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“Determine the demand for shipping services in ports using stated and revealed preference techniques. The case of the major Greek ports”

by

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ABSTRACT

This master thesis evaluated the factors which determine the demand in the major Greek ports, in the liquid and dry bulk sectors using Stated and Revealed preference techniques. Ports all over the world and especially in the demanding area of Eastern Mediterranean are improving their quality measures day by day. A study which will reveal which are the main determinants of demand for shipping services in ports, will assist the major Greek ports of Piraeus, Thessaloniki, Kavala, Volos and Patra to develop their terminals in order to meet the expectations of their customers. This thesis is focusing on answering two main research questions: Which of the two techniques, the Stated Preference or the Revealed Preference one, can best determine the demand for shipping services in the major ports of Greece? Which are the basic characteristics that determine the best quality shipping services in the major Greek ports in the liquid bulk and dry bulk sectors? A qualitative methodology was used in order to answer the main research questions. We prepared and conducted surveys to various shipping companies all over the Greek territory and close to the major Greek ports. The analysis of the surveys' extracted data was conducted with the use of a polynomial model called Logit.

The results of this master thesis were the following:

1. Stated Preference Technique can best describe and determine the demand for shipping services in the major Greek ports.

2. Three main attributes of the shipping services were selected to best determinate the demand in the major Greek ports and in the liquid and dry bulk sectors; Frequency of voyage, Total voyage costs and duration of voyage.

These shipping service's characteristics play an important role in the determination of the demand in the Greek ports. Through the results of the conducted surveys, this master thesis came upon the conclusion that a Greek shipping company is willing to pay the extra amount of money in their total voyage costs of their vessels if the frequency of the trips is increased and the duration of the voyages is decreased. It is up to the Greek port authorities to take this under consideration and seek for a continuous improvement in their services.

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LIST OF ABREVIATTIONS

CBA	Cost-Benefit Analysis
CE	Choice Experiments
CM	Choice Modeling
CR	Contingent Ranking
CV	Contingent Valuation
FF	Freight Forwarders
HPM	Hedonic Price Method
NUV	Non-Use Value
PC	Paired or Pair-wise Comparisons
RP	Revealed Preference
SP	Stated Preference
TEV	Total Economic Value
WTA	Willingness To Accept compensation
WTP	Willingness To Pay

Chapter 1 Introduction

The traditional theory of consumer choice indicates that "*the consumer unit attempts to maximize utility, U, which it obtains directly from the services of goods, xi, purchased in the marketplace*" (Becker, 1973). Consumption theory, in general, can have many interpretations; some may link it to the "*price theory*" of consumption, others to the study of the demand in the marketplace from the viewpoint of the salesperson, thus the one which sells a good or a service and some others with the study of the budget-line, an individual, a household or a business entity is willing to spend (Kyrk, 1923). As Keynes theory states "*the consumption level is influenced by an autonomous figure (a) and a constant fraction of income (by)*" (Miller, 1996). Consumer behavior and consumption theory triggered economists to study it because consumer has "*the capacity of chooser rather than of user of goods*" (Kyrk, 1923). As it is clearly indicated by the above statements consumer behavior is highly depended upon the relationship of benefits and costs. Benefits can be identified by the maximization of the utility with the least possible costs given the budget constraint.

The consumer decision process can be divided into five stages. First stage is the problem recognition, thus, the needs that the customer wants to fulfill. Second stage is the information search. Information search can be either external or internal. Third stage is the evaluation of the alternatives. In that stage the consumer evaluates all the given alternatives and their characteristics in order to make the choice that will fulfill the needs which is willing to satisfy. The fourth stage includes the purchasing process which consists two main considerations; from whom and where to buy the good or the service. Lastly, the fifth stage is the post-purchase behavior thus the evaluation of the selected good or service after the choice has been made. (Louviere, Hensher, Swait, 2000). The five stages of consumer behavior can be shown below in **Figure 1.1**. Consumer choice relays the preferences to the customer demand curves either for a good or a service.

Figure 1.1 Consumer Decision Process

(Louviere, Hensher, Swait, 2000)

This master thesis will focus on the determination of demand for shipping services in ports using stated or revealed preference techniques. Ports all over the world are on a stage of reformation in order to meet the demands of their clients. Major

improvements have been done in the quality of the services they are offering. More sophisticated terminal equipments are used. Public-owned ports are being corporatized (Dooms, 2011). The current trends of globalization, concentration and dedicated terminals have transformed seaports into an essential part of a product's supply chain (Dooms, Van Schuylenburg, 2011). Changes in the production and consumption process are immense. There are an increasing number of ports' stakeholders, both internal and external. In the demanding area of Eastern Mediterranean, these global trends will play a major role in the determination of the traffic flow in the biggest Greek ports. Ports authorities must determine which these characteristics that best determine their shipping services are and how they must improve their services to meet the expectations of their clients. The ports which are going to be studied are the major Greek ports of Piraeus, Thessaloniki, Patra, Kavala and Volos. The demand of shipping services will be related to the liquid bulk and the dry bulk sectors which are highly active in the above mentioned ports. The basic research questions which this thesis will answer are two: Which of the two techniques, the revealed or the stated preference ones, can best determine the demand for shipping services in the major Greek ports, in the liquid bulk and dry bulk sectors? Which are the basic characteristics that determine the best quality shipping services in the major Greek ports, in the liquid bulk and dry bulk sectors?

The approach which was used in order to answer these questions is interviews with various focus groups in the already mentioned ports and sectors. The difficulties encountered during the investigation were the difficulties which arouse in any research which contains a qualitative methodology. The right sample of the various focus groups must be chosen in order for the study to best recommend and propose how the demand for best quality shipping services can be determined in the major Greek ports and in the liquid bulk and dry bulk sectors. The structure of this master thesis will be the following: In the next chapter a literature review will be conducted in order to illustrate the basic characteristics of the stated and revealed preference techniques, which are the advantages and disadvantages of these methods and how these techniques have been used in the past by other researches. Moreover an introduction to the term of the total economic value and economic valuation of goods and services using the Cost Benefit Analysis will follow. The next sub-chapters illustrate the ways which the valuation is conducted and the criteria which are being used. Chapter 2.2.4 will point up how the choice of the best preference technique, which will determine the demand for the best quality shipping service, can be done. The following chapters will demonstrate how a typical stated preference technique survey is being conducted and how the desired sample among the various focus group can be determined in order for the survey to be successful. Furthermore, in the sub-chapters which will follow it will be illustrated how a successful questionnaire design can be constructed and with which way the analysis of the data and the presentation of the results can be done. Chapter 3 will contain the report and the scope of the experiment and the choice of the method which the experiment was conducted and the analysis of the reasons for that choice. Moreover in Chapter 3 the questionnaire is designed in order to demonstrate how the demand for shipping services in the major Greek ports can be determined. The questionnaire is on a digital form in order for the questions to be adjusted depending on the interviewee's sector of interest and place. An example of this questionnaire will be put on the Appendix of this master thesis. Finally, Chapter 4 includes the summary and the conclusions of the research by illustrating how the demand for the best quality shipping services can be determined and which methodology can best describe it.

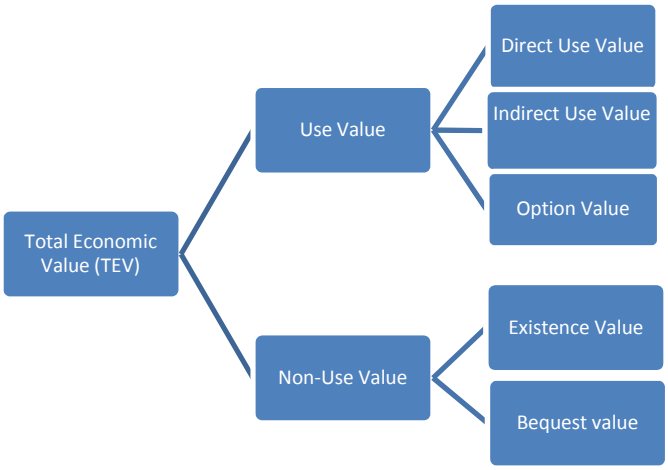
Chapter 2 Literature Review

In this chapter a literature review is conducted in order for the reader to get familiarized with the concepts of Total Economic Value (TEV), economic valuation and the two basic methodological techniques which determine people's preferences, the Stated Preference technique (SP) and the Revealed Preference (RP) one. Later on in the chapter, these methods of survey are being analyzed thoroughly in a way that the reader understands how surveyors gather all the data from these methodological techniques in order to determine the economic value of a good or a service. During this analytical part of this chapter it becomes clear which methodology to use in any given situation. Lastly in the final part of the chapter the thesis focus solely on the Stated Preference (SP) methodological technique and scrutinize all the necessary steps that must take place in this kind of survey. Moreover, the thesis present the different types of the Stated Preference (SP) surveys, the way of conducting them, the approach of selecting the right sample out of a population and the way of designing and analyzing a questionnaire.

2.1 Total Economic Value

The concept of Total Economic Value (TEV), first formed by the London School, was an emerging one during the 90's due to the fact that it created a framework for the Environmental Economists to set up values to previously un-valued terms which are associated to the environment (Plottu, Plottu, 2006). TEV is the sum of two values, the use value and the non-use value. Use value corresponds to the value which people obtain from using a good or a service. It is divided upon three sub-categories; direct use value, indirect use value and option value. Direct value is all the inputs in a consumption process. Indirect use value, on the other hand, has all goods and services which are not directly consumed but create functional advantages. An example could be the external costs and benefits of agriculture in the society. Moreover, the use value can be paid by an individual for the purpose of future usage and is called option value (Pillet, 2006). This term was first introduced by Weisbrod in 1964 and is referring to the "*price that individuals are willing to pay for conservation of an element in view of its possible future use*" (Plottu, Plottu, 2006). The other value which constitutes and creates the TEV is the non-use value. It is being created by the willingness of an individual to pay for a good or a service which he or she will not directly use it nor he or she will gain indirectly something out of it. Non-use values are divided into two categories, the existence value which Krutilla in 1967 best clarifies as "*the satisfaction that an individual gets from knowing that an environmental element will be preserved*" (Plottu, Plottu, 2006) and the bequest or heritage value which refers to the "*satisfaction that individuals derive from knowing that a resource will be preserved for use by future generations*" (Plottu, Plottu, 2006). The concept of the Total Economic Value and its categories and subcategories is clearly shown below in **Figure 2.1**.

Figure 2.1 The Concept of Total Economic Value (TEV)



(Plottu, Plottu, 2006)

The above definition of the concept of TEV and the separation of what does use and non-use values mean is very crucial to be made since many people tend to forget the importance of the non-use values in the formulation of the Total Economic Value

of a product. The monetarization of non-use values is essential for the conduct of a Cost-Benefit Analysis. It is important for any decision maker to include both these kind of values in order for their estimation of the TEV to be correct and take the right decision. After all, for any given good or service, in a Cost-Benefit Analysis, benefits must always exceed costs.

The Total Economic Value (TEV) can be found by the economic valuation and its techniques. The following chapter analyzes the way and the purpose of conducting an economic valuation for a good or a service. Furthermore, several methods of economic valuation are introduced and specifically an emphasis is given on the Cost-Benefit Analysis valuation method. Lastly, we present the two methods of preferences' surveys which this master thesis is dealing with, the Stated and the Revealed Preference techniques.

2.2 Economic Valuation

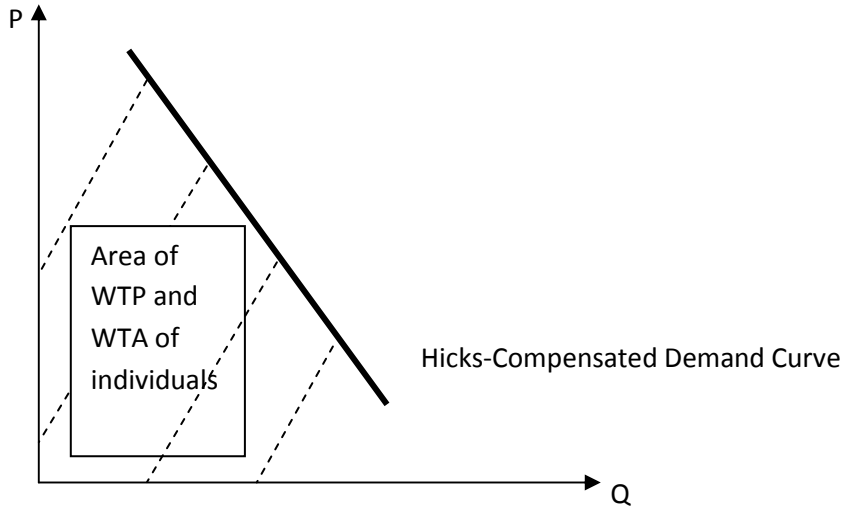
Economic evaluation is the process of allocating monetary values to factors which are not taken under consideration in a financial evaluation and in particular to non-marketed goods and services. Non-marketed goods and services are identified to be the ones which are not bought or sold within a market context. Examples could be the quality of air and water or the damage which pollution causes. It is refereeing to all negative and positive externalities which are caused by the non-marketed goods and services. The main reason of this financial evaluation is lying on the fact that the benefits and the costs of non-marketed goods or services tend not to be evaluated properly and result to bad decision making. Allocating monetary values to these types of goods and services gives the opportunity to the decision makers to value correctly the amount of the good or the service to acquire giving the fact of the accompanied costs associated with them (World Health Organization, 2000). Other main purposes of conducting an economic evaluation can be (Carter, 2003):

- Exhibit and give economic value for the possibility of future production and growth
- Solve business and economic distresses with correct planning and practice
- Create and evaluate possible financial mechanisms and economic inducements for management purposes.

If a good or a service is being beneficial to the market rather than resulting to more costs, it has an economic value. If it makes an individual or an enterprise better off, depends on the personal preferences. It is obvious that any economic valuation is based on people's preferences. Although, decisions, in general, are not taken only under the above criterion but also with what is morally correct for the present and the future.

Individuals' preferences can be exposed by using different types of economic methods. The real people's interest, although, is revealed in the actual market where they are asked through surveys of their Willingness To Pay (WTP) and their Willingness To Accept compensation (WTA) for a certain goods and services (Pillet, 2006). The value of an individual WTP tenders reliable and important information for a good or a service for its economic life and for the tariffs and subsidies that must be associated with (Brookshire, Whittington, 1993). On the other hand, Willingness To Accept (WTA) compensation can be found by the willingness of an individual to accept a compensation for the negative attributes associated within a product or a service (Persson, Cedervall, 1991). As Mr. Van Kooten (1984) stated "*WTP and WTA are the compensating variation and equivalent variation measures of welfare change*". WTP and WTA of people are measured under the proposed "*Hicksian demand curve*" as it is illustrated below in **Figure 2.2**.

Figure 2.2 Hicks-Compensated Demand Curve and WTP/WTA of individuals



(Van Kooten, 1984)

Modern welfare economists have developed Hick's theory of declines in economic welfare a step further. Losses of economic welfare can be measured in terms of the value of the WTP and WTA of an individual consumer's surplus (Gregory, 1984). Demand and WTP and WTA measures are closely related because if people "*want*" to acquire a good or a service, they are willing to pay for that (Wedgewood, Sansom, 2003). The choice for a good or a service is depended upon certain criteria. Cost-Benefit Analysis (CBA) is a method of economic valuation that uses money as the criterion of choice which is illustrated upon the WTP and WTA of people. In that way benefits and costs can be easily compared. CBA method compares the benefits and the costs of either an investment project i.e. a road, a port and an urban expansion or a delivered service and policy (Pearce, 1998).

CBA has certain rules. The basic and the most important one is that a good or a service can be acceptable only and only if benefits are exceeding costs. Usually, benefits are measured by the WTP of an individual or an enterprise and costs by the WTA. Gains and losses can be indentified and measured by the WTP for a gain or the WTP to evade a loss and the WTA to accept a loss or not to enjoy a benefit (Pearce, 2003). In a CBA analysis, it is important to stress out the fact that it is referring to present costs and benefits (Pearce, 2003). In fact, CBA methodology is a tool which will have better results if we use WTP and WTA of an individual or an enterprise as the criteria for economic valuation. CBA is a choice-evaluation procedure. If a person has many different choices to choose, he or she will select the one which has more benefits than costs. As a result of the above statements, it has been clearly identified that the major choice criterion in a CBA analysis is the WTP and the WTA. Other methodologies may have different criteria. These principles, although, must not be randomly selected. There must be always reasoning behind the choice of one principle over the other. The choice of the right

criterion is very important. If, according to our point of view, choices are made depending on what people want then the criteria must be based according to their preferences. On the other hand, in cases where people are unaware or cannot be informed about the consequences of their choices, the criteria must be based upon the choice of the experts.

There are some advantages which set WTP and WTA as the major criteria in a Cost-Benefit Analysis (Pearce, 2003):

- The benefits of either an investment project or a choice or a policy can be directly compared with their associated costs. In that way, a CBA analysis is measured using the total economic value of a good or a service. In other evaluation methods, there is the freedom of choice among alternative situations but don't identify if the current one must change.
- The economic values, which are being used in a WTP and WTA, are principles that are based in an individual preference and the result is credible.
- WTA and WTP criteria allow taking under consideration the results of distributing the decision of certain choice to various layers of decision making.
- Time can be an important economic value and in that respect it can be taken under consideration in the WTP/WTA methodology.

In contrast to the above, WTP/WTA methodology have certain disadvantages:

- If the methodology is used to an individual or an enterprise which are not well informed about the consequences of their choices, wrong decisions is going to be taken.
- Alternative choices might be difficult to be evaluated by people.

There are, normally, three ways to approximate WTP. First, we can observe what an individual pay for their goods or services in a specific market context. Secondly, we can examine which are the expenses of money, time and labor an individual has in order to get any good or service or to evade any loss associated with. Thirdly we can ask people directly what they are willing to pay to obtain a certain good or service in the future. For the first two ways scientists are using the Revealed Preference (RP) methodological technique because they are based upon an individual examination of behavior. The last technique is estimated by the use of the Stated Preference (SP) methodology (Wedgewood, Sansom, 2003).

During the last several years these two techniques of conducting a survey are widely accepted to be the most appropriate ones to identify an individual preference. In the RP surveys, the result is revealed comparing an identical market. In an SP survey, the required result is obtained in markets which are not exist and to hypothetical markets that are being created by the questionnaires whose main focus is to identify the WTP of a good or a better quality service for an individual or an enterprise. SP surveys are divided upon two different categories of evaluating techniques; the Contingent Valuation (CV) and the Choice Modeling (CM). The main difference between these two techniques is that in the first example of a CV survey, people are being directly asked about the willingness to pay for a certain good or service with a value which has already given to them. On the other hand, in a CM approach, people have many choices to choose and evaluate.

2.2.1 Revealed Preference Techniques

The economic valuation of marketed goods and services is conducted by using the revealed preference technique. RP surveys are carried out through the gathering of relevant data from consumers' decisions and choices to a different market than the one which is examined and analyze them. RP is a technique which studies revealed consumer preferences and not stated intentions. The first part of this chapter is going to describe and analyze all the theorems about the revealed preference technique. Who was the first to analyze the RP methodology?

The economic theory of demand states that an individual or an organization has the choice to acquire a bunch of goods over some others in that way so to maximize his or her utility (Lahaie, 2006). The question is how can a researcher study the behavior of such a consumer and come up with a forecast for his or her demand? RP surveys answer this question. Paul Samuelson (1948) was the first scientist who studied the revealed preference model. He stated that "*The economic theory of consumer's behavior can be largely built up on the notion of revealed preference. By comparing the costs of different combinations of goods at different relative price situations, we can infer whether a given batch of goods is preferred to another batch*" (Samuelson, 1948). The previous theorem is called "*The Weak Axiom of Revealed Preference*" (Varian, 2005). Samuelson's theory, although, was based upon two products or bunch of products. Houthakker in 1950 was the first to introduce the "*Strong Axiom of Revealed Preference*" which was simply a step forward to the original norm of Samuelson and introduced the RP method for more than two products (Varian, 2005).

In order for a researcher to derive to the results of a Revealed Preference survey certain approaches are being used in order to assist him or her to analyze them thoroughly:

- The first approach is the discrete choice modeling. In this approach the one who participate in the survey must choose among a number of different alternative choices. It is important to stress out that within this framework the given set of alternatives must display four important characteristics; first they must be totally different one to the other, secondly they must fulfill all the demanded characteristics of the examined individuals, thirdly they must be in finite numbers and finally each of the given alternatives must reflect to the utility function of the consumer. (Train, 2007).

- The second approach which helps us analyze the results of a RP survey is the random utility model. This theory is based on the fact that a given set of alternative choice has a certain probability comparing to the other set of alternatives which distinguish this model. Random Utility Model is usually the method which formulates the travel cost approach. This process is based on the fact that the cost of a certain "recreational" place is reflected upon its "recreational" value (Bateman, 1993).

- The third approach is the Hedonic Price Method (HPM). HPM was formulated by Dr. Sherwin Rosen of Harvard University. He stated that" *Hedonic prices are defined as the implicit prices of attributes and are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics associated with them*" (Rosen, 1974). Hedonic Pricing is a method of evaluating environmental quality through the use of substitute markets. The best example for understanding the HPM is the use of the real estate market as a substitute market. As we all know, the better the quality of air and the lower the noise pollution in certain areas result to higher prices of the rental properties (Gundimeda, 2006).

- A fourth revealed preference method is the averting behavior. This model estimates the cost of an undesirable environmental event for the public interest. For example, in an area where the water is contaminated, the cost of contamination is reflected upon the cost of the bottled water which an individual has to buy in order to avoid the contaminated water.

It is important to stress out that in several cases none of the above methods will be used because the effects of a state of nature are reflected directly to the market. For example, the effect of "infected" meat is reflected on the value of this kind of meat in the market.

Revealed Preference surveys have certain advantages and disadvantages. The advantages can be summarized into following two statements (Varian, 2005):

1. If an individual's revealed preferences are actually his or her real choices then the stated questions in the survey reflect people's real behavior.

2. It is easier to conduct a Revealed Preference (RP) survey.

RP has also several disadvantages (Varian, 2005):

1. The observed characteristics in a RP survey have low variability, so a researcher needs a bigger sample to examine in order to have reliable and sufficient outcomes and that requires higher research costs.

2. In some cases, in given research samples, certain characteristics are correlated and this results to a difficulty in evaluating and distinguishing the effects that they have in the factors of the model.

3. These set of choices are already defined and that creates low adaptability to different situations within the same framework.

2.2.2 Stated Preference Techniques

The term "*stated preference*" and stated preference surveys were very keen to the areas of psychology and marketing in the beginning of 1970s in the United States. Until that time, no serious research concerning this type of preference technique has been conducted. SP surveys are used for the evaluation of both marketed and non-marketed goods and services. Their importance, although, is on the determination of the non-marketed goods and services, thus, the non-use values. Their features are very vital for the determination of the Total Economic Value (TEV). Professors Green and Srinivasan were the first ones who introduced the idea of the "Stated Preference". In their research paper in 1978 they defined SP as "*a method of evaluating the consumer preference by rating a series of different alternative choices which have totally different attributes one to the other* "(Green, Srinivasan, 1978). They introduced, also, "*conjoint analysis*" which is the mathematical technique which determines the SP methodology (Green, Srinivasan, 1978). With this technique, which is highly used in market research, they managed to forecast customers' preferences in a practical and reliable way. Professors Bates and Terzis enriched the definition of "*Stated Preference*" by referring to it as "*a method which is referring to the techniques of developing mathematical models through the collection of the necessary information for this purpose which are based on the stated preferences of the respondents given the alternative hypothetical choices, for which their description are based on the fact that there are pre-established characteristics that have different levels of prices among them*" (Bates, Terzis, 1992).

SP methodology combines two approaches. The first one is the psychometric measurement of the attitudes of the consumers through their evaluation and quantification of their feelings (Norojono, Young, 2000) and secondly the functional measurement which Louviere (1984) referred as the "*judgment paradigm that relies on combinational experience and numerical rating scales as response modes*". The respondents in any Stated Preference survey need to tell the researcher how important they value a certain attribute, given the alternative options, in order the survey to evaluate and determine how the consumers will be better-off and increase their surplus in the economy (De Sarbo, Lehmann, Hollman, 2004). SP method is based on "purpose-designed" questions (Kroes, Sheldon, 1988).

SP methodology and techniques play an important role in the transport sector as well. Kroes and Sheldon (1988) analyzed these techniques by acknowledged that the consumer preferences in various transport alternatives are evaluated under this kind of surveys in order to maximize their utility. In fact, during the past few years and mainly in industrialized countries, SP techniques in the transport sector are preferred to the revealed preference methods (Ortuzar, Garrido, 1994). In most cases, Stated Preference (SP) surveys are preferred to Revealed Preference (RP) ones due to the fact that they overcome all of the restrictions of the RP technique. SP methodology gives to the researcher the opportunity to analyze all the different choices the respondents make and evaluate which of the characteristics of a given market play an important role to the consumer. How can we distinguish the Stated Preference techniques?

SP surveys are using two different techniques; the Contingent Valuation (CV) one and the Choice Modeling (CM). In the first technique respondents are being asked

directly either about their willingness to pay for a specific purpose or about their willingness to accept a compensation to give up this purpose. On the other hand CM technique is based on the evaluation of different alternative choices given certain characteristics to each of them that can be for example cost, average distance or frequency. Then the respondents weigh up these choices and through their answers, the researcher gains important insight about which characteristics play the most important role in a consumer's decision. This can be successfully implemented in a SP technique using specific design methods which manage to sustain that the variability of the different characteristics in any given alternative choice, is statistically independent one to the other. The different alternative choices must be clear and understandable. They must correspond to possible and realistic situations and be related to the problem-definition. In that way the questionnaire designed according to the above methods will be reliable and plausible and the answers will be more realistic. The respondents in Choice Modeling method state their preferences either by choosing a pair of different alternative choices, or rank the alternatives according to their attractiveness or evaluate the given choices in a climax of how important are according to their preference. Choice Modeling approach is divided into four different methodologies:

1. Choice Experiments
2. Contingent Ranking
3. Paired Comparisons
4. Contingent Rating

Stated Preference techniques have some distinguished advantages:

- They offer a variety of different alternative choices to the respondent and allow for the design of statistically viable models.
- They can be used for current or possible states of nature.
- The variability of different alternative choices lowers the cost of the survey and the amount of the interviews comparing to the ones which revealed preference surveys require.

SP surveys, although, have some disadvantages, as well, and they are the following:

- Stated intentions and actual behavior can vary and will create inconsistency to the research.
- SP survey design can be a complex issue.

Contingent Valuation and Choice Modeling are the two basic techniques in a SP survey. They are used to determine and evaluate the non-marketed goods and services and, in fact, their Total Economic Value. The design of this survey will be illustrated, in detail, into the next chapters. Given the advantages and the disadvantages of RP and SP surveys, is it possible to combine these two techniques in order to get safer results? This is going to be the topic of the next chapter.

2.2.3 Combine Stated and Revealed Preference data

In the previous paragraphs, we have indicated all advantages and disadvantages of conducting a Stated and a Revealed Preference survey. Ben-Akiva et al. (1994) suggested that both techniques of survey methodology can be used in a discrete choice analysis. They can also indicate the possibility of a purchase of a product or the frequency that this product is being bought (Ben-Akiva et al., 1994). Revealed Preference data are used to measure the "actual market behavior" whereas Stated Preference ones fail to address. SP data measure a greater variety of alternative characteristics of a "*system*" and quantifying all the different attributes of a good or a service and the attitudes of a consumer towards specific characteristics of that good or service. Is it possible to combine both these data? RP and SP data can be obtained either for the same individuals or from different trials. A combination of RP and SP data offer three advantages to a researcher (Ben-Akiva et al., 1994):

1. "*Efficiency*": Combined evaluation of preferences or feature's importance.

2. "*Bias Correction*": Responses which include both "preference" and "bias" constraints.

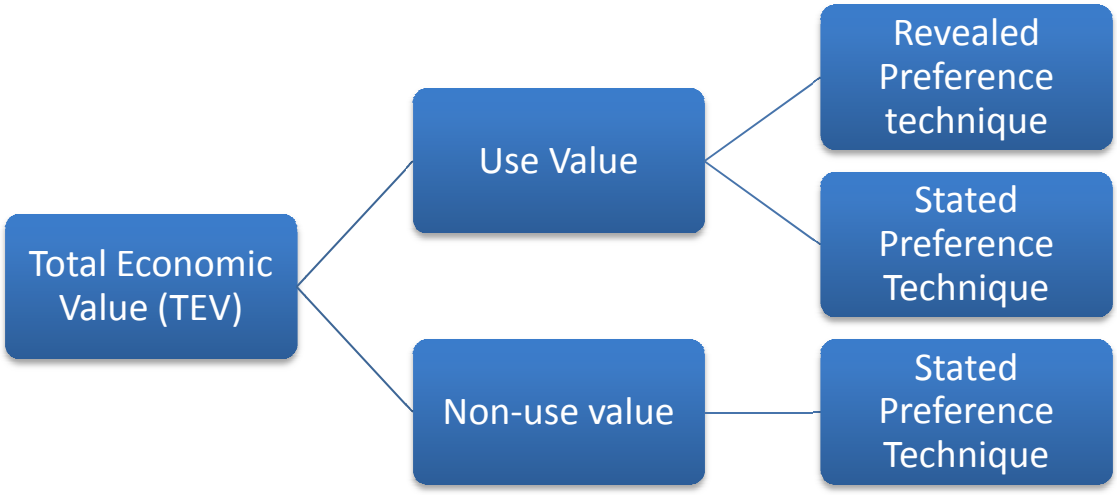
3. "*Identification*": Assessment for new goods and services which include both evaluation of the consumers' preferences and attribute levels of these new products.

The main characteristic of a combined RP/SP method is that the respondent's utility function is based on the same "*preference parameters*" and that assist the researcher to indentify the "*trade-off ratios*" between the most important characteristics of a system such as the cost or the frequency (Ben-Akiva et al., 1994). Bradley and Daly in 1991 and Hensher and Bradley in 1993 suggested that the best statistical approach to combine these two models is the "*nested logit*" one along with the assistance of some software packages (Ben-Akiva et al., 1994). It has also been studied by Carson et al. (2001) that there is a great correlation coefficient between Contingent Valuation and Revealed Preference estimates that reaches 83%, based on the Pearson correlation coefficient approach. The most important feature that lies on the combination of RP and SP data is the increase of the validity of a survey. As it is clearly shown, a combination of RP and SP data has been studied, thoroughly, on a theoretical basis, but the issue remains to be seen in actual practice. Elisabetta Cherchi and Juan Ortuzar (2002) combined these two survey methodologies in evaluating the new suburban train service in the city of Cagliari in Italy. Their RP survey was based on the extraction of data from actual behavior towards train services and a SP survey based on the same data evaluated all the attributes which individual find the most important on this type of service (Cherchi, Ortuzar, 2002). If we combine RP and SP data, we can exploit their advantages and try to limit their disadvantages in order to obtain a greater picture about actual consumer choice and attributes of a given product or service.

2.2.4 Choice between Stated and Revealed Preference technique

In the previous chapters, this thesis explained that the Total Economic Value (TEV) of a good or a service can be found by summing up the use value and the non-use value. Which of the two techniques, the RP and the SP are suitable for determining and evaluating both use and non-use values? Pearce and Ozdemiroglou (2002) suggested that both Revealed Preference and Stated Preference techniques are suitable to determine the use values for a certain product or service. Non-use values, on the other hand, can be evaluated only by an SP technique. **Figure 2.3** clearly demonstrate the above relation between these economic evaluation techniques:

Figure 2.3 Total Economic Value and valuation techniques



(Pearce, Ozdemiroglou et al., 2002)

Knowing all of the above, we can now determine whether an RP or an SP survey is appropriate for any given situation. RP and SP surveys can both be used for the determination of use values. The most important condition, although, is to question whether these techniques are practically viable. RP surveys are used to determine "*actual market behaviors*", but, if there is not an actual market for any given product

or service, RP surveys cannot estimate the use value and the only option is to use the SP technique. If there is an actual market for the RP survey to be based, then this technique and one of its relevant methods that is suitable to cover the requirements of the study is being used, thus, either Discrete Choice Modeling or Hedonic Pricing or Averting Behavior or market value.

RP technique, as it is illustrated in **Figure 2.3**, cannot determine non-use values (NUV). SP and its relevant approaches, Contingent Valuation and Choice Modeling, can be used in order to evaluate them. The question is to whether the non-use value is crucial can be answered only through the advice of an expert in this field of study. Pearce and Ozdemiroglou (2002) recommended that the importance of a NUV lies on the uniqueness and "*heritage*" aspect of the "*asset in question*". An example can be an important monument or a protected wetland. Moreover, NUV is present in a museum or a library, places where an individual tends to highlight their importance on educational purposes. Many empirical studies from the past tended not to evaluate NUV, but, this does not mean that NUV is not essential to be determined. Although it is clear that SP surveys can determine both use and non-use values, there are some "*cognitive limitations*" (Pearce, et al., 2002).

Respondents may not be fully aware what a small change in certain attributes of a product can cause. In order for the researcher to surpass these "*cognitive limitations*" he or she can do (a) Inform the respondent about the consequences of his decision with the assistance of relevant literature and (b) select the appropriate "*focus group*" (Pearce, et al., 2002). In cases where people are not fully aware of the consequences of their decision, then, an RP survey can lead also to confusing results. This is happening because "*wrong*" answers given by an individual, who is not fully educated about an aspect of a product or a service being questioned, leads to prices which have no impact to the actual market. Consequently, an SP technique can only be successful and credible if the respondents are fully aware of the consequences of their answers. Another advantage of an SP study lies on the fact that a researcher can alternate the various characteristics of a good or a service. On the other hand, in an RP survey, researchers cannot distinguish which criteria play important role in a consumer's decision (Pearce, et al., 2002). For instance, the price of a rental property is not based only on the size of it but on many more reasons that include environmental, aesthetic or health issues. If a researcher doesn't use the right survey, the causes of an individual decision cannot be determined. SP surveys are important, also, in the determination of transport demand. RP surveys, as Kroes and Sheldon (1988) suggested, "*Cannot evaluate demand under conditions which do not yet exist*".

As discussed in the previous chapter of this master thesis a combination of RP and SP techniques can be used in order to obtain validity in our research. Although, it is clear, now, that SP techniques are the ones which are consistently used because of their possibility to determine non-use values and the difficulty of obtaining all the necessary information to conduct an RP survey. This thesis will focus in the next chapter on the designing and execution of an SP survey.

Table 2.1 below gives a broader view of which evaluation technique is going to be used in any given situation.

Table 2.1 Evaluation techniques in any given situation

Situation	Appropriate evaluation Technique
Evaluate an NUV	SP
Need of maximizing reliability of the results	SP and RP. Important condition is a use value to be examined
Need of evaluating the characteristics of a good or a service.	Choice Modeling is preferred only if the alternative characteristics are related to each other. RP and Contingent Valuation can be used but they don't offer the possibility of obtaining many characteristics.
Free and flexible markets	RP
Question of the motives for the conducted evaluation	SP is offering the analysis of the behavioral motives in the answers of a survey
Doubt over the cognitive level of the respondents and the ability of perception towards the researched changes	All evaluation techniques are possible to fail
Need of sufficient update on the information about the results	SP

(Pearce, et al., 2002)

2.3 Perform a survey using Stated Preference technique

This chapter introduces and analyzes the steps which are followed in a survey using the Stated Preference technique. Before getting into more details, it is important to stress out that for a SP survey to be successful and have an add-value three important requirements must be met by the conductor of the survey (Pearce, et al., 2002):

1. Must be up-to-date with the latest progresses in the stated preference literature.

2. Must be proficient enough to design the questionnaire and the survey.

3. Must be able to analyze the data using econometric procedures.

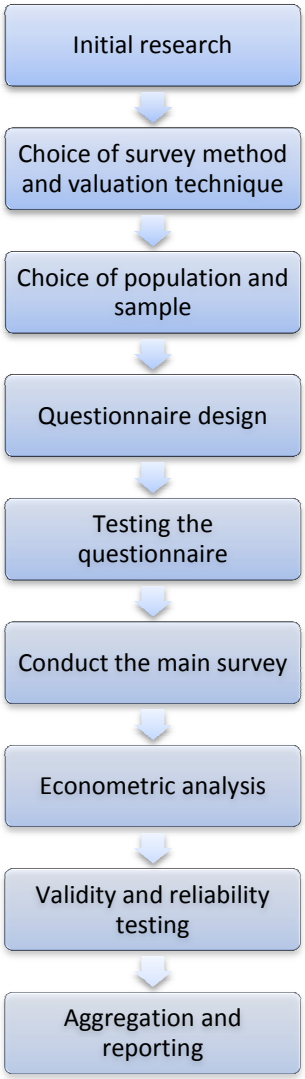
A common mistake that a surveyor using a SP technique does is asking a lot of information in a short amount of questions. A proper approach is the questions to be to "*the point*" and contain all the valuable information about the study. The questionnaire design, although, will be a subject of a next chapter. Let's first focus on the steps and procedures which a SP survey requires.

The steps of a Stated Preference survey, either using the Contingent Valuation (CV) method or the Choice Modeling (CM) approach, are similar. The only difference lies on the design of the questionnaire and the analysis of the extracted data (Pearce, et al., 2002). The first stage of a SP survey is the "initial research". In this primary step, we indentify which are the issues we need to address and answer and which items or attributes are being valued, either a good or a service. The second step includes the choice of the researcher of the survey method and the evaluation technique. The survey method is chosen among a list of different methods which include for example face-to-face interviews, mail or even a mix of those. The evaluation technique, on the other hand, is chosen amongst the two valuation methods of a SP survey, the Contingent Valuation (CV) and the Choice Modeling (CM) (Pearce, et al., 2002). If the survey and the valuation method have been decided, the next step is the choice of the population and the sample out of it which is going to take part in the study. In that phase a researcher should carefully select the "*targeted population*" and the right sample in order for the survey to be valid and credible.

When the researcher has settled out the first three important stages of a SP survey he or she must start to design the questionnaire. It is vital to mention that the design of the questionnaire is depended upon the valuation method the survey is using either CV or CM approach. Although for both types of methodologies, the most important is to clarify the form of the questions in order to obtain the required data and hypothetically the type of "*payment method*" which the respondent is willing to pay, either in the form of a tax, or donation et al. (Pearce, et al., 2002). In CM evaluation approach, in this step, the different case scenarios must be set. Moreover, the next stage of implementing an SP survey is the *"testing of the questionnaire*". In this stage, a small sample group of respondents answer the questions of the survey and the results determine whether the survey needs to be redesigned. This procedure may be done many times before the main survey is

executed which is the next step in the SP methodology. After the implementation of the main survey, the obtained results must be analyzed by econometrics experts (Pearce, et al., 2002). The analysis of the results is conducted differently for a CV method than a CM one. Additionally, the results must be tested for validity and reliability in order for the survey to have an add-value. Finally, the last step of the SP procedure is the collection of the results and the report of them to the target population. Some of these stages are examined in detail in some of the following chapters. In **Figure 2.4** all of the above mentioned steps of a SP survey are graphically shown:

Figure 2.4 The stages of analysis in a stated preference study



(Pearce, et al., 2002)

2.3.1 Choice of the technique of a Stated Preference survey

If a researcher chooses to conduct a survey using the Stated Preference technique, his or her next step should be to decide which evaluation technique will apply on the survey. The choices are two; Contingent Valuation (CV) and Choice Modeling (CM) methods. A general rule about these two types of techniques was given by Foster and Mourato in 2003 who stated: "*CM gives significantly larger or smaller values than CV depending on the inclusiveness of the good*" (Mogas et al., 2006). In the field of environmental economy, CV technique is mostly applied. CV methodology was the first technique of hypothetical-type surveys which was used (Mitchell, Carson, 1989). Despite its popularity in this field of economy, CV is not extensively used in the transport sector.

The choice of the surveyor is going to be, mainly, based on the amount of the details he or she needs to obtain from the different characteristics of the product or service being valued (Pearce, et al., 2002). In some cases, it is preferred to use both evaluation techniques, CV and CM, in order to increase the validity of the survey and evaluate in depth all of the relevant characteristics of the good or the service. A product or a service is thought to be divided upon a bunch of many characteristics. If a SP survey is focusing on evaluating all these different characteristics of that product or service, then, CM technique is more applicable (Pearce, et al., 2002). It is important to mention that the various characteristics, which are being examined, should be different to each other and their changes must not correlate. On the other hand, if the good or the service is being examined as a whole, then, CV technique is preferred. For example, if the studied subject is a forest as a whole, CV will be used to evaluate it but if the researcher is interested on evaluating the different characteristics of the forest such as the potential use for camping or the different excursion sites, CM method will be used.

The different features of a good or a service can be also evaluated by the CV technique. The problem, which frequently arises, is that the designed questionnaire could be unwieldy and challenging for the respondent (Pearce, et al., 2002). One other advantage of the CM technique is that all the statistical problems that may arise in the analysis of the results due to the correlation of the different characteristics of any good or service are solved through the successful design of a CM questionnaire (Pearce, et al., 2002). CV technique has a major drawback in the response process of the questionnaire. This problem is the so-called "*yea saying*". It appears in surveys which ask for a "Yes/No" answer. During this kind of surveys individuals, often, give a positive reply to questions which they believe the opposite. This situation is usually appeared in this kind of surveys for two reasons; first, the respondent is trying to satisfy the surveyor by saying yes when he or she really means no and secondly the interviewee may answer yes to a question which involves higher value than the one he or she believes a good or service is worth due to the fact that the respondent is not going to pay the higher price (Pearce, et al., 2002). This negative aspect of the CV technique can be solved either by the use of the CM technique where respondents can choose among different choices with which they can value their positive preference for a product or a service or researchers can implement CV design by forming "*open-ended*" questions like for

example "*How much you are willing to pay?*" rather than seeking for a simple "*yes*" or "*no*" answer (Pearce et al., 2002).

In every survey using the CM technique, the researcher must always assume that the sum of all the different attributes of a product or a service is equal to the value of the whole product or service. In order for a surveyor to test the validity of this assumption, he or she can verify that the whole value of a product or service which is obtained by CM technique is the same as if he or she was using a different approach (ex. Contingent Valuation) (Pearce, et al., 2002). Nevertheless, CV technique has, also, some advantages over the CM approach. If the researcher is well informed about what the effects of various changes in the attributes of a product or a service can cause, then, CV technique is preferred. If a surveyor is only interested on obtaining individual's WTP to avoid any given change CV design will best serve his or her purposes. Moreover, CM approach on the questionnaires' design requires the patience and the concentration of the respondent. There are many examples of misleading responses due to the big amount of different choices in the questionnaire (Pearce, et al., 2002).

To conclude, CM approach is always used in a SP survey where the objective is to evaluate all the different "*attributes*" or "*characteristics*" of a product or a service. Creating a questionnaire for that purpose by using CV technique would make the survey long and complicated. CM technique, also, ensures that the different changes in the attributes of a given product or service do not correlate. It is vital for a researcher to make sure that the attributes increase or decrease their value differently in any given choice in order for the survey to increase its validity and reveal the preferences of the consumers (Pearce, et al., 2002). Additionally, the increase range of these "*quantity variations*" in CM methodology result to a bigger range of variations of WTP and quantity. CM technique does not use "*direct monetary*" questions for the value of a good or a service but indirectly evaluate WTP through the use of statistical methods, "*choices*", "*rankings*" and "*ratings*" (Pearce, et al., 2002).

If a researcher has chosen the most applicable technique which fits the requirements of his or her survey, moves into the next step of choosing the right survey method. His or her choice depends on the capital and time availability. If the researcher is craving for higher quality and credibility more time and money will be needed (Pearce, et al., 2002). SP surveys obtain, generally, better results if they are conducted face-to-face. They are more expensive comparing to other types of survey methods but the researcher has the advantage of designing more complex questionnaires. In fact, the respondent can solve any query he or she may have, directly (Pearce et al., 2002). Although, other types of survey methods have other advantages comparing to face-to-face surveys. The most important thing to be mentioned here is that, given the cost factor which is vital nowadays, a researcher should make the choice of the right survey method that suits him or her through the use of the right sample out of the targeted population in order to obtain valid results (Pearce, Ozdemiroglou et al., 2002). Below in **Table 2.2** all of the different survey methods are presented along with the advantages and disadvantages each of them have.

Table 2.2 Main survey methods

Method	Advantages	Disadvantages
Mail surveys	Relatively inexpensive Lack of interviewer bias Easier to answer sensitive questions Can be completed at respondent's own pace	Low response rates 25-50 % Self-selection bias Time-consuming Little control over who fills the questionnaire Fixed question order No clarification or probing possible Restricts the use of visual aids Respondent can alter earlier responses
Telephone Interviews	Complex questionnaire structures are possible Cheaper than face-to-face interviews Permits probing and clarification Relatively quick to administer Easy to monitor 60-75 % response rates	No use of visual aids Restricts use of lengthy scales Respondent may get tired Respondents may not answer sensitive questions Non-telephone or non-listed respondents not sampled
Face-to-face interviews	Highly flexible Complex questions and questionnaire structure are possible Permits probing and clarification Larger quantity of data can be collected Potential for extensive use of visual and demonstration aids High response rates 70% + Greatest sample Control	Relatively expensive Possible interviewer bias Intercept surveys: samples normally not representative and self-selection bias Intercept surveys: questionnaires have to be short
Mixed methods: drop off surveys	Initial personal contact gives survey a "human face" Shares the advantages of mail and face-to-face methods	Survey form may be lost in interval before calling back Expensive
Mixed methods: mail + telephone surveys	Gives personal touch to the survey Can complete mailed questionnaire in own time	Shares some of the limitations of mail survey Relatively expensive
Computer assisted interviews	Subsequent analysis is quicker since data inputting stage is not necessary Permits more complex interviews Permits use of e-mail and internet	Possible rejection of "computer technology" E-mail/internet may preclude random sample unless wide coverage of PCs

(Pearce, et al., 2002)

2.3.2 Choice of population and sample

This chapter is going to introduce and analyze the most important aspect of any survey, the choice of the population and the sample. The choice of the desired group of respondents is a vital step in the survey design as it increases the validity and success of any research study.

Any given survey concerns a specific targeted population among individuals. The targeted population affects the nature and the sample of the respondents who are going to be part of a survey (Pearce, et al., 2002). Sampling is the procedure of choosing the appropriate respondents out of a population. If a survey is focusing on the general population, the sample will be selected out of this population. If, on the other hand, a researcher would like to study different "*stakeholders groups*" in order to distinguish their attitudes and WTP separately, then, sub-samples out of the targeted population will be created. The objective of any researcher is to gather the representative data of a given population (Bartlett et al., 2001). Quantitative methods assist this process. As Holton and Burnett (1997) stated "*One of the real advantages of quantitative methods is their ability to use smaller groups of people to make inferences about larger groups that would be prohibitively expensive to study*".

The biggest concern of a surveyor is to avoid biases. Consequently, the sample must be selected cautiously and the biases must be diminished. There are two types of sample biases (Pearce, et al., 2002):

1. "*Sampling Error*": The chosen sample does not represent the whole population.

2. "*Non-response error*": Some individuals out of a sample frame do not respond for some reasons.

A researcher can minimize the chances of a "*sampling error*" by following two types of safety measures. First he or she must select the desired sample in an "*unbiased way*" and second he or she must choose a big enough sample which will make the estimates to be precise (Bartlett et al., 2001). The desired sample group of any survey is also called sampling frame. A sampling frame can include either a small group of people or even a listing of bigger population units such as towns or even a whole nation.

Below in **Figure 2.5**, it is presented the three main steps which a researcher follows in order to select a sample out of a targeted population:

Figure 2.5 How to select a sample out of a population

(Pearce, et al., 2002)

The first step in this process is to choose the target population. As it was explained earlier in the chapter, the target population could be the population of a whole nation or a pre-determined small group of people. This is a vital step in the process as a wrong determination of the targeted population may lead to bias the results and decrease the reliability of a research study (Pearce, et al., 2002). The choice is influenced by the studied good or service and whether the research is interested in the use or the non-use value of a product or a service. If, for instance, non-use values are examined, a larger geographical coverage is needed. In some cases, where a researcher cannot define precisely the targeted population, "*secondary sources*" can also determine the beneficial effects of a studied good or service. An example of a "*secondary source*" can be boating club members who can determine the effects of the water pollution accidents. It is highly advisable that for a study and its final range of values to be credible, the researcher might need to choose more than one targeted population (Pearce, et al., 2002).

The second step in this process is the identification of the sample frame out of a population. The sample frame should include the group of people who are more closely to the characteristics of the targeted population which was chosen in the previous step (Pearce, et al., 2002). An example of a sample frame could be all the registered voters of a city or all the households that can reached with a telephone device. The most important is to choose the right frame in order for the studied good or service to be evaluated by a group of people who are actually using this good or service. The most typical problems in this step include either the omission of a group of people in the survey, or the participation of a group of people more than one time in the survey or the involvement of a group of respondents who are not interested to the study.

The final step of the process of identifying and determining the sample group of respondents out of a population is the selection of a sample out of the defined sample frame using probability sampling (Pearce, et al., 2002). All the different types of probability sampling and their advantages are illustrated in **Table 2.3**. Random probability sampling can be done only by the assistance of computer programs. Probability sampling is the desired approach in the sampling process, although other sampling procedures are also suitable, because it covers the needs of applying all the necessary statistical theory on the results in order to avoid the effect of bias in the "*sample selection*" (Pearce, et al., 2002).

Table 2.3 Types of probability sampling

Form of Sampling	Method	Advantages
Simple Random	Every element of the sample frame is given an equal chance of being selected	Simple
Systematic	Select every "k" element from a randomly ordered population frame	Simple
Stratified	Sample frame population is divided into distinct sub-populations. A separate and independent sample is selected for each stratum, using random sampling with either the same sampling fraction for each of the strata (proportionate stratification) or different sampling fractions (disproportionate stratifications). The data are used to develop separate within-stratum estimates. Finally the separate stratum estimates are combined (weighted) to form an overall estimate for the entire population.	Enables estimates to be derived for each sub-group, even though sub-group may be a small fraction of the population.
Clustered multi-stage	Population is divided into a set of groups or "clusters" but only a random sample of the clusters is selected. Cluster sampling involves sampling all the elements within the selected clusters, but the term is also used to cover multi-stage sampling, in which one selects only a random sample of the elements within the selected clusters.	For surveys of large populations that possess some sort of hierarchical structure, multi-stage sampling is generally more convenient and more economical than one-stage simple random sampling. Multi-stage sampling is attractive when no overall sample frame is available.

(Pearce, et al., 2002)

According to Robert M. Grooves, Floyd J. Fowler, Mick P. Couper, James M. Lepkowski, Eleanor Singer and Roger Tourangean (2009), a main concern of a researcher in the sampling process is that, sometimes, the desired group of interviewees is not covered completely. For example, if a survey's sample frame is the population of a whole nation, the researcher will first have to search this sample frame by using the "*yellow pages*". The problem that will appear is that not all households have telephone services and the survey will give misleading results as not all the desired group of people took place in it. This is called "*sample overlap*". The range of the sample overlap determines the accuracy of the approximation of change in two different situations (Mach, Reiss, Schiopu, 2006). This can be solved

by either maximizing or minimizing the sample overlap. If the sample units which are being overlapped are "*primary sampling units*", an "*overlap maximization*" practice could be the appointment of another surveyor. If the sample units are "*ultimate sample units*", a maximization solution will minimize the extra charges of a new interview. On the other hand, the "*minimization overlap procedure*" is used in order to reduce the "*respondent's burden*" (Ernst, 2005).

To conclude, if the size of the selected sample is getting bigger the result will be more precise. This will increase, as well, the cost of the survey. Consequently, the correct size of a sample frame is affected by the following reasons (Pearce, et al., 2002):

1. The variance of the population
2. Accuracy in the estimation process
3. The response rate
4. The necessity for "*sub-samples*"
5. The accessible resources

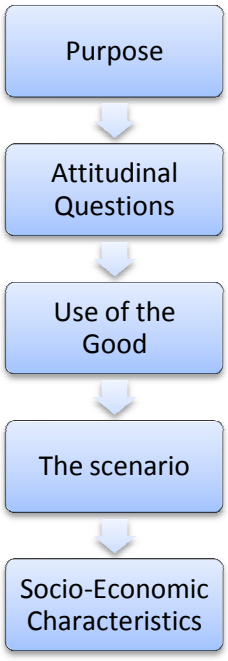
2.3.3 Questionnaire Design

2.3.3.1 Contingent Valuation

In this part of the master thesis, it is going to be analyzed the design of the questionnaires in a Stated Preference survey. From previous chapters, it is already explained that there are two methods which are being used in an SP survey, the Contingent Valuation and the Choice Modeling. In this part of the chapter we are going to explain all the steps which are required to be followed in order to design a questionnaire using the Contingent Valuation approach.

CV methodology is applied in a SP questionnaire design in order to evaluate the WTP or the WTA of the studied product or service by interviewing the random sample that is being selected by the researcher. The types of questions which are being used by the CV technique are straightforward. An example could be "*What are you willing to pay*?" for that good or service in question (Pearce, et al., 2003). The structure and the various steps which are being followed by the researcher using the CV methodology are illustrated below in **Figure 2.6** (Pearce, et al., 2003):

Figure 2.6: Steps and Structure of a contingent valuation questionnaire



(Pearce, et al., 2002)

An important step in the design of a CV questionnaire is to define the purpose of the questionnaire, thus, the purpose of conducting the survey. The respondent will realize from the beginning what he or she has to answer and what is the context of this study. The latter must be designed on a realistic basis in order to get realistic and pragmatic answers. The surveyors should always introduce themselves and for whom they are conducting the survey (e.g. non-profit organization). They must, also, guarantee the respondent that his or her answers will remain confidential (Pearce, et al., 2002).

The second step in a CV questionnaire design is the formulation of "*attitudinal questions*" (Pearce, et al., 2002). With these kinds of questions, the researcher is seeking to reveal the respondent's attitudes towards some general issues regarding the studied product or service.

In the third step of this process, the researcher is posing questions to the respondents regarding the use of the studied product or service. In that way, he or she can separate the "*users*" from the "*non-users*" (Pearce, et al., 2002).

The most important stage in the questionnaire design of a CV survey is the formulation of the "*valuation scenario*". In that particular step of the survey, the respondent evaluates the studied good or service through a number of different scenarios. In that way the researcher achieves to identify the studied good or service and evaluate the consequences of the changes given the different scenarios. It is vital, although, that the survey must not include many different scenarios as the respondent might be confused and the survey will deteriorate from its primary purpose. Moreover, if the different scenarios are not well indentified the responses will be pointless. "*Well defined scenarios*" is the key for the success of the survey. The valuation scenario must be aligned with the primary purpose of the survey (e.g. the necessity of a park in a residential area) and with the "*institution*" which is liable to offer that good or service (in our example can be the government or the municipality). As a result, the survey will be credible and a mutual trust among the respondents and the researcher will be created because the interviewees will realize that their answers will add-value to the study and there are not taken any final decisions regarding the studied good or service prior to their participation to the survey. In the valuation scenario of a CV survey design, three important steps are included; the "*payment vehicle*", the "*value elicitation questions*" and the follow-up ones (Pearce, et al., 2002).

The "*payment vehicle*" is the first stage in the valuation scenario of the CV survey design. During this process, the researcher determines the way the respondent will hypothetically pay for that good or service. The nature of the good or service distinguishes the type of the payment vehicle that will be used. There are not specific rules that govern the choice of the "*payment vehicle*". If for example the studied good or service is for the use of a local community, a national tax as a "*payment vehicle*" won't be the appropriate type to use (Pearce, et al., 2002). There are two types of "*payment vehicle*": The "*coercive*" one which includes the national tax, the local tax, the fee and the price increase. The second type of "*payment vehicle*" is the voluntary one and includes the several forms of donations (Pearce, et al., 2002).

The most important stage in the "*valuation scenario*" is the formulation of the "*value elicitation questions*". These types of questions will determine and evaluate the respondents' willingness to exchange the studied goods or services for money. The purpose of the "*value elicitation questions*" is to extract the respondent's maximum WTP or minimum WTA for the examined product, the two types of valuation measures which the theory of economic valuation is based on (Pearce, et al., 2002). The format of this type of questions can be classified in five different categories which are widely used in a CV survey; "*Open-ended elicitation*", "*payment card*", "*bidding game*", single-bounded and double-bounded dichotomous choice (Pearce, et al., 2002). In the following paragraphs the different formats and their advantages and disadvantages are going to be analyzed.

The "*open-ended*" format is focusing on indentifying the maximum WTP of the respondent, thus, the maximum amount that people are willing-to-pay for a good or a service through a particular payment vehicle (Heinzen, Bridges, 2008). A typical question in the survey could be "For *this good what is the most you would be willing to pay*?" (Heinzen, Bridges, 2008). "*Open-ended*" elicitation format has several advantages and disadvantages in its use in a CV survey. The advantages are the following (Pearce, et al., 2002):

1. It is simple to use it.

2. Avoid respondents' biases due to the fact that it does not give a hypothetical value to the studied good or service.

3. The researcher can extract valuable information because the respondents' maximum WTP is directly indentified.

4. It involves simple statistical techniques in the analysis of the results.

It has also a disadvantage (Pearce, et al., 2002):

1. It contains large percentages of people which don't respond in the survey or give unreliable and unrealistic values. This problem lies in the fact that respondents find it difficult to value and give their maximum WTP for a good or service which they have never used it before or evaluated it in the past.

The first CV elicitation format which has been used in the past is the "*bidding game*" (Heinzen, Bridges, 2008). In this type of format the researcher is trying to find the respondents' maximum WTP for a good or a service by a number of "*yes/no*" questions (Heinzen, Bridges, 2008). The researcher would provide the respondent a value for that product and if he accepts it, he or she would give higher values until the point where the respondent will reject the offer. At that particular point the WTP of that product is found. The opposite is happening if the respondent does not accept the initial offer of the researcher. The surveyor will propose new offers which are lower and the maximum WTP will be indentified in the point where the respondent will finally accept the offer. This format also contains some advantages and disadvantages. The advantage is the following (Pearce, et al., 2002):

1. It assists the respondent to carefully evaluate all the alternative offers and consider their preferences.

The disadvantages of this elicitation format are the following:

1. It may leads to biases since the respondents may be predisposed by the initial offer.

2. The phenomenon of "*yea-saying*" appears.

3. It is impossible to use it in surveys which the respondents fill out the questionnaires by themselves or in mail surveys.

The "*payment card*" elicitation method offers to the respondents a large list of different prices and in response the interviewees select either the one that satisfies and represent their maximum WTP or put a cross to the prices which are not willing to pay for or leave a blank to the prices which they cannot decide if they are the appropriate for their maximum WTP (Heinzen, Bridges, 2008). The advantages of this format are the following (Pearce, et al., 2002):

1. Due to provision of many different bids, biases by the respondent of the starting point bid are prevented.

2. It reduces the possibility of outliers comparing to the other elicitation methodologies.

3. The researcher can use the payment card value as a benchmark for the actual household or industry costs.

The disadvantages of this methodology, on the other hand, are the following (Pearce, et al., 2002):

1. It may be exposed to biases related to the range of the different values that are proposed to the respondent.

2. It is impossible to use in telephone surveys.

"*Single-bounded dichotomous choice*" is another elicitation format which is used in the valuation scenario of a CV survey. During this type of methodology, the respondent is simply asked to answer with a yes or no to a bid in relation to his or her WTP. It is important to stress out that during this format, bids are proposed in a random order throughout the studied sample .The advantages of this format are the following (Pearce, et al., 2002):

1. It simplifies the response process. The respondents have to decide if they are going to give the proposed value for this particular purpose as they do in any actual market.

2. It reduces non-response rates and large outliers.

The disadvantages of this methodology are the following (Pearce, et al., 2002):

1. Studies have shown that this format results to higher WTP values than the ones which are found by previous elicitation formats.

2. "*Yea-saying*" phenomenon is appeared.

3. Insufficient methodology in the sense that the researcher achieves only to realize if the WTP of an individual is higher or lower to the proposed value.

4. Starting point biases appear.

The final elicitation format contains the "*double-bounded dichotomous choice*" (Pearce, et al., 2002). The methodology which is followed in that particular format is the same as in "*single-bounded dichotomous choice*". The respondent must answer with a yes or no in a particular offer given by the surveyor. The difference lies on the fact that, depending on the answer of the interviewee, the researcher is offering a higher or a lower offer to the one which was proposed before. The respondents will have to answer to this new bid again with a yes or a no. The advantage of this format is the following (Pearce, et al., 2002):

1. It is more effective than the "*single-bounded dichotomous choice*" because the researcher extract more information about the WTP of an individual.

The disadvantages of this method are the same with the "*single-bounded dichotomous choice*" (Pearce, et al., 2002).

It is vital to choose the correct and reliable elicitation format because the already mentioned methodologies provide different estimates each time they are used. The formats which are typically used are the "*payment cards*" and the "*dichotomous choice*" ones. The first methodology extracts more information about individual's WTP and is cheaper to employ it than the "*dichotomous choice*" formats and is better than the "*open ended*" and "*bidding games*" ones (Pearce, et al., 2002). The second one is also preferred by the researchers because it is easier to use it and assist the evaluation process of the respondents. Both of these methodologies allow the respondent the state of uncertainty in any of his or her evaluation. "*Payment cards*" through the process of not filling a value with a symbol (either with a cross or a tick) and the "*dichotomous choice*" formats through the use of the "*don't know*" option (Pearce, et al., 2002).

The next stage of a CV survey design is the use of follow-up questions (Pearce, et al., 2002). The fact that the previous process of elicitation formats allow the

researcher to define the WTP or WTA of an individual, leads the surveyor to pose these questions in order to realize and understand the motives of the respondents that lies behind the answers in the elicitation questions. Follow-up questions can appear to be very valuable in the case where there is a protest or an unwillingness to pay for the studied good or service by the respondents (Pearce, et al., 2002). Finally, this stage assists the researcher to evaluate the reliability of the proposed case scenario.

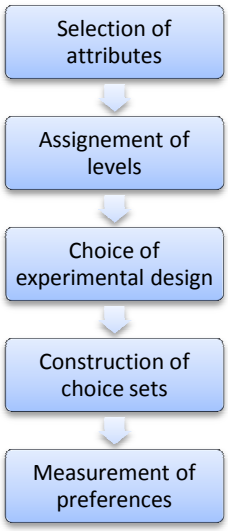
The final step of any CV survey contains questions on the social and economic characteristics of the respondents (Pearce, et al., 2002). The researcher uses this information in order to check if the WTP of the respondent is in line with his or her economic background. In that way it can be measured the credibility of the answers. Examples of characteristics the researcher in interested to find out are the age, sex, interests, income and educational level of the respondents (Pearce, et al., 2002).

2.3.3.2 Choice Modeling

This chapter will give the reader an overview about the design and preparation of a questionnaire using the Choice Modeling approach. CM methodology, being one out of the two approaches which are used in a survey of Stated Preference technique, evaluates the non-marketed goods or services by focusing entirely on the analysis of the different attributes or characteristics each product is accompanied with (Pearce, et al., 2002) and the layers each of them are classified. If a researcher wishes to change the attribute levels of a given good or a service, CM is the approach that will assist him or her to evaluate the effects of the changes on certain characteristics of that product. The process of altering the attributes of a certain good or service will result in a completely different situation that needs to be evaluated and it is the CM technique which will entirely focus on extracting this valuable information for the researcher (Pearce, et al., 2002). The biggest difference of the CM technique comparing to the CV one is that respondents are being asked to give "*rankings*" or "*ratings*" to the studied products according to their preferences rather than evaluate them. In that way, "*protest votes*", a disadvantage of many of the elicitation questions in the CV methodology, won't appear in CM technique as respondents will have to rank or rate the different options rather than evaluate them in monetary terms. It is vital, although, that for the CM methodology to extract the necessary information about the studied good or service to include a "*money indicator*" as one of the given attributes which can take the form of a tax or a price or a charge (Pearce, et al., 2002).

Choice Modeling technique has, just as CV methodology, certain design stages which are followed in order to successfully implement a research study. The steps of the CM approach are five and are illustrated below in **Figure 2.7**.

Figure 2.7: Design stages of Choice Modeling approach



(Pearce, et al., 2002)

The first step in a questionnaire using the CM approach is the selection of the attributes. These are certain characteristics of the studied product or service which the researcher believes are vital for the study he or she is conducting. The selection is often being done with the assistance of either relevant literature review or various focus groups discussions or even through questioning directly the respondents about their opinion on the importance of certain attributes of a given good pr service (Pearce, et al., 2002). Usually, the attributes which are being selected are the ones which will be directly influenced by a certain policy assessment. One attribute which will have to be chosen in any research study must be the cost of the studied product or service due to the monetary nature of it that will assist the researcher to evaluate the WTP of the respondents. The appropriate cost level and payment vehicle is again a difficult decision and the issues which are being raised are the same as in the CV technique. The characteristics of the researched product or service which are being chosen must not be more than 4 or 5 (Pearce, et al., 2002).

The second step in the design of a survey of the CM methodology is the assignment of the attribute levels. The levels of the selected attributes should be reasonable and into the range of the respondents' expected preferences. Moreover, they must include the desired policy target. It is important to stress out that a successful CM survey must have to have the "*do nothing*" option and the existing level of the selected attribute in order to extract the WTP of a gain or the WTP to evade a loss, information which is the main focus of any given survey (Pearce, et al., 2002).

The third stage consists of the choice of the appropriate experimental design. In this part of the survey, the researcher, through the assistance of the statistical theory, combines the various attributes levels and creates the appropriate scenarios which will be presented in the interviewees (Pearce, et al., 2002). The statistical tool which is usually used in this part of the survey is the factorial design, a method which will be explained in the following chapters.

The next step is the "*construction of choice sets*". The scenarios which were created in the previous step are put into several choice sets and are presented to the respondents. The different choice sets, which must not be more than 6, can be either given to the respondents one by one or in groups or pairs. The technique which is being used will determine the appropriate distribution of the different choice sets (Pearce, et al., 2002).

The last stage in a CM survey is the measurement of the preferences. During that step the survey procedure is being chosen. The process is the same as in a survey using the CV methodology (Pearce, et al., 2002).

CM survey can be conducted by using four different alternative options (Atkinson, Mourato, Pearce, 2006). These are the Choice Experiments, the Contingent Ranking, the Contingent Rating and the Paired Comparisons. An interesting research study by Anna Merino-Castello (2003) revealed that the above mentioned four different alternative options for a CM survey can be divided into two smaller groups. Contingent Rating and Paired Comparison methods have a performance-based nature whereas Contingent Ranking and Choice Experiment have a choice-based one. This separation is proposed in order to reveal the difference in the estimation procedures of these four alternatives. The former two options use the "*deterministic utility function*" and the "*ordinary least squares*" to conduct their

estimation procedure whereas the latter two make use of the "*random utility function*" and the "*maximum likelihood*" (Merino-Castello, 2003). Another important aspect regarding these alternative options that needs to be addressed at this point of the chapter is that Choice Experiments are the only method that its results are in accordance to the welfare theory. Contingent Ranking can also extract results which are consistent with the welfare theory if and only if the "*do-nothing*" option is included in the questionnaire (Merino-Castello, 2003).

One of the alternative options in the CM approach is the Choice Experiment (CE). The design and the procedure of conducting a survey under this option is the same as in any other alternatives, and it was explained previously in the chapter. The first ones who used the term "*Choice Experiments*" were Dr. Louviere and Woodworth in 1983. In 1994 Adamowicz et al. conducted this method in environmental management problems. On the other hand, during the same period, Choice Experiments methodology were used in other scientific fields such as marketing and transport economics (Hanley et al., 1998). In CE researchers present a scenario which is based to the current situation of the studying field and various other alternatives in which the selected attributes are changed in quantity (Pearce, et al., 2002). One of the attributes must be of monetary nature in order to evaluate the WTP of the respondent and represent the payment vehicle of the study. The structure of a CE survey is designed to include three different options, A, B or neither. The choice of the "*neither*" option should be included in order to stress out the possibility that respondents are in favor of the current situation of the studied field (Pearce, et al., 2002).

CE methodology is a combination of the "*characteristics theory of value*" and the "*random utility*" theory (Hanley et al., 1998). As it is noted above, CE technique is the only one amongst all the different alternative options that is consistent with the welfare theory for four reasons. Firstly, it offers the interviewees the opportunity to trade-off the adjustments in the various attribute levels in opposition to the actual cost of conducting these changes. Secondly, the respondents can choose to maintain the current situation of the studied good or service rather than altering it. Thirdly, the statistical and the econometric techniques which are used are following the same norms of the theory of "*rational and probabilistic choices*". Finally, a fourth reason is that researchers can obtain 'estimates of compensating and equivalent surplus (Merino-Castello, 2003).CE surveys can be efficiently designed by using multinomial logit models. Orthogonality is another principle which CE surveys use (Alpizar et al., 2001). Both of these principles will be analyzed in the next chapters. Problems that arise in a CE surveys are similar to the ones which arise in any given survey. Respondents may not be fully aware of the different attributes and the amount of the choice sets may affect the quality of the survey. Researchers have the opportunity to tackle these problems by conducting "*verbal protocols*". For instance, the respondent can read the questionnaire out loud or think loudly when responding (Alpizar et al., 2001). The same procedures are also used in a CV survey.

Figure 2.8 Choice Experiment questionnaire

	Option A	Option B	Changes in attribute level from A to B (+ better, - worse)
Attribute	A1	B1	+
	A2	B2	-
	A3	B3	+
	A4	B4	+

(Pearce, et al., 2002)

Contingent Ranking (CR) is another alternative approach under the CM technique. CR methodology follows the same procedure as the CE one. The difference lies on the fact that CR approach is based on the fact that the respondents are being asked to rank the given alternative options in terms of their desirability and preferences (Pearce, et al., 2002). The extracted data of this approach give wider statistical information and this leads to smaller confidence intervals of the estimates. The latter procedure is being done by the assistance of rank ordered and exploded logit models (Merino-Castello, 2003).

Figure 2.9 Contingent Ranking questionnaire

	Option A	Option B	Option C
Attribute	A1	B1	C1
	A2	B2	C2
	A3	B3	C3
	A4 (monetary value)	B4(monetary value)	C4 (monetary value)
Ranking of options 1…….2……..3			

(Pearce, et al., 2002)

A third alternative technique in a CM survey is the Contingent Rating. Under this methodology the respondent evaluate each of the different alternative scenarios individually by ranking the given options on a numeric or semantic scale (i.e. from 1-10, 1 being the least preferred one and 10 the most preferred one) (Pearce, et al., 2002) (Merino-Castello, 2003). The fact that the different scenarios are not evaluated all at once makes the Contingent Rating technique a weaker one comparing to the other methodologies of a CM survey (Merino-Castello, 2003). Respondents' ratings create a utility scale through which the evaluation for the studied good or service is being done. "*OLS*" regression techniques are used to assist to the above data transformation but the drawback is that none of them are in accordance to the traditional consumer theory. This is another disadvantage of the Contingent Rating approach (Merino-Castello, 2003).

Figure 2.10 Contingent Rating questionnaire

Attribute	Option A A1 A2 A3 A4
Tick one level showing your preference for option A 1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 9 – 10	
Very low preference	Very high preference

(Pearce, et al., 2002)

Paired or Pairwise Comparisons (PC) are the fourth and the last survey technique under the CM methodology. The procedure is the same as in any other alternative CM technique with the difference that the respondent evaluates two different scenarios at once and in a numeric scales of 1-10 tick either closer to one if he or she prefers scenario A or closer to 10 if he or she prefers scenario B (Pearce, et al., 2002) (Merino-Castello, 2003). The advantages of this technique comparing to the previously mentioned one are the following (Ngo, 2009):

1. Assist the researcher if his or her priorities are not clearly indentified.
2. Assist the researcher in cases where there are no objective data to support on.
3. Assist the researcher to determine the priorities in cases where there is conflicting demands in his or her resources.
4. Assist the researcher to evaluate which is the biggest problem that needs to be solved.

Figure 2.11 Paired or Pairwise comparisons questionnaire

	Option A	Option B	Change in attribute level from A to B (+ better, - worse)
Attribute	A1	B1	+
	A2	B2	-
	A3	B3	+
	A4 (monetary value)	B4 (monetary value)	+
Tick one level 1 – 2 – 3 - 4 – 5 – 6 – 7 – 8 – 9 – 10			
Strongly prefer A			Strongly prefer B

(Pearce, et al., 2002)

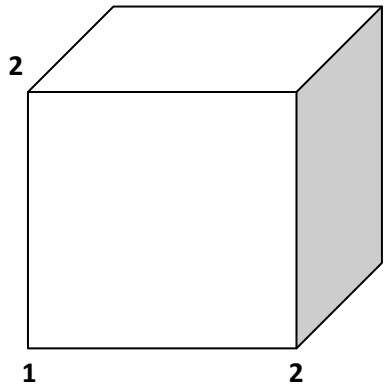
Nevertheless, all of the alternative techniques in CM survey require the researcher's knowledge of several statistical techniques. An introduction to some of those will be given in the following chapters.

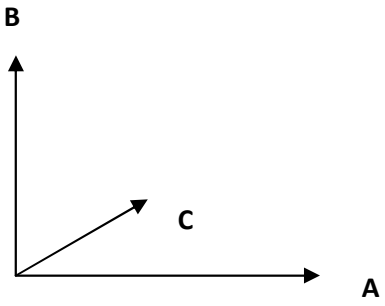
2.3.3.2.1 Factorial Design

A very important stage in the design of a Choice Modeling questionnaire, as we have seen in the previous chapter, is the experimental design. It is important to recall and stress out that with the term "*experimental design*" we mean the procedure which the researcher create the alternative choice sets which are going to be presented to the respondent. Each of the different scenarios (choice sets) is a combination of their characteristics or attributes and the various levels of them (Pearce, et al., 2002). The researcher uses this variation of the levels of the attributes to create a factorial design, only in experiments where two or more attributes with two or more levels are required to be studied (Hensher, 1993). A factorial design which includes all the possible alternative choices of all the different levels of the characteristics is called a full factorial design (Louviere, Hensher, Swait, 2000). Full factorial designs assist the researcher to evaluate and approximate all the statistical outcomes for each and every characteristic, given a particular choice set (Hensher, 1993). An important aspect in cases where a researcher conducts any statistical design such as the factorial one is the orthogonality. Full factorial designs contain this aspect. With the term orthogonality we mean that all the attributes which are presented to the respondents do not correlate with each other. A change in a level of one attribute does not affect the state of nature of the other attribute (Hensher, 1993). Orthogonality creates statistically significant survey results and increases the reliability of the study (Hensher, 1993). A drawback of full factorial designs lies on the fact that in cases where the amount of the attributes and their levels increase, the number of different scenarios increase as well and their study and presentation to the respondents is becoming a difficult task. For instance, if there is a situation where there are 5 different attributes with five different levels each, the full factorial design will include 5^5 = 3125 scenarios.

In order for the reader to better understand the model of full factorial design, it is going to be presented a simpler example in which only 3 attributes (A, B, C) are being studied with two levels each. Thus, our experiment has only 2^3 = 8 different scenarios. We can graphically represent the experiment, below, by the cube in **Figure 2.12**. In each side of the cube the two levels of the attributes are illustrated and the arrows represent the increase of them.

Figure 2.12: 2^3 Factorial design graphical representation





(Louviere, Hensher, Swait, 2000)

Due to the fact that there are only two levels in this example, we denote the higher level as +1 and the lower level of the given attributes as -1 in **Table 2.4** below. A simple method of remunerating all the alternative scenarios in accordance to the full factorial design is the following; in every column (i) of **Table 2.4**, which represents the A, B, C attributes, we first insert -1 and we repeat it for 2^{i-1} times (since in our example we have only two levels) (Dasgupta et al., 2009) (Louviere, Hensher, Swait, 2000). Consequently:

- In the first column the level is changing every $2^{i-1} = 2^0 = 1$
- In the second column the level is changing every $2^{i-1} = 2^1 = 2$
- In the third column the level is changing every $2^{i-1} = 2^2 = 4$

If we follow the above procedure the full factorial design of 2^3 can be illustrated below in **Table 2.4**:

Table 2.4: Full Factorial Design of 2^3

	A	B	C
1	-1	-1	-1
2	+1	-1	-1
3	-1	+1	-1
4	+1	+1	-1
5	-1	-1	+1
6	+1	-1	+1
7	-1	+1	+1
8	+1	+1	+1

(Louviere, Hensher, Swait, 2000)

Each of the columns in **Table 2.4** has a sum of 0 since orthogonality is a prerequisite for a successful experimental design.

There are several experiments which contain more alternative scenarios than the previously mentioned example. In these cases full factorial design is no longer applicable. Researchers use the fractional factorial designs. Under this methodology a part of the full factorial design is presented to the respondents. Although fractional factorial designs may be applicable to survey designs with a larger amount of different scenarios, the “lost” of orthogonality in the results is an issue that researchers need to take under consideration (Louviere, Hensher, Swait, 2000).
.

Several problems may appear even when researchers use the fractional factorial designs for conducting the experimental designs of their CM surveys. Occasionally even with the use of fractional factorial designs the numbers of scenarios are not decreased and the respondents become alienated. An effective measure in order to decrease the amount of scenarios is to distinguish the superiority of the given choice sets. If, for example, a scenario is clearly superior than another one the choice of the respondent will be obvious. The researcher will have to realize that the inferior scenario must be deleted from the choice sets. Moreover, another drawback in the experimental design lies on the content of the choice sets. Thus, certain combinations might not be possible. It is vital for the researchers to understand all these problems and find a solution in order to conduct a successful and reliable CM survey.

2.3.4 Testing the questionnaires

A survey would not be credible and have an add-value if the researcher does not test the questionnaires. The design and testing of questionnaires are vital procedures for the success of any survey. Many critics agree that inadequate design and testing of the questionnaires lead to a study's failure. A researcher must test, revise and even retest the questionnaires. A successful sequence of acts is given by Pearce et al. (2002):

- The first step is the creation of a focus group, thus, a group of people which answer a first draft of the questionnaire. They are discussing the content of the questionnaire, if the questions were understood, if the issues raised were clearly stated and if they touched upon a sensitive task. Moreover, they are discussing if the methodology that was used was the right one for the particular studied good or service. A focus group is usually a group of 6 to 12 people and their debate last for approximately one hour. The number of focus groups depends on the studied issue. The most important is that there must be at least one focus group for any group of people interested on the studied subject. When the debate is ended, the questionnaires are revised and depending on the answers that were given, some corrections are made in order for the researchers to acquire as more information about the good or service in question as possible.

- The next step is the pilot testing of the questionnaires. Usually, this stage involves a larger amount of people than the focus groups, from 25 to 100 respondents. The exact sample is dependent upon the difficulty of the questionnaire design. Pilot testing is conducted many times and the exact number of iterations is based upon the amount of information that is gathered each time.

- The final version of the questionnaire, after the continuous testing, is given to the predefined sample of respondents in the manner we explained in the previous chapters.

2.3.5 Analysis of the data

One of the last stages in a SP survey is the analysis of the questionnaires. With the term analysis we mean, the procedure where the researcher gathers all the extracted data of the survey and convert them into valuable outcomes. In a CV survey, as it is vital for the researcher to carefully design the questionnaire, it is also important to carefully analyze the results of the study. It is of great significance the quality of the analysis of the results because a poor study with a thorough analysis will have a bigger add-value to the community comparing to a well designed study with a poor analytical process (Pearce, et al., 2002).

To recall, the researcher must ensure that before he or she analyzes the results four tasks must be accomplished (Pearce, et al., 2002):

1. Selection of the studied population who's WTP/WTA for the good or service in question is studied.

2. The sample of the population is selected.

3. A CV questionnaire is designed with the main focus on preparing the elicitation questions on the WTP/WTA of respondents in cases where the studied good or service has been changed in its provision.

4. The sample of the population has been tested before the final version of the questionnaire is given to the selected respondents.

The analysis of the data of the questionnaires targets onto finding the mean and the median WTP/WTA of the respondents for the studied good or service. Another objective of the analysis is that it provides equations which may help future studies. Researchers, before proceed into thoroughly analyze the collected data, must first summarize their findings. During that stage they must define the answers which do not reflect to the WTP of the respondents. These cases can be (Pearce, et al., 2002):

- The ones who do not answer the "*valuation questions*".

- The ones who give a zero value appraisal to the studied good or service and not their actual WTP.

- The ones who give unrealistic values for the product in question.

The analyst's decision on indentifying the non-valid answers is a difficult task. The design of the questionnaire must assist the analyst on this decision by containing the following "*sources of information*":

- Questions which define the reason why there is not given answers for the value of the studied product or service.

- Questions which define the respondent's reasons of giving a zero WTP for the good or service in question.

- Comparing the WTP offered by the respondent to his or her actual income and ability to pay.

Often, "*non-valid responses*" reveal the objections respondents have into evaluating the CV scenario. For instance, if they are asked to evaluate a product which they believe it must be offered for free. Respondents with these objections must be pre-defined into the testing stage of the survey. In fact, due to the unknown WTP of this group of respondents, the researchers must erase them from the survey. It is vital, although, that, the group of people who still participating in the survey must acquire the same "*characteristics*" of the previous sample (Pearce, et al., 2002).

Analysts must study the remaining sample of respondents in order to define if a certain weight to the responses of a particular group of people must be given. An ideal situation would have been if every participant had an equal opportunity to be in the sample. Usually, although, the sample which is chosen is not symmetrical and the data that are going to be found are not representative of the whole population (Pearce, et al., 2002). Analytical weight corrects this problem.

In CM surveys the same problems appear in the analysis of the data of the questionnaires. In fact, the gathering of the data in a CM survey is a more demanding task than in the CV survey because each case contains details for the different levels of the scenarios and a monetary attribute that shows the WTP of the respondent. The analysis of the data in a CM survey requires the use of some econometric models that can describe discrete choices in order for the researcher to reach his or her goal in this part of the survey, thus, the mean WTP of the respondents (Pearce, et al., 2002). In the following two chapters, two of the widely used econometric models, Logit and Ordered Logit are analyzed.

2.3.5.1 Logit Model

The most widely used discrete choice model, which assists researchers to analyze the data of a questionnaire in a CM survey, is a polynomial model called logit (Train, 2002). Logit model is the easiest model to use. Luce in 1959 was the first scientist who created the logit formula. His findings were based on the "*independence from irrelevant alternatives (IIA)*", which were assumptions about the attributes of choice probabilities. Logit model is a model that focuses on the study of the maximization of utility of individuals and Marschak was the first one that stated that in 1960 (Erlander, 1998). Marley in 1965 further developed the theory of logit models by showing that "*the extreme value distribution leads to the logit formula*". McFadden in 1974 concluded the analysis of logit models by stating that "*the logit formula for the choice probabilities necessary implies that unobserved utility is distributed extreme value*", an axiom which was contradictory to the one of Marley (Train, 2002).

Let's use an example in order illustrate how the logit model works. A decision maker, n, has to choose amongst J alternatives. The utility, U, that the decision maker acquire from the use of J alternatives is a sum of two parts. First, is the part Vnj which is known to the researcher and secondly is an unknown part Enj which is a random one (Train, 2002). Consequently, for every J alternative the following formula is applied:$Unj = Vnj + Enj$. The distribution for every Enj in a Logit model is called Cumbel or "*type I extreme value*". According to Cumbel distribution, every Enj is "*independently and identically distributed extreme value*" (Train, 2002). A researcher, who uses the Cumbel distribution for every given error, assumes that errors are "*independently normal*". The shape of the extreme value distribution is fatter than the shape of the normal distribution. The importance, although, does not lies in the shape of the Cumbel distribution but in the fact that "*errors are independent from each other*" (Train, 2002). Consequently, the target of a CM survey is achieved, thus, different alternatives in a choice set and their unobserved utilities are unrelated to each other. Recalling from our example Enj is the difference between the utility of alternative i, Unj, and the known part Vnj, which is the "*observed variables*". As a result, Enj is highly affected by Vnj. Due to the independent nature of errors the researcher does not have adequate information about the errors of the different alternatives. The researcher must manage to signify the alternatives' utilities in order for the remaining aspects not to be taken under serious consideration (Train, 2002).

The respondent faces the decision to choose amongst various alternatives in a choice set. The probability that the respondent will choose an alternative i is given mathematically with the following equation (Train, 2002):

$$Pni = Prob\,(Vni + Eni > Vnj + Enj)\ for\ every\ j \neq i$$

The above equation, through some "*algebraic manipulation*", is transformed into the below formula, which gives us the Logit probability of choice (Train, 2002):

$$Pni = \frac{e^{Vni}}{\sum j\ e^{Vnj}}$$

Known parameters of utility Vnj can be given as β´Xnj and the above equation will be re-written as follows (Train, 2002):

$$Pni = \frac{e^{\beta' \mathrm{Xn}i}}{\sum j \, e^{\beta' \mathrm{Xnj}}}$$

The probabilities of a Logit model have the below characteristics (Train, 2002):

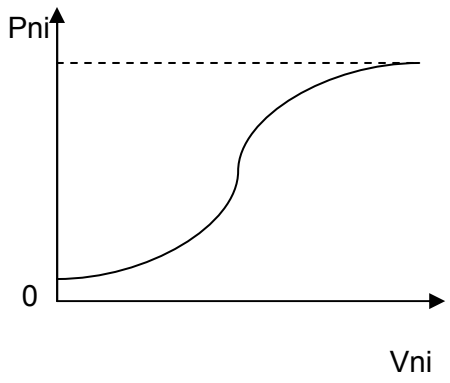
- 0 < Pni < 1 as it is the case for every probability. If Vnj rises, for every j ≠ 1, Pni reaches 1. If, on the other hand, Vnj, the observed utility, declines, then, Pni reaches 0. The Logit probability of choice is never 0 and can be 1 if there is only one alternative in the choice set.

- The sum of all probabilities, as it is the case for every probability, must equal to one:

$$\sum_{i=1}^{J} \sum_i \exp(Vni) / \sum_j \exp(Vnj) = 1$$

The respondent is the one who will make his or decision amongst the different alternatives. The denominator in the above equation serves the purpose of assuring that the numerator, thus, the sum of all probabilities of the alternatives, equal to 1. Logit curve and known utility, Vni, has an S-shaped relation as it clearly shown below in **Figure 2.13**:

Figure 2.13: Logit curve



(Train, 2002)

The S-shape of the Logit curve is determined by the changes in the explanatory variables. If the utility of an alternative is lower than the other alternatives, a slight increase would not mean that this alternative will be chosen by the respondent. If and only if, the given alternative has a probability of 0.5, then the representative utility, Vni, influences the choice of the respondent (Train, 2002) (Roussi, 2006).

A Logit models is applied, usually, in analysis of the extracted data of the Choice Experiment technique. Another important model in the analysis of data of a CM questionnaire is the Ordered Logit Model which is going to be explained in the following section.

2.3.5.2 Ordered Logit Model

Ordered Logit model is a "*flexible duration model*" as Han and Hausman in 1990 proposed (Kamperman, et al., 2003). In statistical terms, Ordered Logit Model is characterized by its conditional probability concept (Kamperman, et al., 2003). The probability of one alternative option in a choice set is highly affected by the probability of the other alternatives. Ordered Logit Model and its functions are often used in Choice Modeling surveys which use the Contingent Rating approach. Let's use an example to understand the use of the Ordered Logit Model.

In a choice set, under the Contingent Rating approach, the respondent has to rank an alternative option, giving one point if he or she has low preference for it or five if he or she has high preference for it. For instance, if we refer to our research study, an example of the ranking process for how satisfied a respondent is from a shipping service can be:

1. Highly satisfied
2. High satisfaction
3. Medium satisfied
4. Low satisfaction
5. No satisfaction

The Logit model cannot be applied to the above example because the Cumbel distribution for every given error is assumed that errors are independent from each other. In Contingent Rating, although, all alternatives are depended to each other, especially the rating alternatives which are almost similar. In order to realize better this concept, consider that the respondent, before rank his or her preferences, has a utility, U, regarding the shipping services. If the respondent is highly satisfied from the offered shipping services higher values than the utility U will be observed and the opposite if the respondent is not satisfied. Although, this particular question can be only be answered using the five alternatives that were given. If respondent's U is above a level k1 then he or she chooses the answer "*Highly satisfied*". If his or her U is below the k1 level and above a k2 level, then the respondent's answer will be "*High satisfaction*". His or her decision can be summarized as followed:

- "*Highly satisfied*" if U > k1
- "*High satisfaction*" if k1>U>k2
- "*Medium satisfied*" if k2>U>k3
- "*Low satisfaction*" if k3>U>k4
- "*No satisfaction*" if k4>U

On the other hand, as it was the case in Logit models, there are certain variables in the decision process of the respondent that cannot be identified. Utility can be divided into observed and unobserved variables ($U = \beta' x + \varepsilon$). The distribution of the unknown variables affects the probability of the above five possible choices. If the distribution of the unknown variable ε is determined and assuming that it is logistic distributed then the probability, for example, the respondent will choose the "*no satisfaction*" answer will be given by the following mathematical equation:

$$Prob\ (U < k4) =$$

$$= Prob\ (\beta' \mathrm{x}\ +\ \varepsilon < k4) =$$

$$= Prob\ (\varepsilon < \kappa 4 - \beta'\ x) =$$

$$= \frac{e^{k4-\beta\prime\chi}}{1+\ e^{\kappa 4-\beta\prime\chi}}$$

The same procedure is followed for the probabilities of the rest of the possible answers. Maximum likelihood procedure will, then, assist to calculate all the parameters of the model. (Roussi, 2006) (Fok, Franses, 2002) (Kamperman et al., 2003)

2.3.6 Reporting the survey

The last stage in a SP research includes the survey's report (Pearce, et al., 2002). Reporting must be clear and cover all the aspects of the study in order to give to the reader all the information he or she may need to acquire about the reason and the content of the study. In that way, the reader will understand all the different approaches which were used and the research will have certain credibility (Pearce, et al., 2002). Moreover, well reported studies and their approaches will influence future ones with a different context. A successful report should include the following parts:

- An executive summary which analyzes and presents all the conclusions and findings of the research and the approach that was used. The language that is going to be used must not be technical in order for the reader to fully understand the different aspects of the study.

- A description of the purposes of the study and of all the non-marketed goods or services that were evaluated. During this part, the researcher must give a full description of all the different attributes and characteristics of the good or service that were studied and the characteristics of the population and the sample of the population which took part in the study.

- An analysis of all the previous case studies, relevant to the current one. This part contains a description of the techniques the previous studies used, thus, either RP or SP or CV or CM. Moreover, a detailed description must follow about the choice of the different alternative scenarios and their attributes, the payment vehicle and the institution that conducted the study. It is vital to mention all the difficulties the previous case studies met in order to avoid them in the future.

- A description about the design of the survey. Having tested the questionnaires through the assistance of the various focus groups, a complete report should contain the following aspects:

    1. The approach of the survey design. Which technique was used (CV or CM)? Are the samples divided upon sub-samples and why? How the choice of the attributes and their levels has been made?

    2. The scenario design. Why the particular group of respondents was chosen? Are they, the proper groups for this study? Is the studied good or service suitably understood from the respondents? Do the respondents have adequate information about the effects of the changes in the various scenarios that were offered? Are the offers realistic?

    3. A description about the elicitation formats which were used (e.g. Payment cards et al.) in order to evaluate the WTP/WTA of the respondents.

    4. An analysis about the institutional context of the study.

- A description about the organization of the study. When and where the interviews took place? Which is the population that is affected by the results of the survey? How the sampling process was conducted? What type of interviews were used (face-to-face, mail surveys etc.)? How many did not respond in the survey? Which was the final representative sample of the survey?

- A summary of the data. In this part, a general overview of all of the respondents who took place in the survey is given.

- A detailed description about the way the extracted data of the survey were analyzed. Which were the non-valid responses? Which mathematical model was used? Are the parameters that were used in the study the appropriate ones?

- Checking for the validity of the study.

- An analysis of the aggregation procedure of results is given. Is the WTP of the sample of respondents the same as the WTP of the whole population?

- A copy of the questionnaire.

Chapter 3 Experiment's Report

3.1 Scope of the experiment

The scope of this master thesis is focusing on the transportation of bulk commodities from the departure ports to the major Greek ports such as Piraeus, Thessaloniki, Volos, Kavala and Patra. The purpose of this thesis is to reveal which are the factors that determine the demand in shipping services in the major Greek ports, in the liquid and dry bulk sector and to obtain their suitable combinations.

The information this master thesis gathered from the responses of the questionnaires will assist to reach to the appropriate conclusions on how the decision makers in a shipping company are affected. Some factors can be the exact location of the head offices of the company or the specific market they are dealing with either geographically or in a particular sector et al.

In order to give to the reader a clear understanding on the master thesis, this report is choose to focus on three important characteristics of the shipping services. Thus, the respondents have to evaluate the below attributes:

- Time of delivery: It is the total time needed for the bulk commodity to be delivered from the port of departure to the final destination, including the time at sea and in port(s).

- Frequency: It is the total number of round-trips in a monthly basis.

- Cost: It is the total voyage costs per vessel (Freight payment, bunkers et al.)

3.2 Previous case studies

During the last few years many studies about the quality of the shipping services in all the maritime sectors (liner, dry bulk and liquid bulk) have been conducted. Below in **Table 3.1** is presented some of the most distinctive case studies which their analytical part differ in terms of the scope of the experiment and the nature of the attributes that are being evaluated. The below table contains information about the title of the research studies, the authors who conducted the research, the survey techniques being used, the subjects that they focused on, the date and the samples of the population that the studies chose to study.

Table 3.1: Previous case studies

	TITLE	AUTHORS	YEAR	ANALYSED MODES	TECHNIQUE	RESPONDENT	ATTRIBUTES
1	A Mode Choice Model to Analyze High Speed Potentiality in the Motorway of the Sea	Francesco Russo and Giovanna Chila	2007	Road, Rail, Combined Road-Rail And Combined Road-Sea	RP	PC (senders)	Transit Time (access /egress time & handling at the terminals and run time between origin and destination terminals), Price of transport
2	Shipper's Stated Preferences on modal choice for Transport from France to Spain	French Ministry of Equipment	2007		SP		Price, Transport Time, Delivery Frequency, (offered by transport supplier), Reliability, Tracing

3	Potential for Water Freight in the UK	ICM Research (commissioned by Sea and Water)	2006	Water transportation		FF	Reliability, Transport Costs, Response to problem, Transit time, Frequency, Personal Service, Quality of infrastructure, Road congestion, Trust in Brand, Road accidents, Air pollution, Value-added services, Trade
4	Valuing the attributes of freight transport quality. Results of a Stated Preference survey	A.S. Fowkes C.A. Nash G. Tweddle	1989	Road Rail	SP		Transport Cost / Ton, Average distance, Frequency of dispatch, Delivery day
5	Transport Logistics and Modal Split of Spanish Exports to Europe	Garcia Menendez, Martinez-Zarzoso, Perez-Garcia	2006			FF	Transport Mode, Transport Costs, Transit Time, Distance, Speed, Frequency of shipments, size of shipments
6	Determining Important Carrier Attributes: A Fresh Perspective Using the Theory of Reasoned Action	Voss, Page, Keller, Ozment	2006		RP-SP		Delivery reliability, Rate charged, Equipment availability, Response, Carrier reputation, Driver quality, Billing accuracy, Complaint follow-up, Security
7	Mode Choice	Marcucci E. and Scaccia	2004	Road vs. intermodal	SP		Transit Time, Transport

	models with attribute cutoffs analysis: the case of freight transport in the Marche region	L.		transport			Cost, Delivery punctuality, damages, service frequency, service flexibility
8	An analysis of ro-ro maritime freight transport: service attributes through adaptive stated preference: an application to a sample of freight forwarders	Bergantino A. , Bolis S.	2004	Land transport vs. ro-ro maritime service	RP & SP	FF	Transit Time, transport cost, reliability, frequency
9	Analyzing freight transport demand using stated preference data: A survey and a research project for the Friuli-Venezia Guilia Region	Romeo Danielis and Lucia Rotaris	1999		SP		Time Reliability Flexibility Frequency
10	Determinants of modal choice for freight transport: consequences for the development of SSS between Spain and Europe	Feo Maria, Leandro Martinez Immaculada and Perez Eva	2003	Road vs. SSS	RP	FF	Transit Time, Transport Cost, Speed
11	SPSD II (Intermediary Report)		2003	Road, Rail, Waterway, SSS, Intermodal, Multimodal		Shippers	Cost, Reliability, Loss, Flexibility, Time, Frequency
12	Survey of Shippers	OPVN Belgium	2003	Inland Waterway	SP	Shippers	Advantages of inland

	needs and preferences in Wallony region						waterway: economic, ecological, Speed/Volume, reliability, Security Disadvantages: transshipment cost, poor network, investment
13	Mode choice modeling literature review on the role of quality of Service attributes	De Maeyer J. and Pauwels T.	2003			Shippers	Transit Time Reliability, Flexibility, Intermodality, Transport Time, Transport Cost, Risk of damage & loss, Risk of Delay, Frequency, Info system, Best Matching logistic structure, Speed, Controllability/ Traceability, Environment, Service Level
14	Shipper's Preferences for freight transport services: a conjoint analysis experiment for an Italian Region	Danielis R. and Rotaris L.	2002		Adaptive Conjoint Analysis, Sp, Graded pair comparison		Cost, Travel Time, Reliability / Risk of late arrival, Risk of loss & damage
15	Logistic Services in Taiwanese Maritime Firms	Lu C.S.	2000	Maritime Transport	Survey, Factor analysis	Shipping companies, Freight forwarders	Speed, Reliability, Value-added service, Sales representative service, Intergraded service, Freight Rate, Equipment & Facilities,

							Promotion
16	Determinants of combined transport's market share	Golias John and Yannis George	1998	Road vs. Combined Transport	SP	FF	Transit time, Transport cost
17	Investigating Selection Criteria for International Freight Forwarders	Murphy P.R. and Daley J.M.	1997		RP, T-Tests, Spearman, Status		Expertise of FF, Reliability of service, Information, Attention, Reputation, Reasonable Prices, Financial Condition, Convenient to use
18	The Determinants of Shipper Perceptions of Modes	Evers P.T., Harper D.V., Needham P. M.	1996	Intermodal-rail-truck	RP, factor and regression analysis	Shippers	Ranking by transport mode: Availability of equipment at destination and at point of origin, Timeliness, D2D transit time, reliability and directness of service, After-sale service
19	Shallow-Draft Water Transportation: Marketing Implications of User and Carrier Attribute Perceptions	Burdg H.B. and Daley J.M.	1985	Water transportation	RP, Behavioral model	Shippers and Carriers	Joint rates, short transit time, dependable transit time, allows large shipments, satisfies customer's requirements
20	Freight Mode Choice and Adaptive Stated Preferences	Shinghal Nalin and Fowkes Tony	2002		SP		Cost, Door-to-Door Transit Time, Reliability of service and Frequency of service

Data gathered by Panteleimon Mytilinaios

3.3 Design of the experiment

3.3.1 Choice of method of conducting the survey

The technique this master thesis used to conduct the survey was the Stated Preference technique. The reasons behind this decision were the following:

- This method does not require containing only marketed services but services that have non-use values.

- The collection of the data of the survey is more economical under the SP approach because more information about each respondent is gathered.

- Statistical-wise the SP approach has some advantages. For instance, there is a greater variety in the levels of the selected attributes in a choice set and any correlation between the attributes is avoided.

- It is possible, under the SP methodology to modulate the characteristics in the studied scenarios of the problem. In that way, the important criteria that affect the decision of any respondent are revealed. This is the main reason behind the choice of SP as the survey technique because for the determination of demand in shipping services, it is vital to evaluate their main characteristics (Time of delivery, frequency and total voyage costs).

3.3.2 Choice of the technique of conducting this SP survey

In a Stated Preference survey, there are two different techniques a researcher can use in order to conduct his or her study:

- Contingent Valuation
- Choice Modeling

The main difference between these two methodologies is that in the Choice Modeling approach, the researcher can evaluate the relevant attributes of a studied subject. In the experiment that this thesis is carrying out, with the CM technique, an analysis of the shipping services can be conducted by focusing on the attributes of them, thus, the cost, the frequency and the time of delivery. For this reason, CM technique was chosen for this particular survey.

There are various ways of conducting a survey and all of them were explained in Chapter 2 of this research study. Bearing in mind that SP surveys are preferred to be conducted with face-to-face interviews, this study chose to perform this survey using the face-to-face approach with the assistance of a portable computer. The reason we chose face-to-face interview was that, even if it is the most expensive approach, it gives the interviewer the chance to use more complex questionnaires. As a result, the respondent can solve any question he or she may have immediately. The use of the portable computer gives to the researcher the opportunity to alter the chosen scenarios or create new ones depending on the capabilities and needs of each of the respondents.

3.3.3 Choice of the population and the sample of the survey

In this part of the survey, the population and the sample of the population must be chosen in order to define who are going to be the group of respondents who will take part in this research study. In the beginning, the target population must be defined. The target population of this study is defined to be various representatives of different shipping companies which transport liquid and dry bulk products to the major Greek ports and chartering brokers whose responsibility is to charter vessels which carry liquid and dry bulk products to these ports. The most important condition of this choice is that these shipping companies must be located in Greece in order to be possible to conduct face-to-face interviews. The geographical range that this study will cover depends on the budget we are willing to spend. A last condition is that the companies which are going to be chosen must use only shipping services for the transportation of their products.

Next, the sampling frame, through which the final sample of respondents will be chosen, must be identified. This frame can be defined with the use of specified guides which contain every shipping company in the greater area of the Port of Piraeus and Athens and in other major ports all over Greece.

Finally, through this frame, the final sample of respondents must be chosen. The size of the sample depends on the budget we are willing to spend. The larger the sample, the more budget we should spend. On the other hand, if the chosen sample is large enough, the greater validity on the results is achieved. The choice of the sample will be done randomly through the "*stratified*" approach. The reason this thesis chooses this approach is because the sample is divided among distinctive sub-groups. As a result, an independent sample will be chosen from each of the sub-groups. In our experiment the same analogy will be used for both sub-groups in order to create credible and reliable answers.

3.3.4 Design of the questionnaire

The structure of the questionnaire which was used in this master thesis followed the same procedures as the ones which were described in Chapter 2, in the relevant section. In the beginning, a short paragraph about the scope of the experiment is given to the respondents, in order to understand the topic and realize what they have to gain from their participation in the survey. As a result the interviewees have a higher motive to contribute to the completion of the study.

The next part of the questionnaire includes questions about the respondent's name, company he or she is working for and the country and the city which the company is located et al. This is done in order to increase the validity of the research. The geographical location of the participating company gives some more information about the market it is operating, data which prove to be useful for the researcher.

The following part includes some behavioral questions for the respondents. In particular, they are asked to evaluate the importance of the selected characteristics of the shipping services. The answers to these questions will be used in the testing procedure of the questionnaire. Thus, it will be tested if the answers which were given in the scenario questions of the survey match with the respondent's opinion about the importance of the selected attributes of a shipping service. In that way, the validity of the answers is being tested.

The third part of the questionnaire consists of questions regarding how the respondents use the shipping services. In the beginning, it is asked to be clarified which are the main products and their quantity, either liquid or dry bulk ones, that the respondents' companies undertake to transport. Through these answers, the researcher realizes the value of the products being transported, either being high or low valued ones, if they have a short period of life and in general all relevant information which may affect the respondent's decision. Lastly, in the third part of the questionnaire, it is asked to be clarified by the respondents a typical shipment, either dry or liquid bulk, the company they are working for undertake to transport by giving information about the port of departure, the time needed for the vessel to reach the destination port, the voyages' frequency to the Greek ports and the total voyage costs. The data that are given from these answers were used to create the different alternative scenarios in the final part of the survey.

In the fourth and final part of the survey, SP approach is used to construct the questions. The different alternative scenarios which were created followed the already mentioned steps of a Choice Modeling questionnaire. At first, the attributes of the shipping services were chosen, the time of delivery, the frequency of trips and the total voyage costs. We make sure that an attribute with a monetary nature (total voyage cost) was selected in order to evaluate the WTP of each of the participating companies. Additionally, the use of only two more attributes (frequency of trips, time of delivery) followed the basic rule of a CM questionnaire, thus, the existence of no more than four or five attributes. The next step included the designation of the levels of the selected attributes. The levels were realistic and clearly different from each other in order for the respondent to be able to determine his or her preference. As a basis of our scenarios we used the respondent's information about the typical shipment the companies they are working for undertake to transport. We set the

values of the selected attributes either higher or lower than the ones the respondents gave us through their answers in the third part of the questionnaire. The time of delivery is in days, the voyage costs are measured in dollars and the frequency of trips is on a monthly basis. Below in **Table 3.2** the designated levels of the attributes are being presented:

Table 3.2: The designated levels of the attributes

	1	2	3
COST ($)	-30 %	0	+30 %
Duration of voyage (days)	-2	0	+2
FREQUENCY (per month)	+1	0	-1

(Data gathered by Panteleimon Mytilinaios)

The next step is the experimental design. Thus, in this part, we choose the scenarios that are going to be included in the survey. According to the norms of factorial design, since in this master thesis 3 attributes were selected, the full factorial will include 27 scenarios (3^3). All the possible combinations of a 3^3 factorial design can be illustrated in a table in order to create a full factorial design. The symbols in **Table 3.3** are the following:

- 0 symbolizes the level of each of the attributes which remains the same as the one the respondent gave to us from the third part of the questionnaire.
- +1 symbolizes the level of each attribute which is increased with the way it was described in **Table 3.2**.
- -1 symbolizes the level of each of the attribute which is decreased with the way it was described in **Table 3.2**.

For the numeration of all the scenarios in the full factorial design of **Table 3.3**, the methodology which was described in Chapter 2 is going to be used. Thus, in every column (i) of the table, the first number is -1 and we repeat it for 3^{i-1} times. The same procedure will be used for the 0 and +1 levels. As a result:

- In the first column we have $3^{i-1} = 3^0 = 1$
- In the second column we have $3^{i-1} = 3^1 = 3$
- In the third column we have $3^{i-1} = 3^2 = 9$

The full factorial design is:

Table 3.3: 3^3 Full Factorial Design

	Voyage Cost	Duration of voyage	Frequency
1	-1	-1	-1
2	0	-1	-1
3	1	-1	-1
4	-1	0	-1
5	0	0	-1
6	1	0	-1
7	-1	1	-1
8	0	1	-1
9	1	1	-1
10	-1	-1	0
11	0	-1	0
12	1	-1	0
13	-1	0	0
14	0	0	0
15	1	0	0
16	-1	1	0
17	0	1	0
18	1	1	0
19	-1	-1	1
20	0	-1	1
21	1	-1	1
22	-1	0	1
23	0	0	1
24	1	0	1
25	-1	1	1
26	0	1	1
27	1	1	1

(Data gathered by Panteleimon Mytilinaios)

Due to the fact that the 27 scenarios that were created are too many to be observed and evaluated, we created a fractional factorial design which though the assistance of the criterion of superiority will successfully diminish the number of the different alternative scenarios. The scenarios which are going to be chosen will be put in separate choice sets in which they are going to be compared with the scenario given by each of the respondents regarding a typical shipment the company which they are working for undertakes to transport. If some of the 27 scenarios of the full factorial design are either clearly superior or inferior to the respondent's scenario, we withdraw them. If for instance, one scenario proposes the alternative to reduce the time of delivery by 2 days, to increase the frequency of trips by 1 time per month and to decrease the costs by 30% then this scenario is withdrawn because it is

clearly superior to the compared one. The same logic of superiority is applied to the whole experimental design and the result is that we withdrew 15 out of the 27 scenarios of the full factorial design. As a result the fractional factorial design will be the following:

Table 3.4 Fractional Factorial design

	Voyage Cost	Duration of voyage	Frequency
3	1	-1	-1
6	1	0	-1
7	-1	1	-1
8	0	1	-1
9	1	1	-1
12	1	-1	0
16	-1	1	0
19	-1	-1	1
20	0	-1	1
21	1	-1	1
22	-1	0	1
25	-1	1	1

If the symbols (-1, 0, 1) are transformed into actual scenario alternatives, 12 different scenarios are created and proposed to the respondents for the improvement of the quality if the shipping services. These scenarios are presented, below, in **Table 3.5**. The values of the illustrated scenarios are compared with the values that are given from the third part of this study's questionnaire.

Table 3.5: Approved scenarios

	Voyage cost ($)	Duration of voyage (days)	Frequency (per month)
1	+30 %	-2	+1
2	+30 %	0	+1
3	-30 %	+2	+1
4	0	+2	+1
5	+30 %	+2	+1
6	+30 %	-2	0
7	-30 %	+2	0
8	-30 %	-2	-1
9	0	-2	-1
10	+30 %	-2	-1
11	-30 %	0	-1
12	-30 %	+2	-1

(Data gathered by Panteleimon Mytilinaios)

The final step in this research's study questionnaire design is to put these 12 hypothetical scenarios into 12 choice sets in order to be presented to the respondents. Thus, we constructed the choice sets. The CM methodology which we used was the Choice Experiments. The choice sets contains two alternative choices and the respondent have to choose amongst the two comparing the scenario that he or she proposed with each one of the 12 alternative scenarios of our study. The most preferred alternative scenario is chosen. In order to illustrate the above we give an example of the technique this study used. Alternative B in this hypothetical figure is the one which the respondent proposed to us.

Figure 3.1 An example of a choice set

SCENARIO 1			
ALTERNATIVE A		**ALTERNATIVE B**	
VOYAGE COST($)	**125**	**VOYAGE COST($)**	**100**
DURATION OF VOYAGE(DAYS)	**4**	**DURATION OF VOYAGE(DAYS)**	**5**
FREQUECY OF VOYAGES(PER MONTH)	**3**	**FREQUECY OF VOYAGES(PER MONTH)**	**2**
WHICH OF THE ALTERNATIVES YOU PREFER?			
ALTERNATIVE A		**ALTERNATIVE B**	

(Data gathered by Panteleimon Mytilinaios)

3.3.5 Analysis of the survey's data

Respondents in this research study must give their preferences between two different scenarios, A or B. Scenario B is the current state of practice that each of the respondents' companies undertake to transport a particular liquid or dry bulk shipment. Scenario A is a new proposed scenario. As we already mentioned in the previous chapters the best models to describe a SP survey are the logit ones. Recalling from Chapter 2, the utility which either the respondent or his or her company obtains from choosing either scenario A or B is given by the following equation:

- $UnA = VnA + \varepsilon\, nA$
- $UnB = VnB + \varepsilon\, nB$

VnA and VnB are the observed utilities of each of the n respondents in the study. Observed utility is known to us and can be re-written accordingly:

VnA = β'XnA

VnB = β'XnB

XnA and XnB are the vectors of the observed utilities and β' symbolizes the importance of each of the variable has on the utility of the given scenario. So the observed utility can be analyzed by the following equations for both scenarios A and B:

1. $VnA = \beta COST * COSTnA + \beta TIME * TIMEnA + \beta FREQ * FREQnA$
2. $VnB = \beta COST * COSTnB + \beta TIME * TIMEnB + \beta FREQ * FREQnB$

Where:

1. βCOST < 0, because an increase in cost will decrease the utility of a particular alternative.
2. βTIME < 0, because an increase in the duration of the voyage will decrease the utility of a particular alternative.
3. βFREQ > 0, because an increase in the per month frequency of trips will increase, as well, the utility of a particular alternative.

EnA and εnB represents the unknown and random values in the utility equation. According to the logit model, εnA and εnB are independent and equally distributed values, which is called Gumbel distribution or "*type I extreme value*". The possibility the respondent n will choose alternative A of the given choice set is derived from the fact that he or she maximizes his or her utility.

$$PnA = Prob\,(VnA + \varepsilon nA > VnB + \varepsilon nB) = Prob\,(\varepsilon nB < \varepsilon nA + VnA - VnB)$$

The previous equation, through an algebraic manipulation originates the following equation:

$$PnA = \frac{e^{VnA}}{e^{VnB} + e^{VnA}}$$

This is the logit probability of alternative A. In the same manner, the logit probability of alternative B is:

$$PnB = \frac{e^{VnB}}{e^{VnA} + e^{VnB}}$$

Chapter 4 Summary and Conclusions

This master thesis aims to establish the appropriate methodological technique for the design of a survey which is capable of revealing how the best quality of shipping services is determined in the transportation of liquid and dry bulk products to the major ports of Greece. The ports which are studied are the ports of Piraeus, Thessaloniki, Volos, Patra and Kavala. The reason behind this choice lies in the fact that these ports are observed with the largest traffic flows comparing to the rest of the Greek ports and have an acceptable geographical coverage of all the Greek territory. Moreover, in the above mentioned ports, liquid and dry bulk products are being shipped on a regular basis. Major difficulties encountered in the conduction of the survey. Some of the respondents could not thoroughly understand the concept under which the questionnaires were based. Some others were difficult to be reached due to their extended working hours. All of these problems were solved by organizing the interviews in an acceptable hour for the respondents and the use of a portable computer solved any cognitive inquiries they may have.

Throughout the preparation of the survey and seeking to indentify the factors that influence the quality of the shipping service, this thesis concluded that shipping service must be separated into its basic characteristics in order to evaluate which of them is considered to be more important into respondents' decisions. The characteristics which were chosen are the total voyage costs, the duration of the voyage and the frequency of the trips on a per month basis. The fact that in the various scenarios, which this master thesis revealed in its survey, we altered the levels of the selected attributes of the shipping services in each of the 12 different choice sets of the survey, Stated Preference methodology and Choice Modeling technique was the appropriate methodology to use. The reason behind this choice lies on the fact that SP methodology is mainly used to evaluate the non-use values of a product or a service. The duration of the voyage and the frequency of the trips are shipping service's characteristics that are not in monetary terms and cannot be indentified using the Revealed Preference methodology. In fact, during the past few years and mainly in industrialized countries, SP techniques in the transport sector are preferred to the revealed preference methods. CM methodology, being one out of the two approaches which are used in a survey of Stated Preference technique, evaluates the non-marketed goods or services by focusing entirely on the analysis of the different attributes or characteristics each product is accompanied with and the layers each of them are classified. For that reason, this master thesis chose to prepare the survey using the CM methodology in order to give the non-marketed types of service's characteristics different levels. The effects of those changes can only be identified by the use of the CM methodology.

The setting of the levels in the selected attributes of the shipping services was made in order to create the 12 hypothetical scenarios of this survey. The levels were not the same for every respondent due to the fact that each company has different needs and desires. Following this rule, each of the levels was constructed, in a way that was adjusted to the needs each respondent's companies had. Sequentially, the survey was in an electronic form in order to present realistic scenarios.

These realistic scenarios were compared to the ones each respondent gave regarding a typical dry or liquid bulk shipment the company they are working for undertake to transport. Consequently, the 12 choice sets that were created, questioned the respondent to reveal his or her preference to the alternative that maximizes his or her utility. The Logit model was chosen to be the most appropriate one for the analysis of the data of the survey. This polynomial model, which is the most widely used discrete choice model, is an easy model to implement and the basis of each formula lies on the fact that each of the chosen alternatives must be independent to each other. This was the target of this thesis' survey. Each of the selected attributes (duration of voyage, voyage costs and frequency of trips) and their different levels which was given in each of the 12 different choice sets were independent to each other and any alternation in one attribute does not affect the other two. The primary focus, in the end, of the Logit formula is to identify the maximization of the utility of the respondent. In the same manner, this survey, though the analysis of its data revealed how the shipping companies maximize their utility curves by evaluating the above mentioned attributes of the shipping service.

Through the analysis of the data, this master thesis concluded that all the selected characteristics (duration of voyage, voyage costs and frequency of trips) are considered to be equally important in the decision of a shipping company. Total voyage costs, especially in the worldwide economic crisis of our time which affected the shipping industry as well, is considered to be even more important feature. But the maximization of the respondents' utility is not achieved only by minimizing the voyage costs they have to pay. An increase in the frequency of trips and a decrease in the duration of their voyages have a positive effect to their utility curves. Shipping companies are Willing To Pay the extra amount of money in their total voyage costs in order to minimize the duration of their voyages and maximize the per month frequency of their trips to the major ports of Greece. In the long term, companies gain more than loosing from more trips and less time of delivery of their dry and liquid bulk products. Especially in a volatile industry such as the bulk one, this adds to the importance of these characteristics. As a result the demand in the major Greek ports will increase if the quality of the services offered is improved in order for the Greek companies to achieve their target and maximize their utility from the services they are offering as well.

The way this master thesis conducted the SP surveys was by face-to-face interviews. The reason behind this choice lies on the fact that with face-to-face interviews more complex issues can be raised because every respondent's query is answered immediately through the assistance of the computer applications.

This master thesis' purpose is the determination of demand for shipping services in the major Greek ports. Further research studies can be based in our findings, concerning any other port, worldwide. Many companies located in other markets and geographical areas can use the findings this thesis proposed. In fact, the thesis can be further developed and more characteristics of the shipping services can be analyzed. For instance, such attributes could be the reliability in the time of delivery, the quality of the shipping service, the pollution shipping services cause and even comparing the shipping services with other modes of transport like road or rail. This remains to be seen in the future.

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Appendix

A copy of the questionnaire of the survey

PART A, B, C

QUESTIONNAIRE

This study is based on the transport of dry or liquid bulk commodities from the departure port to the major Greek ports.
The purpose of this research is to determine which are the factors that influence the demand in the major ports of Greece.

Please fill in the cells by answering to the following questions.
We can assure you that your answers on the below questions will remain classified.

A.
GENERAL INFORMATIONS

A1) Name-Surname	
A2) Telephone	
A3) e-mail	
A4) Company Name	
A5) Position/Department	
A6) Address/ Country	
A7) Website	

B.
Behavioral Questions

B1)
For the below distinctive features of shipping transport
fill, according to your opinion, the degree of importance ranging from
1 (not important) to 5 (very important).

FEATURE	CLARIFICATION	LEVEL OF IMPORTANCE				
COST	Total voyage costs per vessel.	1	2	3	4	5
FREQUENCY	Total number of round-trips in a monthly basis.	1	2	3	4	5
TIME OF DELIVERY	It is the total time needed for the dry or liquid bulk commodity to be delivered from port of departure to the final destination (time at sea, time in port)	1	2	3	4	5

C.

THE USE OF SHIPPING TRANSPORTATION

C1)

Please fill in the given boxes the main liquid or dry bulk commodities carried and the quantity of them which the company you are working for, typically undertakes to transport.

PRODUCT	WEIGHT (ton)

Please answer the following questions regarding a typical shipment of a dry or liquid bulk commodity the company you are working for, usually undertakes.

C2)

Port of departure

C3)

Port of Arrival

C4)

Time needed for the vessel to reach its destination (days)

C5)

Frequency of trips to this particular destination (per month)

C6)
Total voyage costs [ ] ($)

PART D

In the below boxes based on the information you gave us regarding a typical shipment of a dry or liquid bulk commodity the company you are working for usually undertakes, we offer you 12 hypothetical scenarios. The features-variables which will change in every hypothetical scenario are the voyage frequency, the time needed for the vessel to reach its destination and the total voyage costs. For each of the hypothetical scenarios, please, note your preference between the hypothetical scenario (choice A) and the scenario (choice B) which you have already gave us regarding the typical shipment of your dry or liquid bulk commodity.

SCENARIO 1

ALTERNATIVE A		**ALTERNATIVE B**	
VOYAGE COST($)	**0**	**VOYAGE COST($)**	**0**
DURATION OF VOYAGE(DAYS)	**-2**	**DURATION OF VOYAGE(DAYS)**	**0**
FREQUECY OF VOYAGES(PER MONTH)	**1**	**FREQUECY OF VOYAGES(PER MONTH)**	**0**

WHICH OF THE ALTERNATIVES YOU PREFER?

ALTERNATIVE A ☐ **ALTERNATIVE B** ☐

SCENARIO 2

ALTERNATIVE A		**ALTERNATIVE B**	
VOYAGE COST($)	**0**	**VOYAGE COST($)**	**0**
DURATION OF VOYAGE(DAYS)	**0**	**DURATION OF VOYAGE(DAYS)**	**0**
FREQUECY OF VOYAGES(PER MONTH)	**1**	**FREQUECY OF VOYAGES(PER MONTH)**	**0**

WHICH OF THE ALTERNATIVES YOU PREFER?

ALTERNATIVE A ☐ **ALTERNATIVE B** ☐

SCENARIO 3

ALTERNATIVE A		ALTERNATIVE B	
VOYAGE COST($)	0	VOYAGE COST($)	0
DURATION OF VOYAGE(DAYS)	2	DURATION OF VOYAGE(DAYS)	0
FREQUECY OF VOYAGES(PER MONTH)	1	FREQUECY OF VOYAGES(PER MONTH)	0

WHICH OF THE ALTERNATIVES YOU PREFER?

ALTERNATIVE A	ALTERNATIVE B

SCENARIO 4

ALTERNATIVE A		ALTERNATIVE B	
VOYAGE COST($)	0	VOYAGE COST($)	0
DURATION OF VOYAGE(DAYS)	2	DURATION OF VOYAGE(DAYS)	0
FREQUECY OF VOYAGES(PER MONTH)	1	FREQUECY OF VOYAGES(PER MONTH)	0

WHICH OF THE ALTERNATIVES YOU PREFER?

ALTERNATIVE A	ALTERNATIVE B

SCENARIO 5

ALTERNATIVE A		ALTERNATIVE B	
VOYAGE COST($)	0	VOYAGE COST($)	0
DURATION OF VOYAGE(DAYS)	2	DURATION OF VOYAGE(DAYS)	0
FREQUECY OF VOYAGES(PER MONTH)	1	FREQUECY OF VOYAGES(PER MONTH)	0

WHICH OF THE ALTERNATIVES YOU PREFER?

ALTERNATIVE A	ALTERNATIVE B

SCENARIO 6

ALTERNATIVE A		ALTERNATIVE B	
VOYAGE COST($)	0	VOYAGE COST($)	0
DURATION OF VOYAGE(DAYS)	-2	DURATION OF VOYAGE(DAYS)	0
FREQUECY OF VOYAGES(PER MONTH)	0	FREQUECY OF VOYAGES(PER MONTH)	0

WHICH OF THE ALTERNATIVES YOU PREFER?

ALTERNATIVE A	ALTERNATIVE B

SCENARIO 7

ALTERNATIVE A		ALTERNATIVE B	
VOYAGE COST($)	0	VOYAGE COST($)	0
DURATION OF VOYAGE(DAYS)	2	DURATION OF VOYAGE(DAYS)	0
FREQUECY OF VOYAGES(PER MONTH)	0	FREQUECY OF VOYAGES(PER MONTH)	0

WHICH OF THE ALTERNATIVES YOU PREFER?

ALTERNATIVE A

ALTERNATIVE B

SCENARIO 8

ALTERNATIVE A		ALTERNATIVE B	
VOYAGE COST($)	0	VOYAGE COST($)	0
DURATION OF VOYAGE(DAYS)	-2	DURATION OF VOYAGE(DAYS)	0
FREQUECY OF VOYAGES(PER MONTH)	-1	FREQUECY OF VOYAGES(PER MONTH)	0

WHICH OF THE ALTERNATIVES YOU PREFER?

ALTERNATIVE A

ALTERNATIVE B

SCENARIO 9

ALTERNATIVE A		ALTERNATIVE B	
VOYAGE COST($)	0	VOYAGE COST($)	0
DURATION OF VOYAGE(DAYS)	-2	DURATION OF VOYAGE(DAYS)	0
FREQUECY OF VOYAGES(PER MONTH)	-1	FREQUECY OF VOYAGES(PER MONTH)	0

WHICH OF THE ALTERNATIVES YOU PREFER?

ALTERNATIVE A	ALTERNATIVE B

SCENARIO 10

ALTERNATIVE A		ALTERNATIVE B	
VOYAGE COST($)	0	VOYAGE COST($)	0
DURATION OF VOYAGE(DAYS)	-2	DURATION OF VOYAGE(DAYS)	0
FREQUECY OF VOYAGES(PER MONTH)	-1	FREQUECY OF VOYAGES(PER MONTH)	0

WHICH OF THE ALTERNATIVES YOU PREFER?

ALTERNATIVE A	ALTERNATIVE B

SCENARIO 11

ALTERNATIVE A		ALTERNATIVE B	
VOYAGE COST($)	0	VOYAGE COST($)	0
DURATION OF VOYAGE(DAYS)	0	DURATION OF VOYAGE(DAYS)	0
FREQUECY OF VOYAGES(PER MONTH)	-1	FREQUECY OF VOYAGES(PER MONTH)	0

WHICH OF THE ALTERNATIVES YOU PREFER?

ALTERNATIVE A	ALTERNATIVE B

SCENARIO 12

ALTERNATIVE A		ALTERNATIVE B	
VOYAGE COST($)	0	VOYAGE COST($)	0
DURATION OF VOYAGE(DAYS)	2	DURATION OF VOYAGE(DAYS)	0
FREQUECY OF VOYAGES(PER MONTH)	-1	FREQUECY OF VOYAGES(PER MONTH)	0

WHICH OF THE ALTERNATIVES YOU PREFER?

ALTERNATIVE A	ALTERNATIVE B