows the cash flow schedule of the company for the projected years.

Table 8.9 Cash flow schedule

Cash Flow Schedule				
	Year 0	**Year 1**	**Year 2**	**Year 3**
	I - Operating Cash Flow			
Net Income		429.900	924.110	1.500.558
Depreciation		132.500	132.500	132.500
Operating Cash Flow		562.400	1.056.610	1.633.058
	II –Working Capital (WC)			
Working Capital	-250.000	92.969	120.586	153.563
Working Capital Recovery				
Addition to working Capital	-250.000	-92.969	-120.586	-153.563
	III – Capital Spending			
Capital Expenditure	-1.325.000			
	Year 0	**Year 1**	**Year 2**	**Year 3**
Total Cash Flow	**-1.575.000**	**469.431**	**936.024**	**1.479.495**

8.4.6 Calculation of net present value (NPV).

Net Present Value is defined as the value creation through the process of investment. To be able to calculate net present value; it has been assumed that the required rate of return by the investors is 20 %.

$$NPV = \left(469431 / (1+0.20) + 936024 / (1+0,20)^2 + 1479495 / (1+0,20)^3 \right) - 1575000$$

NPV = 189.398,39 USD

Since NPV is positive; the investment project should be accepted.

8.4.7 Calculation of internal rate of return

The IRR for an investment is the discount rate for which the total present value of future cash flows equals the cost of the investment.

Internal Rate of Return (IRR) is the discount rate that makes the NPV nil.

$$0 = \left(469431 \Big/ (1 + IRR) + 936024 \Big/ (1 + IRR)^2 + 1479495 \Big/ (1 + IRR)^3 \right) - 1575000$$

From the above equation; IRR is calculated to be 30.5 %.

8.4.7 Sensitivity analysis

To measure the impact of change of income, with the change on sales price and production and sales capacity a sensitivity analysis has been done. For sales price; the net income has been recalculated for a price sold 10% less in price as well as 10% more in price. As a similar way, the production and sales capacity has been decreased 20% and net income has been calculated. Also, it has been tested how the income figures would change if the company would find more business and produce 15% more diapers per year than the projected sales figures. The revised sales prices and production volumes has been provided at Table 8.10

Table 8.10 Sales prices and production capacities to be used for sensitivity analysis.

Sales Price	Projected Sales Price (USD/diaper)	0,07292	0,07656	0,07875
	10% less	0,06563	0,06891	0,07088
	10% more	0,08385	0,08805	0,09056
Capacity	Projected Capacity (diaper/month)	8.500.000	10.500.000	13.000.000
	20% less	6.800.000	8.400.000	10.400.000
	15% more	9.775.000	12.075.000	14.950.000

Once the calculations has been made; it has been find out that, if the company would fall in a position to sell the projected capacity at a price of 10% lower than the projected price; it would loose money in the first 2 years of the projected period. As expected with the increase at the sales price the profit showed an increase. 10% increase in the sales price almost doubled the average profit made in the projected period. All calculations are based on the projected production volumes.

With the sensitivity analysis made; by keeping the sales prices as it was originally projected, it has been observed that a 20 decrease in the production volume still gives positive numbers at the income statements. Table8.11 shows the changes of net income with the changes made as per sensitivity analysis.

Table 8.11 Sensitivity analysis

Sensitivity Analysis		**Net Incomes (USD/Year)**		
		Year 1	**Year 2**	**Year 3**
Projected Income		429.900	924.110	1.500.558
Sales Price	10% less	-313.850	-40.577	272.058
	10% more	1.173.650	1.888.798	2.729.058
Capacity	20% less	134.900	512.016	958.573
	15% more	651.150	1.233.181	1.907.047

As it can be seen from the table, the increase in sales price and capacity, as expected, increases the net income. More critical is when they are reduced. 20% reduction in production capacity costs about 70% reduction in projected income. This is due to increase in fixed costs rate in the overall cost. However, the income is still a positive number. When the sales price is reduced 10%, the income changes dramatically to a negative value which means it is a lost for the investor. Observing how 10% change affects the results, it should be reminded that a risk analysis should be done for real life investment analysis.

8.5 Conclusion

In this chapter, all information gathered in previous chapters has channeled and used as input to assess the viability and the profitability of the new venture. Financial and commercial analysis are made.. To take as reference figures to be able to make the necessary calculations for the economic feasibility study, a scenario has been made. According to this scenario, a 3-year production and sales forecast is made and most common economic feasibility analysis methods are used. To check the sensitivity of the outcomes with the changes in the 3-year projection, a sensitivity analysis has been made. It should be noted that, even tough obtaining the most accurate data which is most close to real life, the analysis is made under certain conditions and uncertainty shall be studied by making a risk analysis in real-life environments. Even tough the economic life cycle of the line is given for 10 years, the scenario built and the financial analysis is done for only 3 years. Therefore, it would be valuable to make a longer term analysis before making an investment. i.e. the machinery's junk price has not been taken in any account. According to the analysis made under certain conditions, it is concluded that the baby diaper investment is viable and profitable.

CONCLUSION

Modern disposable baby diapers and incontinence products have made an important contribution to the quality of life of millions of people. Disposable baby diapers have contributed to social progress in terms of quality of life, comfort, convenience and skin health benefits. They are healthier for the infant's skin because their usage results in reduced skin rash incidences, skin irritation and infections; Their softness, lightness and the breathable nature of some of the raw materials provide for superior comfort for the baby; they are easy to put on and remove, taking up less time, for example, than using cloth diapers; they are convenient because they eliminate the need for constant laundering, boiling and drying.

Disposable baby diapers have become the method of choice for nearly all families across Europe. There can be little doubt that the convenience of disposable diapers is a huge benefit in today's busy lifestyles where time is a precious asset. They lessen the burden of domestic chores, freeing parents to spend more time on other activities in their family, social or economic lives.

In summary, because of their health and performance benefits, diapers today best meet the needs and expectations of many consumers.

Feasibility analysis is the first step in planning a new enterprise and before spending money & time. So, feasibility studies save money and ensure that available funds go further. Making a feasibility analysis is a complex task and includes several decisions to be given. In most SME's and even the State Planning Organization of Prime Ministry are using intuitive methods and decisions in the studies. Especially, in SME's this may result that unintentionally one of the participants may dominate the others which potentially would cause failure of the project.

Feasibility analysis is used to determine probable success of a new business or project and it contains several decision making problems. The quality of a decision directly affects the quality of the feasibility study and the performance of the project.

Industrial Engineering deals with the solution of the problems that occur during the phases of planning, design, implementation and development in organizations and work to eliminate waste of time, money, materials, energy, and other commodities. Therefore involvement of an Industrial Engineer is necessary during the feasibility analysis is being made to increase quality of the decisions given.

"Decision Science" as falls in one of the main sphere of interest of Industrial Engineering; the decisions given would be more accurate and of high quality by involvement of IE in analysis steps. From an "Investor" stand point of view, a case study for baby diaper manufacturing investment has been analyzed, the information has been gathered and the decisions has been given from an "Industrial Engineering" point of view by using some of the most common decision making tools yet letting the investors to give their decisions according to their background and experience. So that the quality of the decisions gives would improve. It should be noted that there is no other study who studies the feasibility analysis in this framework.

In this study, several steps of technical and economical feasibility of disposable baby diaper manufacturing investment have been completed. As a part of the feasibility analysis a market assessment has been done. A qualitative marketing research has been done by means of focus groups and interviews including but not limited to observing competitors, reviewing the market structure and understanding economic trends that make up the business environment

Historic and statistical data available in the literature has been reviewed and a SWOT analysis has been made to the baby diaper market segment and depending on this analysis and the market information a corporate business strategy has been developed by making a business portfolio analysis.

In parallel with the business strategy developed a multi criteria, group decision model has been developed and the location selection problem has been solved by using analytical hierarchy process (AHP) methodology. Due to the complexity and the number of pair wise comparison judgments made, an computer software is used for analyzing the evaluations.

The cost contribution elements of a baby diaper have been studied in detail and the cost per diaper has been calculated according to a scenario built.

A 3-year production and sales projection has been made and break-even analysis, payback analysis, cash flow scheduling is done. The net present value and the internal rate of return for the proposed investment have been calculated and a sensitivity analysis has been made to measure the impact of change on income, with the change on sales price and production and sales capacity.

It should be noted that the 3 year projection and financial feasibility analysis is made under certain conditions. However the real-life environment, there are several uncertainties that is needed to be taken into account. This brings up the necessity of making a risk analysis as a part of the feasibility analysis. Therefore, it is essential to note that an investor taking this study as reference shall make a risk analysis and keep in mind that some of the figures provided in the study base on assumptions to disregard the uncertainties. Risk quantification is one of the most difficult tasks associated with investment project. It would be valuable if a risk assessment is done fort he uncertainty of the calculation parameters in the form of fuzzy numbers.

The models developed for technology selection and location selection problems, uses the input from the decision givers. It should be noted that even though the methodology applied improves the quality of the decision, the results still depend on the evaluation of the people involved in the decision giving process. This study does not discusses the accuracy of the evaluations and inputs that are made according to personal experiences and know how of the decision givers.

It has been concluded that the disposable diaper manufacturing business is a promising business with about 2% annual growth rate. Locating a plant in Southern Anatolia Region and depending on a China-made full servo diaper production machinery, would give good production volumes that would lead to have about 20 months payback period for the investment made. A summery of the feasibility study made on this thesis has been provided at Appendix 2 in a feasibility format.

It is concluded that the baby diaper investment is viable and profitable.

APPENDIX 1 : Baby Diaper Prices in the Supermarkets

MANUFACTURER	SIZE & PACKING				MARKET PRICES (YTL)			MIN. PRICE (USD / Diaper)
	Size No	Size Name	Baby Weight	Diapers / pack	Real Market	Yimpas Market	Whole - seller	
Procter &Gamble (Pampers/Prima)	1	yeni dogan	2-5	44	16,00			0,2694
	2	Mini	3-6	70		17,00		0,1799
				98	24,00			
	3	Midi	4-9	60	18,50	17,00		0,2058
				90	24,00	25,00		
	4	Maxi	7-18	26	11,00			0,2176
				52	18,50			
				80	23,50			
			8-14	20	8,00			
		Let's go	9-14	30	18,50			0,4568
	5	Junior	11-25	28		25,00		0,6296
				20	11,00	17,00		
	6	Large	16+	33	18,50	16,00		0,3591
KIMBERLY CLARK (Ovisan / Pedo & Pedo Klasik)	2	Mini	3-6	40	7,00			0,1296
	3	Midi	4-9	35	7,00			0,1235
				60	10,00			
	4	Maxi	8-19	25	7,00			0,1296
				80	14,00			
	5	Junior	11-25	25	7,00			0,2222
				40	12,00			
KIMBERLY CLARK (Huggies)	2	Mini	3-6	24	8,00			0,2011
				70	19,00			
	3	Midi	5-8	60	19,00			0,2222
				90	27,00			
	4	Maxi	8-14	20	8,00			0,2707
				52	19,00			
			10-16	70	26,50			
	5	Junior	12-22	60	26,50			0,3272
HAYAT KİMYA (Molfix)	2	Mini	3-6	40	10,00			0,1587
				70		15,00		
	3	Midi	4-9	30	10,00			0,1852
				60	16,00	15,00		

	4	Maxi	7-18	52		15,00		0,2083
				80	22,50			
			9-20	46		15,00		
				70	22,50			
	5	Junior	11-25	40	15,50			0,2778
				60	22,50			
ONTEX (Can-Ped / Can-Bebe)	2	Mini	3-6	35	7,50			0,1481
				70	14,00	15,00		
	3	Midi	4-9	30	7,50			0,1728
				60	14,00	14,00		
	4	Maxi	7-18	23	7,50			0,1994
				52	14,00			
			9-20	23	7,50			
				46	14,00			
	5	Junior	11-24	23	7,50			0,2593
				40	14,00			
				60	21,00			
EVYAP (Evy Baby)	1	yeni dogan	2-5	44	14,00			0,2357
	2	Mini	3-6	70		15,00		0,1587
			5-9	35	9,00			
				70	16,00			
				140	29,00			
	3	Midi	5-9	30	10,00			0,1534
				60	15,50	15,00		
				140	29,00			
	4	Maxi	8-18	26	9,00			0,2137
				52	15,50	15,00		
				70	29,00			
			9-20	70	22,00			
	5	Junior	12-25	20	9,00			0,2716
				40	16,00			
				60	22,00			
ROZI (Love Baby)	2	Mini	3-6	68	12,00			0,1307
	3	Midi	4-9	60	12,00			0,1481
	4	Maxi	7-18	52	12,00			0,1709
	5	Junior	11-25	40	12,00			0,2222
PAKSEL (Bebiko)		Mini	3-6	35		5,50		0,1164
		Midi	5-9	30		5,50		0,1358
		Maxi	8-19	25		5,50		0,1630
MELITA (Unisex / Pupe)		Mini	3-6	35		5,00		0,1058
		Midi	4-10	30		5,00		0,1235

		Maxi	9-18	25		5,00		0,1481
HAZEL (Uni / Ninni Bebe)	1	Mini	3-6	34		5,00		0,0966
				69		9,00		
	2	Midi	5-9	30		5,30		0,1111
				60		9,00		
	3	Maxi	8-18	26		5,30		0,1510
ERUSLU (Sleepy)		Mini	3-6	35		5,00		0,1058
		Midi	5-9	30		5,00		0,1111
				60		9,00		
		Maxi	8-15	50		9,00		0,1333
ERUSLU (no name)		Mini	3-6	13			1,50	0,0855
		Midi	5-9	12			1,50	0,0926
		Maxi	8-18	11			1,50	0,1010
PAKTEN (Onlem & Joyful)		Mini		35			4,50	0,0899
				70			8,50	
		Midi		30			4,50	0,1049
				60			8,50	
		Maxi		25			4,50	0,1259
				50			8,50	
		Junior		15			4,50	0,2222
NO NAME (Bello)		Mini	3-5	70		9,00		0,0952
		Midi	5-9	60		9,00		0,1111
BERKE		Maxi	9-18	25		5,50		0,1630

Notes: Retail sales price provided on this table includes VAT. List does not include all producers. It includes only the companies whose products were available on the shelves of the 3 market that the research has been conducted. YTL to USD exchange rate has been taken as 1USD=1,35YTL. Prices base on March 2006 market prices

APPENDIX 2 :Thesis on a Feasibility Analysis Format

FEASIBILITY ANALYSIS FOR DISPOSABLE BABY DIAPER PRODUCTION

CONTENTS

1. INTRODUCTION TO THE PROJECT

1.1 Name of the Project: Baby Diaper Production

1.2 Location of the Project: Kilis/Turkey

1.3 Capacity of the Project: 67.000.000 diapers / year, installed capacity.

1.4 First Investment Cost : 1.325.000,- USD

1.5 Project Time: 6 months

1.6 Project Economic Life : 10 years

1.7 Expected employement : 34 People

1.8 Production Flow Chart: Raw material to finished product flow chart is given below.

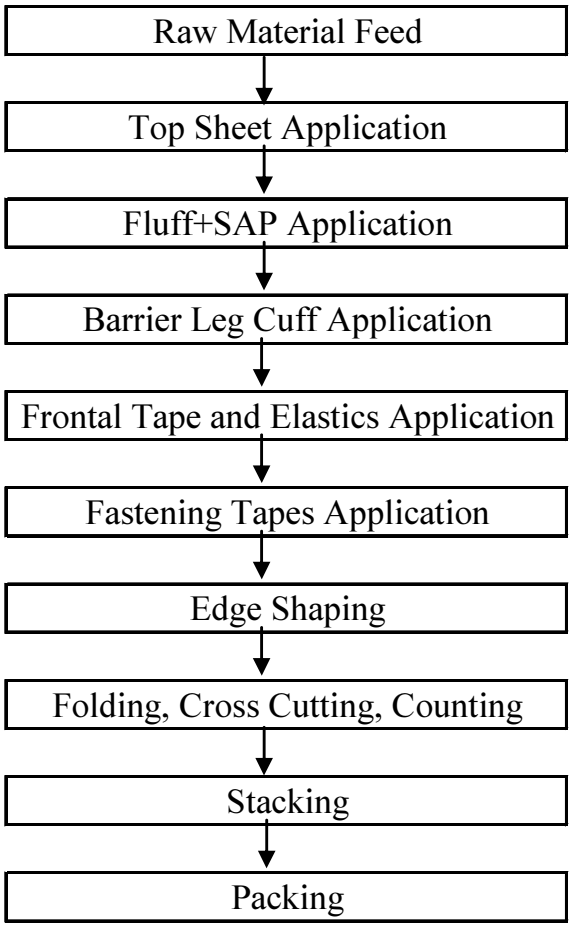


Figure 1 Baby Diaper production flow chart

2. MARKET ASESSMENT

Diapers are hygiene absorbent products engineered to absorb and contain urine and faeces of a baby. Diapers have been used since ancient times, however since 1960's today's disposable diapers has started to be used. Use of disposable diapers is increasing each day and therefore new diaper production machines come on stream as well. The population, especially the birth rates, is very important in the disposable baby diaper segment of the business.

The developing and underdeveloped market regions of the world continue to be the primary sources of this volume growth as the mature markets of the U.S and Canada, Western Europe and Japan are already highly penetrated. In most countries throughout the world, birth rates are gradually declining; however, infant populations continue to grow due to the increasing number of women entering the child-bearing age bracket [43,44].

2.1 Disposable Diaper Consumption

Once all available data are taken into account, it can be estimated that a total number in a range of 3.700 to 4.200 diapers used during the entire life of the baby. There are many regions of the world that use fewer diapers than USA. China and Russia are good examples as they are probably the very best at potty training. Parents in these countries are able to achieve this goal before the age of 20 months, instead of 33 in the USA. The rest of the world is considered somewhere in the middle [37].

Table 1 A baby's diaper consumption [38]

Age	Average Units/Day
0-12 months	4,8
12-24 months	4,2
24-36 months	1,9
36-42 months	0,4
Approx 4100 units/baby	

2.2 Disposable Baby Diaper Market Worldwide

Global Hygiene products include diapers and pants, sanitary protection, wipes, incontinence products, and cotton wool/buds. Widely viewed as a commodity product, the diapers/pants sector captures the largest share of total (46%) hygiene product sales globally, followed by sanitary protection with 35%.

Industry growth is highly dependent upon population, household formation and income. Global population has now surpassed 6 billion, but only 1.2 billion of that is concentrated in the G7 countries, which are expecting growth of only another 4% in the next twenty years. The annual population growth rates of complete World, India, USA, China, UK, Japan and Germany are given on below graph. The population, especially the birth rates, is very important in the disposable baby diaper segment of the business. The global hygiene products market is experiencing a healthy growth of 3.1% over the previous year [34].

When looked at the regional performances; North America and Western Europe represents a combined share of over 50% of the global hygiene products market, holding nearly equal portions of around 26% of value sales globally. With the U.S. largely dividing sales in North America, the region has seen its most dynamic performance in the last 10 years, increasing by an exceptional 23% in value since 1997. However this growth was restrained in 2002 as a slowing economy. Western Europe benefits from wealthy nations such as the UK, France, Germany and their particularly high consumer spending patterns. It should be noted that development, in dollar terms, was significantly effected by unfavorable exchange rates in 2000 and a very strong Euro in 2002, resulting in an inflated 12.3 % growth in the latter year.

At 22% in 2002, the Asia-Pacific regional share comes in third, with its third fastest growth rate since 1997 at 14%. The region's performance has been somewhat subdued by the economic depression in Japan.

A 12% share puts Latin America in fourth place, with Africa and Middle East, Eastern Europe and Australasia accounting for the remaining 14%. Eastern Euro has increased its share by almost 40% since 1997 till 2002, albeit from a very low base [34].

In 2004 the annual volume of disposable baby diaper products sold was estimated to be 20.25 billion units with an annual market value in 2004 of some 4.5 billion euros;

Over the past 2 years the total European baby diaper market is estimated to have grown by 2.7 %. Many of the established European markets are mature now and given current demographic trends are only growing slowly. The newer markets have grown by 9 % in the same period and are expected to continue to grow in coming years; The total estimated volume of incontinence products sold in Europe, the Middle East and Africa in 2004 is around 5 billion units with an estimated revenue value to manufacturers of some 1.5 billion euros [13,36].

The region of the Middle East and North Africa is collectively known as MENA and includes mainly three areas: Golf State Countries, Other Middle East Countries and North Africa. Golf States Countries are: Saudi Arabia, Kuwait, Qatar, Oman, United Arab Emirates and Bahrain. All of the above listed Golf State Countries listed above has a baby diaper market penetration of over 90%. As for the other Middle East Countries: Lebanon, Syria, Jordan, Iran, Iraq and Yemen. The market penetration of the disposable baby diapers are respectively: 80%, 25%, 75%, 20%, 10%, 18%. North Africa Countries; Egypt, Libya, Algeria, Tunisia and Morocco has the market penetration of 10%, 80%, 35%, 25%, 15% respectively. These MENA countries comprise 325 million people. In respect to hygienic disposables, an annual birthrate of 6.8/ million illustrates the potential of these markets. MENA markets for diapers are put at an annual 4.4 billion pieces with penetration rates averaging 25% and varying 90% in Gulf Countries to just 10% in Iraq and Egypt [37].

2.3 Disposable Baby Diaper Market in Turkey

The main absorbent hygiene products in Turkish market are baby diapers, feminine care products (sanitary napkins, panty shields, tampon), Wet wipes, Adult Incontinence diapers. Infant population (0-2.5 years) approx 3.5 millions with a percentage of 5 % of total population and has about 2 % increase per year [50]. Turkey has a positive growth of population. There are about 1.5 million new born each year in Turkey which basically mean about 3.5 million (potentially) everyday diaper users in Turkey [52].

Table 2 Baby population in Turkey [50]

Infant Population in Turkey								
Age		0<X<1	1<X<2	2<X<3	0<X<3	0<X<2,5	Change	
Years	Total Population						0<X<2,5 Increase	Total Increase
1995	60.755.469	1.193.086	1.174.573	1.159.833	3.527.492	2.947.575	1,013	1,015
1996	61.692.236	1.214.562	1.192.191	1.173.751	3.580.504	2.993.629	1,016	1,015
1997	62.865.574	1.259.622	1.213.784	1.191.428	3.664.835	3.069.121	1,025	1,019
1998	63.865.865	1.286.578	1.258.816	1.213.008	3.758.402	3.151.898	1,027	1,016
1999	64.896.282	1.314.111	1.285.755	1.258.010	3.857.876	3.228.870	1,024	1,016
2000	65.957.651	1.342.233	1.313.270	1.284.932	3.940.434	3.297.968	1,021	1,016
2001	67.050.822	1.370.956	1.341.374	1.312.429	4.024.759	3.368.545	1,021	1,017
2002	68.176.669	1.400.295	1.370.079	1.340.515	4.110.889	3.440.632	1,021	1,017
2003	69.336.130	1.430.261	1.399.399	1.369.202	4.198.862	3.514.261	1,021	1,017
2004	70.530.115	1.460.869	1.429.346	1.398.503	4.288.718	3.589.466	1,021	1,017
2005	71.759.614	1.492.131	1.459.934	1.428.431	4.380.496	3.666.281	1,021	1,017
2006	73.025.660	1.524.063	1.491.176	1.459.000	4.474.239	3.744.739	1,021	1,018
2007	74.329.277	1.556.678	1.523.088	1.490.222	4.569.988	3.824.877	1,021	1,018
2008	75.671.572	1.589.991	1.555.682	1.522.113	4.667.786	3.906.729	1,021	1,018
2009	77.053.662	1.624.017	1.588.973	1.554.686	4.767.676	3.990.333	1,021	1,018
2010	78.476.711	1.658.771	1.622.977	1.587.956	4.869.704	4.075.726	1,021	1,018

According to a study [50] made in late 2004 by Hayat Kimya, Turkey's biggest Turkish producer of baby diapers producing diapers under Molfix brand name, the market penetration of diapers in Turkey is about to reach 45 % and has 2 % annual growth rate. Same study, advice an installed diaper production capacity of 4.5 billion diapers per year. Below table gives an outlook to baby diaper market

Table 3 Outlook to baby diaper market in Turkey [50,52,53]

Outlook to Diaper Market in Turkey	
Number of babies (0-30 month)	3.500.000
Market Penetration	45%
Annual growth rate	2%
Installed production capacity (diapers/year)	4.500.000.000
Capacity utilized (diapers/year) includes export volumes	3.000.000.000
Market Volume (USD)	450.000.000

Purchasing power parity, PPP, is the rate of currency conversion that equalizes the purchasing power of different currencies, in this case Turkish Lira, and eliminates the differences in price levels between countries. USD is taken as 1. The increase in

PPP of Turkey can be interpreted to be a show of the increase of people's ability to afford using disposable diapers for their baby.

In addition to the consumption of diapers in Turkey, it is also exported to neighboring countries. The diaper import and export volumes have been obtained form Government Statistical Institute fore customs tariff code 481840910000 and 4818409900000. The values obtained starting from year 1996 till the first 9 months of 2005 has been extrapolated to cover till the end of year 2005.

Table 4 Import export volumes of baby diapers 1996-2005 USD [54]

Import Export of Baby Diapers (customs tariff code: 481840910000 and 481840990000)		
Years	**Import (USD)**	**Export (USD)**
1996	8.136.324	3.838.470
1997	5.249.514	11.133.270
1998	3.370.729	7.569.380
1999	5.394.006	13.217.063
2000	10.992.530	11.626.595
2001	5.386.182	34.835.166
2002	2.363.756	56.717.610
2003	1.611.351	71.525.805
2004	3.402.078	111.801.825
2005 9 months	3.469.284	98.751.151
2005 12 months (expected)	4.625.712	131.668.201

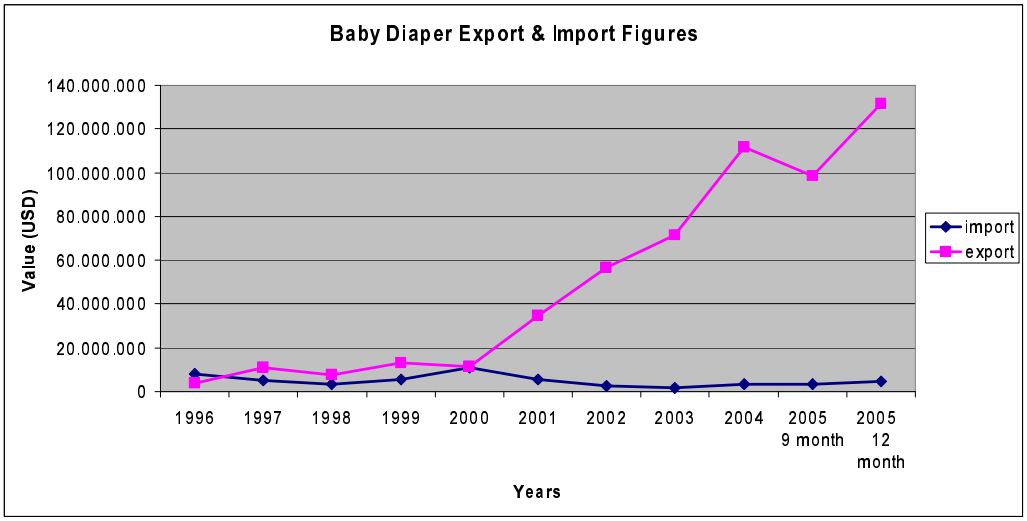


Figure 2 Baby diaper import export volumes 1996-2005 in USD [54]

2.4 Disposable Baby Diaper Producers in Turkey

Below table shows diaper producers in Turkey, their locations, number of machines in operation and respective market shares. Figure 3 shows their locations on map.

Table 5 Diaper producers, number of production lines and market share in Turkey

Company #	Location	Region	Number of lines	Market Share
Company 1	Gebze	Marmara	6	30-35 %
Company 2	Gölcük / İzmit	Marmara	4 (+2)	20-25 %
Company 3	Bahçelievler / Istanbul	Marmara	5	10-15 %
Company 4	Tuzla / Gebze	Marmara	4 (+2)	10-15 %
Company 5	Istanbul	Marmara	3	10%
Company 6	İstanbul	Marmara	4	
Company 7	Adapazarı	Marmara	4	
Company 8	Kayseri	Central Anatolia	3	
Company 9	Çerkezkoy/ Tekirdağ	Marmara	3	
Company 10	Beylikduzu / Istanbul	Marmara	2	
Company 11	Adana	Mediterranean	2	10-15%
Company 12	Haramidere / Istanbul	Marmara	2	
Company 13	Istanbul	Marmara	2	
Company 14	Karaman / Konya	Central Anatolia	3	
Company 15	Adana-Mersin	Mediterranean	3	
Company 16	Gaziantep	Southeast Anatolia	2	
Company 17	Haramidere / Istanbul	Marmara	2	
Company 18	Ceyhan / Adana	Marmara	(+2)	
Company 19	Yenibosna / Istanbul	Marmara	3	
Company 20	Uşak	Aegean region	1	
Company 21	Yeniköy / Antalya	Mediterranean	1	
Company 22	Mersin	Mediterranean	1	
Company 23	Gaziantep	Southeast Anatolia	1	
Company 24	Gaziantep	Southeast Anatolia	1	
Company 25	Istanbul	Marmara	1	

The Company names have been masked because; it is possible that some of the information provided herein may be confidential for some of the companies. The information provided in terms of the number of lines and the respective market shares has been obtained during face to face communications made people involved in the industry as well as the digital and printed media. There are about 26 baby diaper producers in Turkey and new companies are entering to market. Location, geographic region they operate at, number of baby diaper manufacturing lines in operation. The numbers mentioned in parenthesis are the lines either at installation phase or it has been purchased but not yet delivered. The capacity among regions is provided in Table 4.14. Producers in Turkey are mostly located at Marmara Region, especially the companies with higher production capacities [50,52,53].

Table 6 Baby diaper capacity among geographic regions of Turkey

Capacity Among Regions (diapers only)	
Marmara Region	85 - 90 %
Southern Anatolia Region	Less than 5 %
Mediterranean Region	Less than 4 %
Central Anatolia Region	Less than 3 %
Aegean Region	Less than 1%
Black Sea Region	Less than 1%
Eastern Anatolia Region	Less than 1%

Figure 3 Locations of baby diaper producers in Turkey

2.5 Disposable Baby Diaper Prices in Turkey

The prices are obtained by making a supermarket survey. First, prices have been obtained from Real Supermarket which is one of the biggest supermarkets of the city. Then prices available at Yimpas Supermarket, a district market and finally from the Gaziantep wholesaler's market house has been noted. Minimum prices for the same diaper size and pack size has been taken as reference price and the summarized pricing table has been provided at Table 7.

Table 7 Companies diaper end user prices available in the supermarkets

Manufacturer	Brand name	Average End User Market Prices for Major Sizes (USD/diaper), (VAT discounted)				
		New born	Mini	Midi	Maxi	Junior
P&G	Pampers	0,2282	0,1525	0,1744	0,1844	0,5336
KC	Huggies		0,1704	0,1883	0,2294	0,2773
Hayat Kimya	Molfix		0,1345	0,1569	0,1765	0,2354
Ontex	Canbebe		0,1255	0,1464	0,1690	0,2197
Evyap	Evybaby	0,1997	0,1345	0,1300	0,1811	0,2302
Rozi	Love Baby		0,1108	0,1255	0,1448	0,1883
Paksel	Bebiko		0,0986	0,1151	0,1381	
KC-Ovisan	Pedo		0,1098	0,1047	0,1098	0,1883
Melita	Pupe		0,0897	0,1047	0,1255	
Hazel	Ninni Bebe		0,0819	0,0942	0,1280	
Eruslu	Sleepy		0,0897	0,0942	0,1130	
No Name	No Name		0,0725	0,0785	0,0856	
Pakten	Onlem/Joyful		0,0762	0,0889	0,1067	0,1883
No Name	Bello		0,0807	0,0942		
Berke	Pufy				0,1381	
	Average Price:	0,2140	0,1091	0,1211	0,1450	0,2576
	Max. Price:	0,2282	0,1704	0,1883	0,2294	0,5336
	Min. Price:	0,1997	0,0725	**0,0785**	0,0856	0,1883

The second information source for pricing is a baby diaper producer who does export some part of their production to Middle East. The price obtained from this source is 17.5 USD for 240 diapers. Details have been given at Table 8.

Table 8 Baby diaper sales price to Middle East market

Sales Price				
Packs per stack	Diapers per pack	Total number of diapers per stack	Sales price per stack (USD)	Unit price (USD/diaper)
8	30	240	17,5	**0,07292**

3. TECHNICAL & OPERATIONAL FEASIBILITY

3.1 Raw Materials

A diaper consists of several materials that require a very good supply chain management. Below, table shows these cost elements, their usage per a medium size diaper and unit material cost of a diaper.

Table 9: Materials used in diapers and potential vendors

Materials	Use per Diaper	Specs	Potential Vendors
Fluff pulp	21 g	N/A	Lenzing, SCA Forest Products.
Textile Backsheet, SMS. (Laminated film or polyethylene film can be alternative)	0,13 m2	20 g/m^2	Gulsan, General Nonwovens, Pegas, Dunour, Avgol.
Topsheet (SS or SSS spunbond, or thermobond. hydrophilic surfactant treated)	0,1 m2	15 g/m^2	Gulsan, General Nonwovens, Telasis, Pegas, Dunour, Avgol.
Leg Cuff Materiial (SMS nonwoven)	0,03 m2	20 g/m^2	Gulsan, Pegas, Dunour, Avgol.
Acquisition Layer Material (High loft nonwoven)	0,04 m2	20 g/m^2	Freudenberg, Lyocell, Telasis, Tradegar.
Elastics & Lycra	0,13 g	N/A	Dupont, Freudenberg, Radici Spandex.
Frontal Tape	0,25 lm	45 g/m^2	Bento, 3M, Ko-Asia.
Super Absorbant Product (SAP)	7 g	N/A	Amcol, Atafia, BASF, Bayer, Dow Chemical, Degussa, Lysac.
Glue (Hot Melt Application)	1,2 g	N/A	Bayer, Cognis.

3.2 Facility Location

Many factors influence location decisions. However, it often happens that one or a few factors are so important that they dominate the decision. In this analysis the most important factors has been determined and 3 site alternatives are identified. These are Istanbul, Kocaeli and Kilis. The selection of the location is based on Analytical Hierarchy Process (AHP) model developed. Below figure shows the location selection model for baby diaper production in AHP framework. The selection factors shown in each box on below table has been evaluated and the evaluations are taken as input to a software. The software has analyzed the preferences with respect to the goal, selection of location for baby diaper manufacturing investment, and the results that the investment shall be located at Kilis.

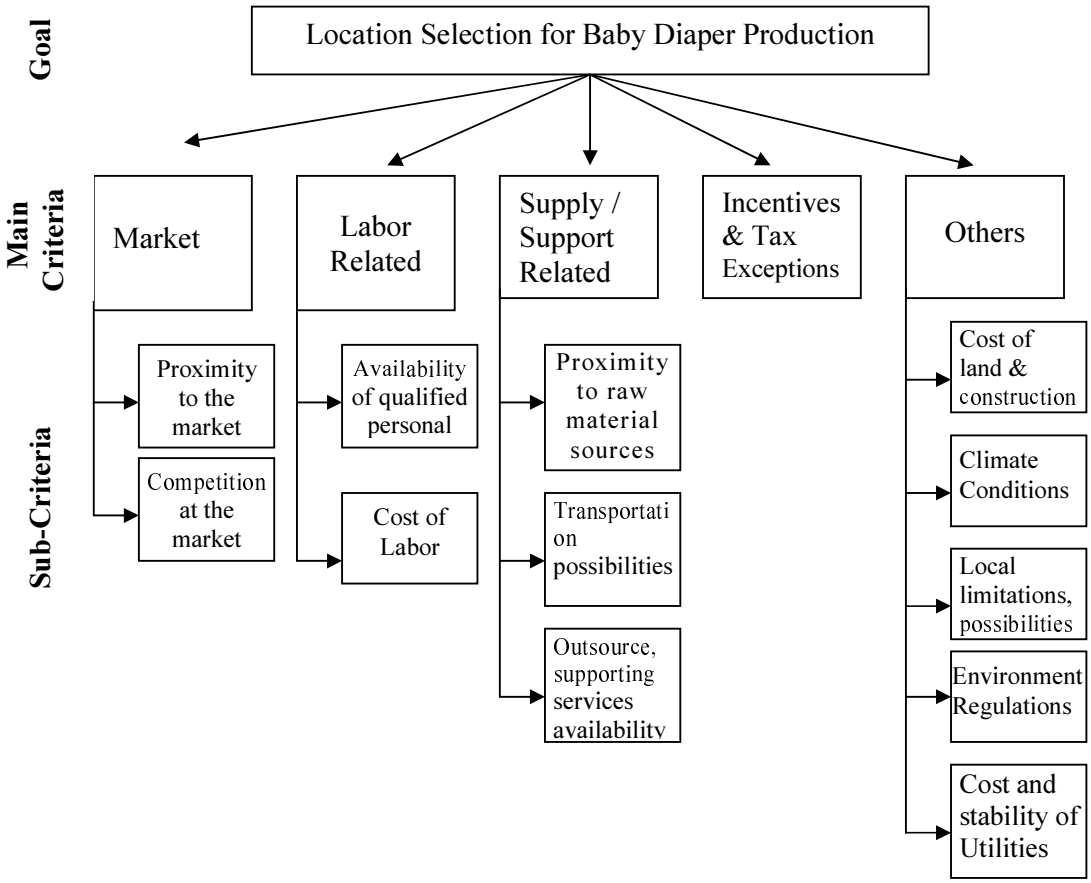


Figure 4 Location selection model in AHP framework

3.3 Technology Selection

As a part of the technical feasibility, it has been decided to take 3 machinery manufacturers as reference. One of them has been selected out of the three big players of the baby diaper machinery industry. One of them has been selected form the biggest baby diaper production machinery manufacturer of China. And the last one has been selected from Turkey, as a local vendor.

Technical specifications and quotations have been requested from these companies and evaluated. A candidate system Matrix has been formed to see similarities and differences between candidate systems. It has been made by brainstorming and by means of a group discussion.

Table 9: Candidate System Matrix used in technology selection

Characteristics	Candidate 1	Candidate 2	Candidate 3
Automation of the machine	Full Servo	Full Servo	Semi-Servo
Product Size(s)	4 sizes, Designed for 1 size. Comes with adaptors for 3 other sizes at additional cost. These are included in the price.	4 Sizes - Small, Medium, Large, X-Large	3 Sizes - Small, Medium, Large
Main Machine Components	Cellulose pulp fiberizing and S.A.P preperation + Top sheet + SAP applicator + aquisition Layer + barrier leg cuffs + elastics feeding + polyethylene backsheet + frontal tape + leg elastics + fastening tapes applicaiton system + cutting folding ans stacking	Pulp preperation + SAP applicator + acquisition layer + elastic feeding + leg cuff apllicator + elastic waistband + polyethylene film backsheet applicator + side tapes + frontal tapes + cutting and folding	Cellulose pulp preperation + SAP applicator + top sheet + acquisition layer + elastic band + barrier leg cuff + tape application system + frontal tape + polyethylene laminated backsheet + cutting, folding and stacking
Design Speed, max	500 pieces/minute	500 pieces/minute	450 pieces/minute
Reliable Speed	500 pieces/minute OR 250 m/min line speed whicever comes first. Size dependant	500 pieces/minute (medium size)	No info available. Expected reliable speed :350 pieces/minute medium size
Product Structure	Complex	Average complexity	Average complexity
Efficiency Given	Efficiency>85%, Scrap<3%	Efficiency>90% (expected to be less)	N/A. Expected to be >85%
Hot Melt Application System	Yes (10 sets)	Yes (4 sets total, USA made)	Yes (1 for PE+nonwoven lamination and 1 set for elastic bands)
Counting and Stacking	Yes, Automatic, works in coordiantion with automatic packing system	Yes, 2 exits, Automatic	Yes, 2 exits, Automatic
Packing System	Yes, full servo, minimum 300pieces/min packing. Up to 65 packages/min.	Not quoted. N/A	Not quoted. N/A
CE certification	Yes	Yes	No
Lead Time	9 months	5 months	7 months
Project Price (incl. spare	USD 3,350.000,-	USD 650,000,-	USD 1,000.000,-

Determination of the technology to move forward has been made by making a cost/benefit analysis. The selection criterions were as follows: production capacity, productivity, time needed for size changes, proximity to machinery suppliers, customer service and support, lead time of the machinery and finally suitability of the machinery to the strategy developed in the market assessment section. The evaluation of these criterions is made by a group. The importance level of each

criteria is defined by the members. According to the provided values the weighed and normalized priorities has been calculated and these figures has been divided by the normalized values of machinery costs. By doing so the benefit / cost analysis is completed. Below table shows the weighed normalized priorities and their ratios.

Table 10 Benefit/Cost ratio for the selection of baby diaper production machinery

	Candidate 1	**Candidate 2**	**Candidate 3**
Benefits	0,351	0,300	0,349
Costs	0,670	0,130	0,200
Benefit / Cost ratio	**0,524**	**2,308**	**1,746**

3.4 Capacity

The diaper production capacity of the line selected is 500 diapers per minute. However this is the maximum output of the machine defined for small size diapers. The calculations made on this analysis base on a medium size product that has medium complexity. The capacity for this product ranges 350 to 400 diapers per minute. For calculation purposes; some certain figures has to be defined or assumed. The input of a diaper producer was taken as reference in making these assumptions and determinations. The capacity value has been taken as 380 diapers per minute. The efficiency has been taken as 85%. Working hours per day is 24 hours by 3 shifts running. However effective running of the line per day has been taken as 22 ½ hours given the fact that the machine has to stop for set-ups, size changes, cleaning, raw material feeding, roll changes, maintenance and similar purposes. When calculation is made according to these figures; the line reaches about 12 million diapers per month.

3.5 Organization

For a machinery with a capacity of 300 to 600 machine; there is a considerable amount of person is required to be able to run the system 24 hours continuously. One of the most important factors affecting the number of people required to run a diaper line has to do with the count on the package and weather or not automatic packaging equipment is used. The diaper machinery will need 2 operators and 1 helper. A

typical machine with manual packaging will need about 8 people per shift; if automatic packaging is used, the need would be only about 5 per shift. All these people are just for the direct labor in-line, it is necessary to have more people to run the laboratory, the diaper inspections, the spare parts room, the instrumentation, the finished products warehouse, the raw material warehouse, in addition to the entire engineering infrastructure required to run an efficient factory. A typical diaper factory running only one diaper machine at 300 to 600 diapers per minute and three shifts per week (full capacity) with manual packaging and using a typical count of 20 diapers per bag, will require about 50 people [92].

Taking all these into consideration; together with the input of a diaper producer, the below table is formed. It shows the number of people that has been defined to run the baby diaper production plant smoothly.

Table 11 Personnel required running the diaper production line smoothly

Human Resources	**Number of Personnel**
1 General Manager	1
1 plant manager works day time	1
1 engineer works day time	1
1 chief of production X 3shifts	3
5 operator X 3shifts.(automatic packing)	15
1 lab technician X 3 shifts	3
1 Raw Material and finished product warehouse X 3 shifts	3
1 Mechanic for set-up & maintenance	1
1 sales manager and 1 sales assistant	2
1 assistant works day time	1
2 drivers work throughout the day	2
1 Accountant	1
Total :	**34**

4 FINANCIAL AND COMMERCIAL FEASIBILITY

4.1 Product Costing

In this section cost of a single diaper is calculated. Table 8 was provided the sales price while table 9 was shows the material costing. Below table shows the cost contribution elements of a baby diaper.

Table 12 Cost contribution elements of a baby diaper

Cost Elements	USD/month	USD/diaper	Percents
Cost of the material only	654.216	0,05456	83%
Labor	40.800	0,00340	5%
Depreciation & amortization	11.042	0,00092	1%
Cost of production (others)	17000	0,00142	2%
Cost of packing material, transportation, purchasing & handling…etc	30.000	0,00250	4%
Cost of sales marketing and promotion	25.000	0,00208	3%
Other general expenses	10.000	0,00083	1%
Total Cost:	**909.516**	**0,06572**	**USD/diaper**

4.2 Calculation of Theoretical Profit for Baby Diaper Production

This section is to make a calculation based on the full capacity for a medium size baby diaper production. The capacity, cost and sales price are obtained from previous sections of the analysis. However this is a 100% capacity, full time running calculations, which does not necessarily shows the actual conditions.

Table 13 Annual profit capability assuming a full time run year-around.

Sales Price	0,0729167	USD/diaper
Cost	0,0657187	USD/diaper
Capacity (medium size)	11.991.375	Diapers/month
Profit	0,0071979	USD/diaper
Monthly profit	86.313	USD/month
Annual profit (theoretical)	1.035.756	USD/year

4.3 Calculation of Break Even Point

To be able to make a breakeven analysis; the projected fixed and variable operating costs have to be identified. Fixed costs are the costs that remain constant regardless of the number of sales. Variable costs vary depending upon the volume of production and sales.

Table 14 Break-even analysis

Breakeven Analysis		
Total fixed costs =	87.092	USD/month
Variable Costs =	0,05846	USD/diaper
Sales Price =	0,07292	USD/diaper
Break Even =	6.022.611	pieces/month

4.4 Investment Period Costs

Below table shows the expenses that need to be done before the line gets into commercial production.

Table 15 Costs incurred during the phase of investment

Project Costing	**USD**
Baby diaper production machinery	650.000,-
Baby diaper automatic packing equipment	200.000,-
Auxiliary and ancillary equipment	85.000,-
Cost of the land and construction in Kilis. (2000m2)	180.000,-
Forklift truck and a personnel service van	75.000,-
Other expenditures(project analysis, equipment transportation and insurance, customs clearance and importation costs, unexpected costs, tools for installation)	85.000,-
Cost of Installation and start-up	50.000
Total :	**1.325.000,-USD**

4.5 Scenario Analysis : 3 year production and sales projection

A scenario is built under certain conditions. It should be noted that since this feasibility analysis does not includes the uncertainty, there should be a risk analysis be made before any investment decision is given.

Table 16 3-year production and sales projection

3 –Year Projection			
	Year 1	**Year 2**	**Year 3**
Price per unit	0,07292	0,07656	0,07875
Unit Sales (month)	8.500.000	10.500.000	13.000.000
Revenues (month)	619.792	803.906	1.023.750
Fixed Costs (per month)	-76.050	-83.655	-89.739
Variable Costs per unit	-0,05846	-0,06021	-0,06138
Depreciation (month)	-11.042	-11.042	-11.042
Taxes (tax incentive)	0	0	0
Net Income (month)	35.825	77.009	125.046
Net Income (year)	429.900	924.110	1.500.558

Another view of the above provided table is the operation term expenses. Below table shows the expenses incurred during the projected 3 year period.

Table 17 Projected operating term costs

	Year 1	**Year 2**	**Year 3**
Raw materials	5.565.120	7.080.797	8.936.928
Ancillary raw materials	286.875	354.375	438.750
Energy	99.688	118.438	141.875
Labor	489.600	514.080	548.352
Maintenance	75.063	83.313	93.625
General Expenses	100.000	120.000	140.000
Amortisation	132.500	132.500	132.500
Cost of sales and marketing	259.092	318.945	352.410
Yearly operating expenses total (USD)	7.007.937	8.722.447	10.784.440

Table 18 Projected term income table

	Year 1	Year 2	Year 3
Unit sold per year	102.000.000	126.000.000	156.000.000
Unit sales price (USD/diaper)	0,07292	0,07656	0,07875
Yearly Income (USD)	7.437.840	9.646.560	12.285.000
Yearly Operating Expenses	7.007.937	8.722.447	10.784.440
Net Income (USD/month)	35.825	77.009	125.047
Net Income (USD/year)	429.900	924.110	1.500.558

4.6 Payback analysis

Payback analysis shows when the baby diaper production investment would pay for itself. The amount payable has been taken as USD 1.325.000,- and a calculation has been made. It has been calculated as follows.

Table 19 Payback analysis according to 3-year projection

Payback Analysis	1.325.000	first investment cost
	1.6	Years (in decimals)
	20	months

4.7 Cash flow schedule

According to the 3-year projection made; below a cash flow schedule has been prepared. To be able to make the cash flow schedule it has been assumed that at the beginning, company requires a $250,000 injection of working capital (WC). Subsequently, working capital would be about 15 % of sales. Table shows the operating sash flows, networking capitals and the capital spending for the first 3 years. It should be noted that, the investment is considered to be made from the company capital. In case a loan would be involved, the principal payments and interests shall also be included in the cash flow schedule. Another point is that since the location for the investment is in Kilis and this city is in the governmental investment incentive region. Therefore, as it can bee seen from below table there is

no taxes discounted from the net income. Below table shows the cash flow schedule of the company for the projected years.

Table 20 Cash flow schedule

Cash Flow Schedule				
	Year 0	**Year 1**	**Year 2**	**Year 3**
	I - Operating Cash Flow			
Net Income		429.900	924.110	1.500.558
Depreciation		132.500	132.500	132.500
Operating Cash Flow		562.400	1.056.610	1.633.058
	II –Working Capital (WC)			
Working Capital	-250.000	92.969	120.586	153.563
Working Capital Recovery				
Addition to working Capital	-250.000	-92.969	-120.586	-153.563
	III – Capital Spending			
Capital Expenditure	-1.325.000			
	Year 0	**Year 1**	**Year 2**	**Year 3**
Total Cash Flow	**-1.575.000**	**469.431**	**936.024**	**1.479.495**

4.8 Calculation of net present value (NPV).

Net Present Value is defined as the value creation through the process of investment. To be able to calculate net present value; it has been assumed that the required rate of return by the investors is 20 %.

$$NPV = \left(469431 / (1+0.20) + 936024 / (1+0,20)^2 + 1479495 / (1+0,20)^3 \right) - 1575000$$

NPV = 189.398,39 USD

Since NPV is positive; the investment project should be accepted.

4.9 Calculation of internal rate of return

The IRR for an investment is the discount rate for which the total present value of future cash flows equals the cost of the investment.

Internal Rate of Return (IRR) is the discount rate that makes the NPV nil.

$$0 = \left(469431 \Big/ (1 + IRR) + 936024 \Big/ (1 + IRR)^2 + 1479495 \Big/ (1 + IRR)^3 \right) - 1575000$$

From the above equation; IRR is calculated to be 30.05 %.

4.10 Sensitivity analysis

To measure the impact of change of income, with the change on sales price and production and sales capacity a sensitivity analysis has been done. For sales price; the net income has been recalculated for a price sold 10% less in price as well as 10% more in price. As a similar way, the production and sales capacity has been decreased 20% and net income has been calculated. Also, it has been tested how the income figures would change if the company would find more business and produce 15% more diapers per year than the projected sales figures. The revised sales prices and production volumes has been provided at Table 8.7

Table 8.7 Sales prices and production capacities to be used for sensitivity analysis.

Sales Price	Projected Sales Price (USD/diaper)	0,07292	0,07656	0,07875
	10% less	0,06563	0,06891	0,07088
	10% more	0,08385	0,08805	0,09056
Capacity	Projected Capacity (diaper/month)	8.500.000	10.500.000	13.000.000
	20% less	6.800.000	8.400.000	10.400.000
	15% more	9.775.000	12.075.000	14.950.000

Once the calculations has been made; it has been find out that, if the company would fall in a position to sell the projected capacity at a price of 10% lower than the projected price; it would loose money in the first 2 years of the projected period. As expected with the increase at the sales price the profit showed an increase. 10%

increase in the sales price almost doubled the average profit made in the projected period. All calculations are based on the projected production volumes.

With the sensitivity analysis made; by keeping the sales prices as it was originally projected, it has been observed that a 20 decrease in the production volume still gives positive numbers at the income statements. Table8.8 shows the changes of net income with the changes made as per sensitivity analysis.

Table 8.8 Sensitivity analysis

Sensitivity Analysis		**Net Incomes (USD/Year)**		
		Year 1	**Year 2**	**Year 3**
Projected Income		429.900	924.110	1.500.558
Sales Price	10% less	-313.850	-40.577	272.058
	10% more	1.173.650	1.888.798	2.729.058
Capacity	20% less	134.900	512.016	958.573
	15% more	651.150	1.233.181	1.907.047

As it can be seen from the table, the increase in sales price and capacity, as expected, increases the net income. More critical is when they are reduced. 20% reduction in production capacity costs about 70% reduction in projected income. This is due to increase in fixed costs rate in the overall cost. However, the income is still a positive number. When the sales price is reduced 10%, the income changes dramatically to a negative value which means it is a lost for the investor. Observing how 10% change affects the results, it should be reminded that the a risk analysis should be done for real life investment analysis.

5 Conclusions

Disposable baby diapers have become the method of choice for nearly all families across Europe. There can be little doubt that the convenience of disposable diapers is a huge benefit in today's busy lifestyles where time is a precious asset. They lessen the burden of domestic chores, freeing parents to spend more time on other activities in their family, social or economic lives.

In summary, because of their health and performance benefits, diapers today best meet the needs and expectations of many consumers.

It should be noted that, even tough obtaining the most accurate data which is most close to real life, the analysis is made under certain conditions and uncertainty shall be studied by making a risk analysis in real-life environments. Even tough the economic life cycle of the line is given for 10 years, the scenario built and the financial analysis is done for only 3 years. Therefore, it would be valuable to make a longer term analysis before making an investment. i.e. the machinery's junk price has not been taken in any account.

It has been concluded that the disposable diaper manufacturing business is a promising business with about 2% annual growth rate. Locating a plant in Southern Anatolia Region and depending on a China-made full servo diaper production machinery, would give good production volumes that would lead to have about 20 months payback period for the investment made. It is concluded that the baby diaper investment is viable and profitable.

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