

# Using ‘Decision-Making Tools’ for Business Investments: Feasibility Analysis for Baby Diaper Production – A Case Study

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## ABSTRACT

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. Some of the most common tools of ‘*decision making*’ have been employed and a feasibility analysis for ‘*baby diaper production*’ is carried out in this study. SWOT analysis to baby diaper market segment, business portfolio analysis, facility location selection, technology selection has been also introduced. The calculation of the product cost has considered and a three-year production together with sales projection has been presented. Financial analysis according to the projection has been also included in the analysis. It has been shown that ‘baby diaper manufacturing’ is still a feasible, viable and profitable investment in Turkey.

**Keywords:** Feasibility, baby diaper, SWOT analysis, technology selection, location selection.

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## 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. 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?"

In most of the SMEs in Turkey, the investment decisions are given by individuals who are either owner of the company or the member of the top management team. It has been observed that, such companies use group decisions in investments and seldom make a detailed feasibility analysis. The decisions are made according to the experience and know-how of the members and it is probable that one member dominates others. These are the main reasons that it is observed either the risk of failures at the decisions made are increased or the funds are not used as effective as it should be.

The primary objective of this section is to present an overview of the pre-dominant decision making tools with an eye towards feasibility analysis. The intend of the study is not necessarily to cover every available method or tool but provide a thorough review of the most common current methods that have been used in the case study made.

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 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 five tests for feasibility: *Economical, Operational Feasibility, Technical Feasibility, Schedule Feasibility, and Financial Feasibility.*

*“Economic Feasibility” is the step that includes the market assessment.*

*“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.*

*“Financial 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 1 shows the feasibility assessment diagram.*

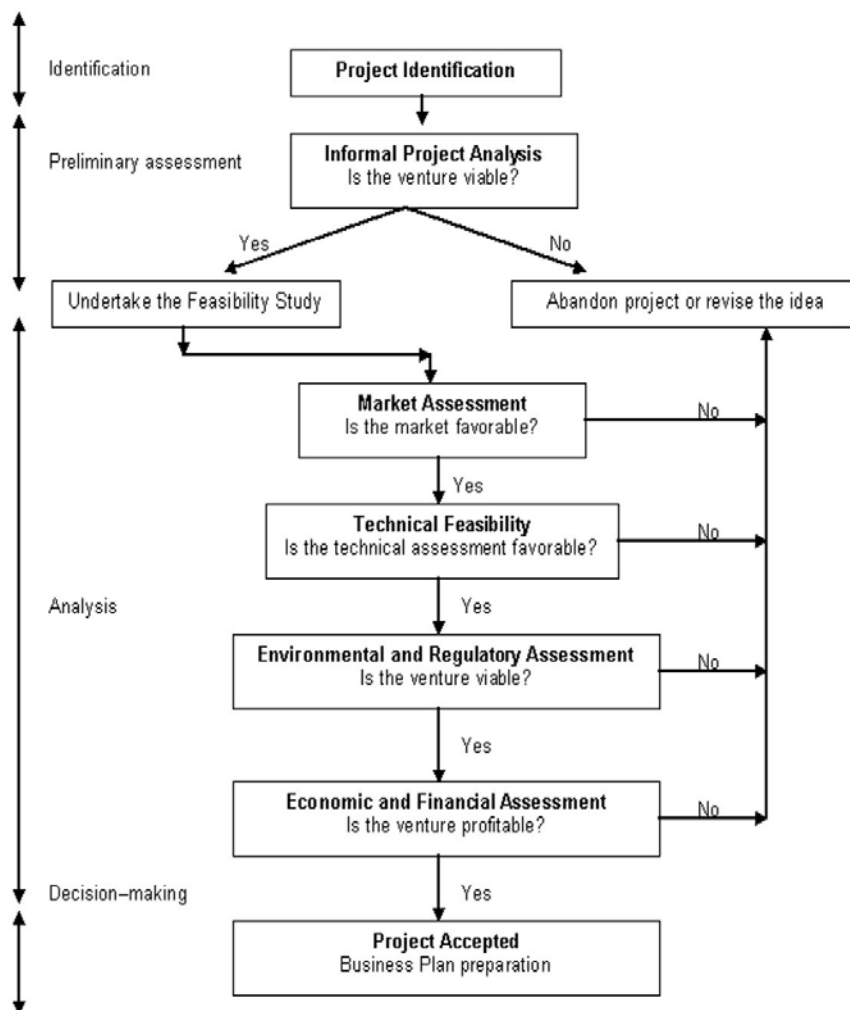


Figure 1: Feasibility Assessment Diagram

## **Framework of a Feasibility Analysis**

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. The questions to be answered are as follows [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?

### **Markets:**

- What is the current structure of 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?
  - What are the costs? - 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)

### **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?

### **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?
  - low prices,
  - advertising,
  - promotion,
  - customer service, or some other method

### **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?

### **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?

### **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

### **Production processes:**

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

### **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.

### **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?

### **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?

### **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.

### **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.

### **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.

## Decision Making

Decision making is the study of identifying and choosing alternatives based on the values and preferences of the decision maker. Making a decision implies that there are alternative choices to be considered, and in such a case we want not only to identify as many of these alternatives as possible but to choose the one that best fits with our goals, desires, lifestyle, values, and so on. Decision making is the process of sufficiently reducing uncertainty and doubt about alternatives to allow a reasonable choice to be made from among them. This definition stresses the information gathering function of decision making. It should be noted here that uncertainty is reduced rather than eliminated. Very few decisions are made with absolute certainty because complete knowledge about all the alternatives is seldom possible. Thus, every decision involves a certain amount of risk [2].

There are four main decisions that individuals make in organizations: *Autocratic*, *Autocratic with individual Input*, *Leader with group input*, or *total Consensus*. In autocratic decisions, one person, typically the leader, makes a decision for the entire team. In Autocratic with individual decisions, the leader requests input from individual team members then makes a decision using input. At decisions made by leader with group input; a leader asks the group to meet, collect inputs and then the decision is made by leader using the outcome of the group discussion. In consensus decisions, leader and group reach a decision that everyone understands and can support

The main elements that make up any decision process can be summarized as follows:

- *The people making the decision*
- *The other stakeholders who care about the decision but aren't part of the team*
- *The problem itself and how it is described*
- *The information that the team members (and eventually stakeholders ) need to make the decision*
- *The type of decision chosen to make, and the tools to use in decision making process.*
- *The supervision of the decision process [3].*

Many normative decision models assume that a firm pursues the single objective of stockholder wealth maximization. However, a modern enterprise is a complex organization in which various stakeholders interact with one another, each with its own possible interpretation of wealth maximization, subject to concerns about risk, liquidity, social responsibility, environmental -



protection, employee welfare, and so forth. Consequently, a multi criteria, multi objective decision making problems has to be solved in a way to use the resources most effective [4].

## **Decision Making Tools for Feasibility Analysis**

Since individuals, organizations, and community groups are often faced with difficult problems to solve and important decisions to make. For a group to be successful, it must find methods to creatively solve problems and focus on reaching goals and achieving satisfactory results. In this section the some of the most common decision making tools that are also being used at the feasibility analysis case study has been explained.

### **Multivoting:**

Multivoting narrows a large list of possibilities to a smaller list of the top priorities or to a final selection. Multivoting is preferable to straight voting because it allows an item that is favored by all, but not the top choice of any, to rise to the top. It can also be called as NGT voting or nominal prioritization. It is used after brainstorming or some other expansion tool has been used to generate a long list of possibilities and when the list must be narrowed down or when the decision must be made by group judgment.

The procedure can be summarized as follows:

1. Display the list of options. Combine duplicate items. List reduction may also be useful.
2. Number all items.
3. Decide how many items must be on the final reduced list. Decide also how many choices each member will vote for. Usually, five choices are allowed. The longer the original list, the more votes will be allowed, up to 10.
4. Working individually, each member selects the five items (or whatever number of choices is allowed) he or she thinks most important. Then each member ranks the choices in order of priority, with the first choice ranking highest. For example, if each member has five votes, the top choice would be ranked five, the next choice four, and so on. Each choice is written on a separate paper, with the ranking underlined in the lower right corner.
5. Tally votes. Collect the papers, shuffle them, and then record on a flipchart or whiteboard. The easiest way to record votes is for the scribe to write all the individual rankings next to each choice. For each item, the rankings are totaled next to the individual rankings.

6. If a decision is clear, stop here. Otherwise, continue with a brief discussion of the vote. The purpose of the discussion is to look at dramatic voting differences, such as an item that received both 5 and 1 ratings, and avoid errors from incorrect information or understandings about the item. The discussion should not result in pressure on anyone to change their vote.
7. Repeat the voting process in steps 4 and 5. If greater decision-making accuracy is required, this voting may be done by weighting the relative importance of each choice on a scale of 1 to 10, with 10 being most important [5].

### **Decision Matrix:**

A decision matrix evaluates and prioritizes a list of options. The team first establishes a list of weighted criteria and then evaluates each option against those criteria. This tool may also call as Pugh matrix, decision grid, and selection matrix, criteria rating form or criteria-based matrix.

This tool can be used when a list of options must be narrowed to one choice or when the decision must be made on the basis of several criteria. The procedure can be summarized as follows:

1. Brainstorm the evaluation criteria appropriate to the situation. If possible, involve customers in this process.
2. Discuss and refine the list of criteria. Identify any criteria that must be included and any that must not be included. Reduce the list of criteria to those that the team believes are most important.
3. Assign a relative weight to each criterion; based on how important that criterion is to the situation. Do this by distributing 10 points among the criteria. The assignment can be done by discussion and consensus. Or each member can assign weights, then the numbers for each criterion are added for a composite team weighting.
4. Draw an L-shaped matrix. Write the criteria and their weights as labels along one edge and the list of options along the other edge. Usually, whichever group has fewer items occupies the vertical edge.

Evaluate each choice against the criteria. For each criterion, rank-order all options according to how well each meets the criterion. Number them with 1 being the option that is least desirable according to that criterion. Multiply each option's rating by the weight. Add the points for each option. The option with the highest score will not necessarily be the one to choose, but the relative scores can generate meaningful discussion and lead the team toward consensus [6,7].

### **Paired Comparison Analysis:**

Paired Comparison Analysis helps to work out the importance of a number of options relative to each other. It is particularly useful where there is no objective data to base this on. This makes it easy to choose the most important problem to solve, or select the solution that will give you the greatest advantage. Paired Comparison Analysis helps to set priorities where there are conflicting demands on the resources. It is also an ideal tool for comparing "apples with oranges" - completely different options such as whether to invest in marketing, a new IT system or a new piece of machinery.

To use the technique, a matrix is formed. This matrix is used to compare each option with each other option, one-by-one. For each comparison, decision giver will decide which of the two options is most important, and then assign a score to show how much more important it is. The procedure can be summarized as follows:

1. List the options you will compare. Assign a letter to each option.
2. Mark the options as row and column headings on the worksheet. Note that the cells on the table where you will be comparing an option with itself have been blocked out.
3. The cells on the table where you will be duplicating a comparison are also blocked out.
4. Within the remaining cells compare the option in the row with the one in the column. For each cell, decide which of the two options is more important.
5. Write down the letter of the more important option in the cell, and score the difference in importance from 0 (no difference) to 3 (major difference).
5. Finally, consolidate the results by adding up the total of all the values for each of the options. You may want to convert these values into a percentage of the total score [8].

### **Six Thinking Hats:**

Six Thinking Hats is an important and powerful technique. It is used to look at decisions from a number of important perspectives. This forces decision giver to move outside its habitual thinking style, and helps him to get a more rounded view of a situation. Many successful people think from a very rational, positive viewpoint. This is part of the reason that they are successful. Often, though, they may fail to look at a problem from an emotional, intuitive, creative or negative viewpoint. This can mean that they underestimate resistance to plans, fail to make creative leaps and do not make essential contingency plans. Similarly, pessimists may be excessively defensive, and more -

emotional people may fail to look at decisions calmly and rationally. The decisions made by using this tool will mix ambition, skill in execution, public sensitivity, creativity and good contingency planning. Each 'Thinking Hat' is a different style of thinking. These are explained below:

1. **White Hat:** With this thinking hat decision giver focus on the data available. Look at the information he has, and see what he can learn from it. Looks for gaps in his knowledge, and either try to fill them or take account of them. This is where he analyzes past trends, and tries to extrapolate from historical data.
2. **Red Hat:** Wearing the red hat, the decision giver look at problems using intuition, good reaction and emotion. Also tries to think how other people will react emotionally. Tries to understand the responses of people who do not fully know his reasoning.
3. **Black Hat:** Using black hat thinking, decision giver look at all the bad points of the decision. Look at it cautiously and defensively. Try to see why it might not work. This is important because it highlights the weak points in a plan. It allows eliminating them, altering them, or preparing contingency plans to counter them. Black Hat thinking helps to make plans 'tougher' and more resilient. It can also help to spot fatal flaws and risks before embarking on a course of action. Black Hat thinking is one of the real benefits of this technique, as many successful people get so used to thinking positively that often they cannot see problems in advance. This leaves them under-prepared for difficulties.
4. **Yellow Hat:** The yellow hat helps decision giver to think positively. It is the optimistic viewpoint that helps to see all the benefits of the decision and the value in it. Yellow Hat thinking helps to keep going when everything looks gloomy and difficult.
5. **Green Hat:** The Green Hat stands for creativity. This is where the decision giver can develop creative solutions to a problem. It is a freewheeling way of thinking, in which there is little criticism of ideas.
6. **Blue Hat:** The Blue Hat stands for process control. This is the hat worn by people chairing meetings. When running into difficulties because ideas are running dry, they may direct activity into Green Hat thinking. When contingency plans are needed, they will ask for Black Hat thinking, etc.

A variant of this technique is to look at problems from the point of view of different professionals (e.g. doctors, architects, sales directors, etc.) or different customers [9].

### **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.

### **Cost Benefit Analysis:**

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

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. [10,11,12]

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 [12].

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 [12].

### **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 [13].

AHP is a 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. [14, 15]

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 [16].

In Phase 2, pair-wise comparisons are done by using a nine-point scale as suggested by Saaty [17].

The nine-point scale is shown in Table 1.

Table 1 The nine-point scale [17]

<b>1</b>	Equal importance	Two activities contribute equally to the objective
<b>3</b>	Weak importance of one over other	Experience and judgment slightly favor one activity over another
<b>5</b>	Essential or strong important	Experience and judgment favor one activity over another
<b>7</b>	Demonstrated importance	An activity is strongly favored and its dominance is demonstrated in practice
<b>9</b>	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation
<b>2,4,6,8</b>	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 [18]. Up to date successful applications of the AHP have been reported in marketing, finance, education, public policy, economics, medicine and sports [19].

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 [20].

### **Scenario Analysis:**

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 [21].

### **Financial Analysis:**

Below the most common financial analysis used in making investment decisions has been provided.

1. **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.
2. **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 [22]. 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.
3. **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.

4. **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?

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.

5. **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.

6. **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 [23].

## A Case Study for Baby Diaper Production Feasibility Analysis

For a company interested in investing on *baby-diaper manufacturing* there are several steps that needs to be clarified or studied. A feasibility analysis including market analysis, location selection, technology selection and long term production and sales projections has to be made.

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. 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. 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 [24]. According to a study made in EU countries, a baby consumes 4100 diapers until baby has the potty training. Detailed information is given in Table 2.

Table 2 A baby's (typical) diaper consumption [25]

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	

### 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. Turkey has a –

positive growth of population. Turkey ranks 17 in the world population ranking for year 2005. With an 1.4 % average growth rate of national population for 2000-2005 years period [26]. There are about 1.5 million new born each year 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 [27,28].

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 rate was 6,9 in year 1955. It has dropped to 2,7 in year 200 and the projected rates for years 2005, 2015 and 2050 is 2.43, 2.12, 1.85 respectively.

Apart from the fertility rate, Table 3 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 3 Infant population in Turkey

Years	Total Population	Population of babies younger than 30 months
1995	60.755.469	2.947.575
1996	61.692.236	2.993.629
1997	62.865.574	3.069.121
1998	63.865.865	3.151.898
1999	64.896.282	3.228.870
2000	65.957.651	3.297.968
2001	67.050.822	3.368.545
2002	68.176.669	3.440.632
2003	69.336.130	3.514.261
2004	70.530.115	3.589.466
2005	71.759.614	3.666.281
2006	73.025.660	3.744.739
2007	74.329.277	3.824.877
2008	75.671.572	3.906.729
2009	77.053.662	3.990.333
2010	78.476.711	4.075.726

It should also be noted that, the purchasing power parity, the rate of currency conversion that equalizes the purchasing power of different currencies and eliminates the differences in price levels between countries, has an increases every year. Table 4 gives an outlook to baby diaper market in Turkey.

Table 4 Outlook to baby diaper market in Turkey [27,28,29]

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

### **Diaper prices in the market**

The study to determine the sales prices revolves around three main information sources. First one is obtained through a market survey. First, prices have been obtained from prominent supermarkets. Then the prices available at a hypermarket, a district market (outlet) 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 has been obtained. The prices vary between 0,19 to 0,08 USD/diaper. Minimum price found is about 0,0785 USD/diaper.

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.

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. The price obtained is 0,08 USD/diaper.

## **SWOT Analysis to the 'Baby Diaper Market Segment' in Turkey**

A SWOT analysis has been done to the baby diaper market segment in Turkey. It has been performed interactively by a related group of 4 persons [30].

### **Strengths:**

1. It is a growing market. The annual growth rate is about 2% and has a market penetration of 22%. [31]
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. More openly; 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 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.



## Business Portfolio Analysis for Baby Diaper Market

At this point 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
- Good financial position.

**GE Multifactor Business Portfolio Matrix**

Business Position	High	Selective Investment	Invest/Grow	Invest/Grow
	Medium	Harvest/Divest	Selective Investment	diaper Invest/Grow
	Low	Harvest/Divest	Harvest/Divest	Selective Investment
		Low	Medium	High
		Industry Attractiveness		

Figure 2 GE multifactor business portfolio analysis

The rate of industry growth in Turkey is about 2% per annum, and has a market penetration of 22% [31] with 2.700.000 new born per year [26]. 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

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.

As a part of 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 thought and covering an issue thoroughly.

By taking all above discussion into consideration, the potential seen at the supermarket-branded diapers and the need at the neighboring countries, 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 major potential market that would require diapers are to be the southeast neighbors of Turkey.

## **Location Selection**

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.

One of the goals of this study 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 three *site alternatives* are identified. The phase of evaluation has been made by inputs from four people who have the necessary experience and can evaluate both factors and site alternatives as far as an industrial location selection is concerned. Figure 3 shows the locations of current baby-diaper producers in Turkey. It has been observed that more than 85% of all installed capacity is located at the Marmara region. The factors to be used for location selection problem have been determined and the hierarchy tree has been formed accordingly (Figure 4).

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; baby diaper producers' locations, diaper producers' capacity, governmental investment incentives and business strategy made previously.



Figure 3. Locations of baby diaper producers in Turkey

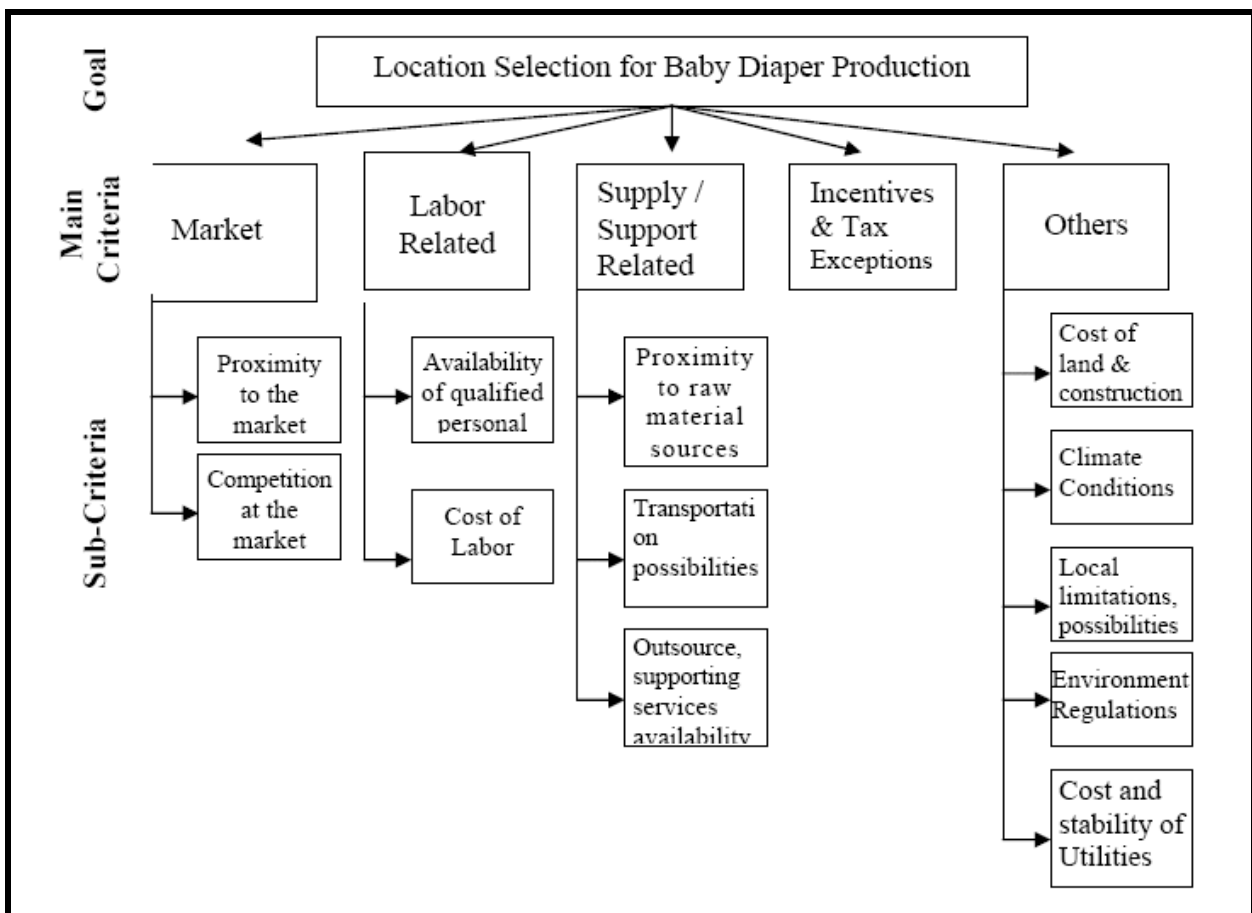


Figure 4 Hierarchy tree for location selection

By taking all above into consideration and to have a starting point of the study, three alternatives for the site selection has been intuitively determined. These are: city *Istanbul*, city *Kocaeli* and city *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 work, the three sites have been assumed to be the best three alternatives available. 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. Decision-makers can weight criteria using a process for developing priorities and building consensus through the use of available AHP software (e.g. Expert Choice). 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. Each 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.

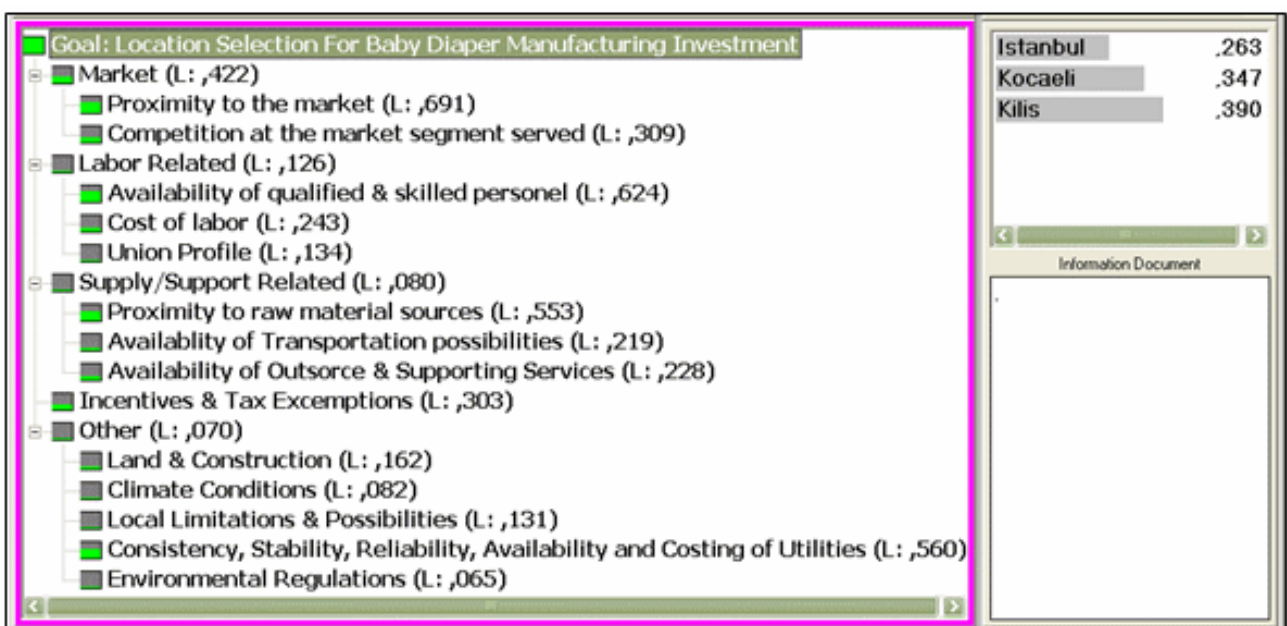


Figure 5. Hierarchy tree for location selection criteria

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. Figure 5 shows the detailed priorities for each factor and alternative.

Figure 6 illustrates the performance graph for the selection factors for all three alternatives. Even though *Kilis* city is not first preference for some of the selection criteria, at the end, the overall performance of *Kilis* city ranks the first. The software has analyzed the preferences with respect to the determined goal. According to the multi criteria, group-decision model formed for location selection problem that has been solved through analytical hierarchy process (AHP) software (e.g. Expert Choice), and, at the end of the day, the manufacturing investment has been decided to be located at *Kilis* city.

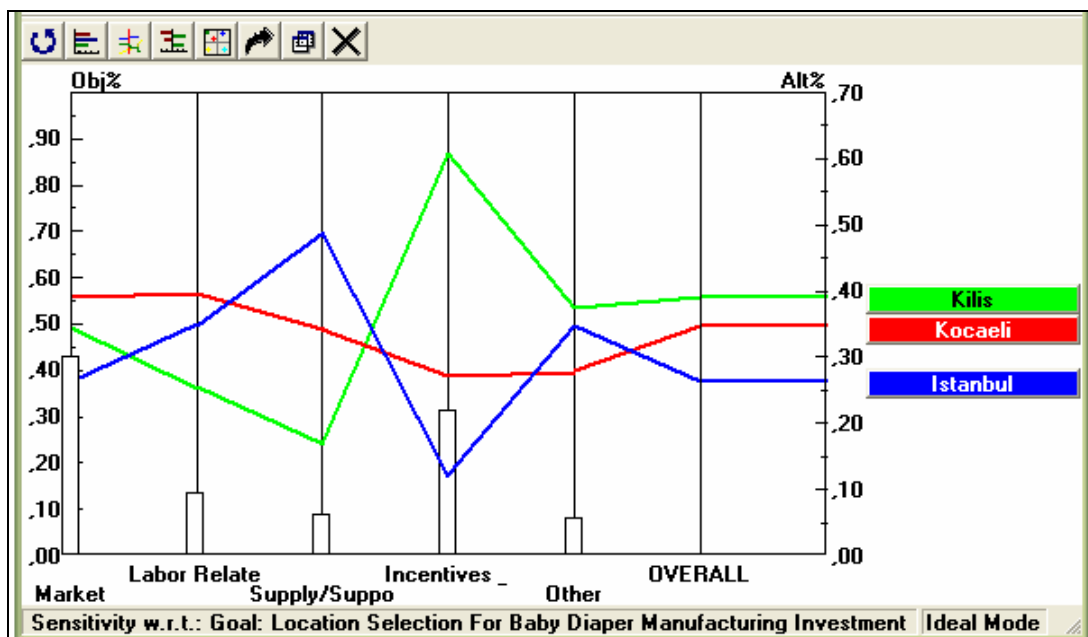


Figure 6 Performance of cities with respect to selection criterions

## Technology Selection

To make the technical feasibility, it has been decided to take at least three machinery manufacturers as reference. One has been selected out of the three big players of the baby diaper machinery industry. One 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. To develop the matrix, all three 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.*

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 matrix prepared.

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. The selection of technology for this study will be made by using a benefit/cost analysis. The evaluation has been made depending on the offers mode by the machinery builders and the outcome of the brainstorming listed on the candidate system matrix. 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 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.*

The benefits part of the cost benefit analysis consists of seven criteria. The values for each criterion have been substituted. Their normalized values to make criterions to a comparable scale have been also calculated.

Table 5 Candidate system matrix

<b><u>Characteristics</u></b>	<b><u>Candidate 1</u></b>	<b><u>Candidate 2</u></b>	<b><u>Candidate 3</u></b>
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 preparation + Top sheet + SAP applicator + acquisition Layer + barrier leg cuffs + elastics feeding + polyethylene backsheet + frontal tape + leg elastics + fastening tapes applicaiton system + cutting folding ans stacking	Pulp preparation + SAP applicator + acquisition layer + elastic feeding + leg cuff applicator + elastic waistband + polyethylene film backsheet applicator + side tapes + frontal tapes + cutting and folding	Cellulose pulp preparation + 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 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,-



It has been asked to the *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 sub-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 have been multiplied by this weighting sub-factor. These values have been listed in Table 6.

Table 6 Normalized and weighted values of benefits

Benefits	Sub 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:		<b>0,351</b>	<b>0,300</b>	<b>0,349</b>

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 and their normalized values have been listed in Table7.

Table 7 Normalized values for costs

Costs	Values			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

To calculate the *benefit cost ratio*, the weighted values of the benefit for each candidate shall be divided by the normalized cost value of the respective candidate. The normalized benefit values presented in Table 6 and the normalized cost values presented in Table 7 have been used to calculate the ratio of benefits to costs for each candidate. For *candidate-1*, the benefits value (0,351) divided by the costs value (0,670) give 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 8 Calculation of weighted benefit/cost ratio and selection of technology

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

The technology is growing very rapidly. Due to this quick change, decision makers to face great uncertainty and complexity regarding the selection of which technology to depend on. Even tough the comparison of the technologies are made quite good, mostly the decisions are made intuitively in SMEs. 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 matrices have been formed and weighted cost benefit analysis has been made to make a vendor selection. The proposed methodology improves 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. The computed benefit cost ratios are given in Table 8. It is obvious from Table 8 that *Candidate 2* should be selected for producing baby diapers.

## Costing of the product

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.*

A diaper consists of several materials that require a very good *supply chain management*. The components of a diaper form the main material cost elements. These cost elements, their usage per a medium-sized diaper and unit material cost of a diaper has been calculated.

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 are based on a medium size product that has medium complexity. The capacity for this product ranges 350 to 400 diapers per minute.

For calculation purposes; this 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.

As for the labor cost, the studies made show that 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.

First investment costs are basically the costs that fall under the calculation of amortization and depreciation (Table 9). The economic life cycle of the machinery has been taken as 10 years.

Table 9 First investment costs

First Investment Costs	Cost (USD)
Baby Diaper manufacturing equipment	650.000
Diaper packing equipment	200.000
Auxiliary 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
<b>Total Cost (USD)</b>	<b>1.325.000</b>

The energy cost has been calculated according to the energy consumption figures given by the machinery supplier. 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. These values have been determined and the product cost calculations are made according to these assumptions. The unit cost per diaper has been calculated as 0,06572 USD. Table 10 shows the calculated cost of production.

Table 10 Cost calculation 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%
<b>Total Cost:</b>	<b>909.516</b>	<b>0,06572 USD/diaper</b>	

## **Financial Analysis**

In this section, the financial feasibility analysis of baby diaper production is presented a multi-year production and sales projections have been performed. The costing of the product has been revised and the most common financial analysis tools have been used in the analysis.

### **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. Breakeven is calculated by fixed costs including depreciation divided by the difference between price per unit and variable costs per unit. When calculated according to the assumptions made, the company has to produce 6 million diapers per month to be able to cover its expenses.

### **A three-year projection:**

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. Hence, 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 selected location (*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 11.

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. In addition to this, the following assumptions and determinations are made as a part of developing the business scenario. The raw material cost is increased 3% in the 2<sup>nd</sup> year and 5% in the 3<sup>rd</sup> year. The auxiliary 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 2<sup>nd</sup> year and 12% increase in the 3<sup>rd</sup> 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. 2<sup>nd</sup> year an addition of 5% and 3<sup>rd</sup> year an addition of 8% is foreseen. The following tables (Table 11, 12) have been formed in line with the assumptions above and the scenario built.

Table 11 Projected operating term costs

	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>
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
Amortization	132.500	132.500	132.500
Cost of sales and marketing	259.092	318.945	352.410
<b>Yearly operating expenses total (USD)</b>	<b>7.007.937</b>	<b>8.722.447</b>	<b>10.784.440</b>

Table 12 Projected term incomes

	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>
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

**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 (Table 13).

Table13 Payback analysis according to 3-year projection

<b>Payback Analysis</b>	1.325.000	first investment cost
	1.6	Years (in decimals)
	20	months

**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. Subsequently, working capital would be about 15 % of sales. Table 14 shows the operating sash flows, networking capitals and the capital spending for the first three 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 the city is in the governmental investment incentive region. Therefore, as it can bee seen from below Table 14, there is no taxes discounted from the net income. Table 14 summarizes the cash flow schedule of the company for the projected years.

Table 14 Cash flow schedule

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

**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%.

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

$$NPV = 189.398,39 \text{ USD}$$

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



**Calculation of internal rate of return:**

The *Internal Rate of Return (IRR)* for an investment is the discount rate for which the total present value of future cash flows equals the cost of the investment. *IRR* is the discount rate that makes the NPV nil.

$$0 = \left( \frac{469431}{(1 + IRR)} + \frac{936024}{(1 + IRR)^2} + \frac{1479495}{(1 + IRR)^3} \right) - 1575000$$

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

**Sensitivity analysis:**

In order to measure the impact of change of income with the change on sales price as well as production and sales capacity, a *sensitivity analysis* has been performed. 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 15.

Table 15 Sales prices and production capacities to be used for sensitivity analysis

<b>Sales Price</b>	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
<b>Capacity</b>	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 two 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 performed; 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. Table 16 shows the changes of net income with the changes made as per sensitivity analysis.

Table 16 Sensitivity analysis

Sensitivity Analysis		Net Incomes (USD/Year)		
		Year 1	Year 2	Year 3
<b>Projected Income</b>		429.900	924.110	1.500.558
<b>Sales Price</b>	10% less	-313.850	-40.577	272.058
	10% more	1.173.650	1.888.798	2.729.058
<b>Capacity</b>	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 16, 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.

## Discussion and concluding remarks

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. Most of the SMEs in Turkey are using spontaneous methods for decision making in investment processes. This may result that unintentionally one of the participants may dominate the others which potentially would cause failure of the project. It is well worth pointing out that the 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. Therefore involvement of "system approach" and the use of industrial engineering tools are needed during the feasibility analysis since "*decision making and science*" falls in one of the main interests of *industrial engineering*.

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 in a systematic way and letting the investors to give their decisions according to their background and experience.

In this study, several steps of technical and economical feasibility of disposable baby diaper manufacturing investment have been presented. As a part of the feasibility analysis a *market assessment* has been also performed and presented. A qualitative market 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. Historical 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, a computer software (Expert Choice) 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 three-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 three-year projection and financial feasibility analysis is made under certain conditions. However for the real-world environment, there are several uncertainties that are 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 for the 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 have not discussed the accuracy of the evaluations and inputs that are performed 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 of Turkey 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 has been found that the baby diaper investment in Turkey is still viable and profitable.

## Acknowledgments

The second author is grateful to Turkish Academy of Sciences (TÜBA) for supporting his scientific studies.

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