

**Developing a Building Construction Associated
Social Cost Estimation System for Turkish
Construction Industry**

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Social Cost Estimation System for Turkish
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ABSTRACT

Purpose - Construction projects, especially in the urban areas, generate serious environmental nuisances for the adjacent residents. Construction causative adverse impacts on the neighbouring communities are known as the social costs. The amount of social cost changes from country to country depending on the applied building code of practices and building permission regulations. If the relevant code of practice is mandatory or the regulations are strict, contractors inherently will pay more attention to obey them and the occurrence of the social cost is less likely. However, in many especially developing countries, like north Cyprus and Turkey, those rules are either not existing or loose and in this case high amount social costs are caused by the contractors. The presence of the social costs are broadly embraced in theory however, they are not predominantly applied yet during project initial cost estimation practices. One of the reasons for that is, the social costs are rather complicated to measure and quantify due to lack of a paradigm for practice that guides the professionals on how to classify and assess them in the most applicable way possible. Thus, this research aims to develop a generic a social cost estimation system for Turkey and North Cyprus construction industries which assists to identify the social cost drivers, to estimate the social costs on the basis of the identified drivers, to incorporate social cost into project initial cost and to compensate it for the third parties. In this system, the contractors will be enforced to minimize the nuisances of the people residing around a construction site. Otherwise, the contractors will be forced to compensate them through a bonding system.

Design/Methodology/Approach – the research adopts a triangulation strategy adopting multi-method approach in tackling the social cost phenomenon through a rigorous research process. For example, through comprehensive literature review, the research identified the social cost impact types; social cost components are established by the focus group through brainstorming sessions, and observations and self-experience in case study projects either via site visits or participating in the case study projects; the enumeration of the qualitative components of the social costs are obtained via questionnaire based survey.

Findings – The segmentation of the social costs are evaluated as the impacts on house, household and neighbourhood. A total of 17 perceivable nuisance criteria are defined for those segments. The enumeration of all perceivable nuisance criteria is implemented where the estimated total social cost can be generated by using them.

Practical implications – It paves a solid foundation for the professionals in the Turkish construction industry to perform precise building construction associated social cost estimations.

Originality/value – This research provides sound and sequential system to estimate and compensate social costs for building constructions in the residential areas of developing countries.

Keywords – Social cost, construction adverse impacts, building construction nuisance criteria, Turkish construction industry, and quantification of the social costs.

I dedicate this thesis
with love and eternal appreciations to my father,
Prof Tahir elik,
and in honour of my recently born son,
Tahir elik.

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DECLARATION

This thesis is presented as an original contribution based on Doctorate of Philosophy research at University of Salford, Salford, United Kingdom and has not been previously submitted to meet requirements for an award at any higher education institution under my name or that of any other individuals. To the best of my knowledge and belief, the thesis contains no materials previously published or written by another person except where due reference is made.

..... (Signature)

TOLGA ÇELİK

..... (Date)

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CHAPTER 1: INTRODUCTION TO THE RESEARCH

1.1 INTRODUCTION

Construction is a large, multifaceted, and dynamic industry that plays an important role for the growth of local and national economies (Chen, 1996; Lewis, 2004; Rameezdeen, 2005; Behm, 2008; Osei, 2013). Constructing residential and office buildings, hospitals, factories, schools, bridges, sewers and ports along with many other things is only part of what this sector undertakes. Additionally, the sector carries out repair and maintenance to accomplish improvements on all of those structures (OECD, 2010).

The built environment which comprises all structures and living spaces constructed or modified by human beings offers social and welfare benefits (Ofori, 2002; Sarkis et al., 2008). For instance, housing accomplishes to meet the second necessity of mankind by offering shelter from the elements (George, 2002; Ijigah et al., 2013). Concordantly, construction industry underpins to foster a good quality of life as it creates the built environment and provides the tangible facilities and infrastructures in accordance with the needs, wants and values of the people (Bartuska, 2007; Myers, 2013). Therefore, happiness, life and need satisfactions of the society are interrelated with the quality of the built environment thus it is one of the standard indicators of the quality of life (Pearce, 2003; Mohit, 2013).

Despite the fact that completion of construction projects and their entry into service have a direct influence on people's wellbeing, development phases of construction projects generate countless unintentional adverse impacts on their surrounding environments (Butterworth, 2000; Gilchrist and Allouche, 2005; CGG, 2006 ; Sev, 2009; Abidin, 2010; Balaban, 2012).

Especially in urban areas, due to high density of population implementation of construction projects turn out to be the sources of serious nuisances to, including but not limited, adjacent residents and businesses (Pucker et al., 2006; Gangolells *et al.*, 2009; Ferguson, 2012). Near or in every construction zone, no matter if the executed project accommodates processes for building new or renovating existing structures, contractors place signs which state "We apologise for the inconvenience we cause to environment". Many researchers (Allouche et al., 2000; Rahman et al., 2005; Gilchrist and Allouche, 2005; Yu and Lo, 2005; Najafi and Gokhale, 2005), by referring the

term “environment” as the society who surround the construction sites that are adversely impacted by the operation of these sites in terms of pollution, traffic problems, economic activities and damage to natural/built environment, embark to estimate the cost of contractors’ “apology” on behalf of the society (Wang et al., 2008; Appeldoorn, 2013).

These researchers have commonly entitled this attempt as the quantification of the construction causative “social costs”. Many definitions of the social costs particularly associated with civil engineering projects have been proposed over the past 17 years (Boyce and Bried, 1998; McKim, 1997; Rahman et al., 2005; Pucker et al. 2006; Yu and Lo, 2005). For instance, Tanwani (2012) offered the following definition: construction causative adverse impacts that neighbouring communities are inevitably being exposed to due to implementation of construction projects and for which in traditional practices parties involved in the project such as; owner, designer, contractor, and users are not held accountable is named as “social costs”.

On the other hand, the quantification of social costs is set of procedures followed to evaluate the cost of construction originated adverse impacts. Various scholars have proposed numerous approaches where each approach accommodates similar procedures to evaluate the social costs. It is construed that majority of the performed studies focused on evaluation of the infrastructure projects related adverse impacts.

For instance, Jiang (1999) focused on evaluation of the highway construction causative additional travel time, consumption of extra fuel oil, and wear and tear of vehicle parts incurred on the third parties due to traffic bottlenecks.

Lee et al (2005) as well as Florez et al (2012) performed evaluation of the adverse impacts of highway construction on neighbouring community via identifying road user and agency costs. Another highway construction causative adverse impact evaluation study performed by Herbsman and Glagola (1998) concerned lane rental method, where contractors have to pay the cost of delays for peak and off-peak periods due to traffic obstructions composed of lane and shoulder closures.

In another study, Yu and Lo (2005) tried to integrate road construction causative adverse impacts namely; traffic, environmental, and business. Gilchrist and Allouche (2005) proposed a model based on four types of construction social costs; traffic, economic activities, air and water pollution, and damage to the physical environment. They categorized construction dependent adverse impact types and guided the professionals on valuation methods applicable for each adverse impact.

Civil engineering projects' development phases associated social costs while widely acknowledged, are predominantly not considered during estimation process of the project initial cost hence, they are rarely considered in the design, planning or bid evaluation phases of construction projects (Gilchrist and Allouche, 2005).

According to Ferguson (2012), this can be ascribed to the reality that it is rather complicated to measure and quantify the social costs. Three reasons are put forward by Yu and Lo (2005) to explain why the social costs are not considered in traditional construction management practices. At first, the construction social costs are incurred to the public rather than to the parties involved in the project. Therefore, these costs are not included in the bill of quantities or in any construction contractual documents. Secondly, construction social costs are difficult to measure and quantify with the available techniques, since most of them are intangible, rather than visible costs. Thirdly, the public who are incurred by the construction social costs do not participate in the project planning and management process.

By virtue of the difficulties in quantifying the social costs and traditionally applied contractual and bid evaluation practices in which majority of the contractors' goals are limited; to complete the project for the lowest cost, within the time limits, and the quality requirements (Bowen *et al.*, 2012), necessity to take cognizance of the social cost notion is overlooked by parties involved in construction projects.

However, during design build and construction phases of a project, only considering needs, wants, and expectations of parties involved in the project and responding to these accordingly without being concerned about the expectations of other interest groups as in the present case, surrounding community of a construction site who are incurred by the social costs, leads to lack of responsibility and improper management of the social costs which can in return result with public objection hence delay the completion date of the project (Yu and Lo, 2005).

This is why many researchers who have a consensus about the difficulty of predicting the social costs due to lack of a standard estimating method attempted to develop applicable estimating methods (Boyce and Bried, 1994; McKim, 1997; Gilchrist and Allouche, 2005; Yu and Lo, 2005; Rahman *et al.*, 2005; Pucker *et al.*, 2006; Matthews and Allouche, 2010). Additionally, each proposed method suggests a cost category for the consideration of the social costs but the way to compensate these costs for the society is yet to be determined.

On the other hand, it is inconvenient to presume that intensity of the perceived construction causative adverse impacts by the third parties will show similarities in different geographical

locations. People's perception about the felt nuisance varies according to their culture and manners of the society (Oltedal *et al.*, 2004).

Additionally, location of the construction site (i.e. densely populated or not), the building permission regulations and code of practice of the country, and applied construction methods are also parameters which are necessary to be considered during estimation of the construction associated social costs.

Within the context of Turkey and North Cyprus, although no data was ever recorded concerning definition of the social costs, their quantification method and a way to compensate these costs, at the end of field surveys which are performed as a part of this study, it is revealed that the social cost issue is well recognised by the society remaking the necessity of consideration of the social costs by the industry professionals.

Therefore, this study seeks to develop a generic a social cost estimation system for Turkey and North Cyprus construction industries which assists to identify the social cost drivers, to estimate the social costs on the basis of the identified drivers, to incorporate social cost into project initial cost and to compensate it for the third parties.

1.2 PROBLEM STATEMENT AND RESEARCH JUSTIFICATION

Over the last two decades, many definitions of the social costs particularly associated with civil engineering projects have been proposed (Boyce and Bried, 1998; McKim, 1997; Rahman *et al.*, 2005; Pucker *et al.* 2006; Yu and Lo, 2005).

For instance, Allouche *et al.* (2000) defines the social costs as costs generated due to execution of a construction project incurred by the parties involved in the contractual agreement. For measuring purposes, they encompassed social costs by the costs incurred on the third parties as a result of being exposed to air pollution, noise, vibration, disruption to traffic and increased level of traffic accidents. In their work, they identified costs subject to contract as direct, indirect, and social costs.

Gilchrist and Allouche (2005) just as Allouche *et al.* (2000) proposed that project contractual costs should be comprised of direct, indirect and social costs but for measuring purposes distinctively grouped the social costs based on the area of impact namely: traffic, pollution, economic activities, and ecological/social/health.

On the other hand, other researchers (McKim and Kathula, 1999; Rahman *et al.*, 2005) similarly identified social costs as the overall impact of a construction activity on the welfare of society.

They categorised the encompassing social costs as direct, indirect and intangible costs. Apeldoorn (2013) offers the following definition: Implementation of construction projects generates disruptions to common life patterns of the society around the construction zones. Equivalent monetary values of these disruptions are called social costs. Contrary to previous researches, they offered two categories for costs associated with a construction project namely, costs incurred to the owner of the project: direct and indirect costs; and costs incurred to the society: quantifiable and non-quantifiable social costs.

It is clear enough that suggested definitions for the term “social cost” and suggested cost categories for consideration of these costs shows differences. One of the most common ways of eliminating differences in the use of a term is achieved by defining it in accordance with what is intended, or actually is, expressed or indicated by the meaning of the term to set out the essential attributes of the defined term. Essential attributes of an approach for a specific subject varies in accordance with the people’s point of view. As the people’s point of view for a specific subject cannot be standardised as so the social cost estimation methods.

Pucker et al. (2006) explained why project participants do not take responsibility for considering the infrastructure related social costs as follows;

“For the most part, social costs are not considered during a construction project’s planning, design and bid evaluation stages because they cannot be calculated using standard estimating methods. In recent years efforts have been made to introduce approaches for predicting social costs associated with utility construction projects. Nevertheless, unit cost data needed for the verification of such prediction methods is lacking.”

This is why in practice the contractors’ estimators did not involve in estimating the social costs for bidding purposes so far. Having not performing an effort to estimate the social cost does not mean that, the social costs are not existent. The study found that social costs can account for up to 400% of construction costs on certain projects (Rahman et al., 2005).

On the other hand, it is observed that, recently the building construction industry is developing fast in North Cyprus and Turkey (SPO, 2012; TCA, 2014a). This implies that the effects of the building construction caused social costs especially in the densely populated areas will become more important. It is obvious that, today the concerns of people on the environmental issues and on the social rights are rising in Turkey and in North Cyprus as well as in many other countries. This trend is making the people to pay more attention to the activities especially closely affecting them or cause disturbances on their environment, society, households, and personal rights. It is

known that, the construction activities in residential areas have adverse impacts on the daily routine of the people residing in the vicinity of them.

As aforementioned, in the present case what is intended, or actually is, expressed or indicated by the meaning of “social costs” can be offered in different contexts. Since previously offered definitions will not be adopted for use in this research, there is a need to clearly define the term “social cost” in order to set out the essential attributes of the defined term. Below given definition is offered to demarcate the boundaries of the social cost notion recognized throughout this study, and to underpin the mounted arguments on the scope illustrated by the definition.

Construction social costs defined by the author;

“The people themselves and the environment they live in; their homes and neighbourhoods if located around the building construction zones are exposed to adverse impacts of the construction activities. In return, people react via altering their daily routine to resolve or alleviate the exposed disruptions to their common life patterns. Cost of this reaction is defined as the social costs associated with building construction projects”.

Therefore in this study, in accordance with the adopted use of the “social cost” term, there is a need to identify building construction causative adverse impact types which are the typical social cost indicators, considering the social and cultural manners of the Turkish society. Afterwards, there is a need to propose social cost estimation and compensation methods for Turkish construction industry. Meanwhile it is critical to determine an appropriate cost category for considering the social costs as it should be kept out of bidding because due to lack of standard it could result with unfair contractor selection.

Last but not least, in majority of the past researches, scholars focused on measuring the infrastructure construction (mainly highways/roads) causative adverse impacts on the neighbouring community and finite number of attempts are given to measure the building construction associated social costs. This may be chalked up to the fact that variety of infrastructure construction activities are rather limited compared to the activities of building construction. For this reason, estimation of infrastructure oriented social costs turn out to be more implementable with the existing estimation methods. As building construction industry is rapidly growing in Turkey and North Cyprus, proposed social cost estimation method will seek to determine building construction associated social costs.

1.3 RESEARCH QUESTION, AIM AND OBJECTIVES

In this respect, the research question identified for this study is as follows;

“How to estimate the cost of alterations in the daily routine of the people residing in the vicinity of building construction sites and how to compensate it in North Cyprus and Turkey?”

After considering all the aforementioned grounding information for the research, the aim of the research is fixed as;

“The aim of this project is to develop a system to identify the changes in the items of daily routine of the people residing near building construction sites, to estimate the cost (social cost) of those changes by developing a monetizing method, and propose a cost category and a compensation method for the estimated social costs in north Cyprus and Turkey.”

In order to achieve the stated aim, the following research objectives were identified;

- I. To identify the key drivers of the social costs occurring due to execution of building construction projects in residential areas.
- II. To explore the existence of the social costs for Turkish construction industry in Turkey and North Cyprus.
- III. To determine the alterations in the daily routine of people residing in the vicinity of building construction sites in residential areas.
- IV. To conceptualise a social cost monetising system applicable for Turkish construction industry in Turkey and North Cyprus.
- V. To identify an appropriate cost category for social costs.
- VI. To specify a building construction caused social cost compensating method for the affected people for Turkish construction industry in Turkey and North Cyprus.
- VII. To evaluate and validate the proposed social cost monetising compensating methods

1.4 SCOPE OF THE RESEARCH

The main reason of having a research scope is to narrow down the research area and also to set boundaries to what should be investigated. In this context the scope is further discussed as follows:

i. Definition of the social costs

There is no a single definition of the “social cost” among the researchers. The meaning of “social” has varied understandings among for example the economists and the engineers. Therefore, the

social cost also has varied interpretation. In this thesis the author defined the social cost as “the cost of building construction caused alterations in the daily routine of the people residing in the vicinity of a site”.

ii. Variation of the social cost depending on the characteristics of building permission regulations

The amount of social cost changes from country to country depending on the applied building code of practices and building permission regulations. If the relevant code of practice is mandatory or the regulations are strict, contractors inherently will pay more attention to obey them and the occurrence of the social cost is less likely. However, in many especially developing countries, like north Cyprus and Turkey, those rules are either not existing or loose and in this case high amount social costs are caused by the contactors. Therefore, the developed framework to estimate the building construction caused social cost is more meaningful in many developing countries like north Cyprus and Turkey.

1.5. RESEARCH METHODOLOGY

Considering the beliefs, assumptions, and the nature of reality and truth about the phenomenon under investigation, set of processes which reflect the way in which this research is undertaken from design through to conclusion are sequentially organised as illustrated in Figure 1.1. Due to the nature of this study, triangulation has been applied to the overall research strategy to ensure the reliability and validity of the research through adopting multi-methods for data collection and analysis. Types of research methods and techniques adopted to perform each process are also depicted in the Figure 1.1. By all means, designed research process is compatible with the tasks performed to accomplish this study.

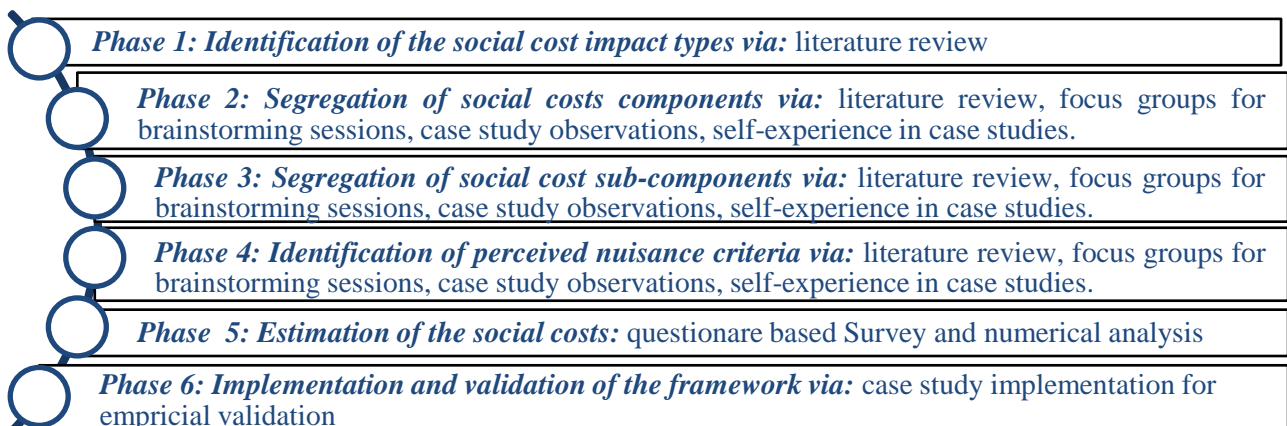


Figure 1-1: Research Process

1.6 RESEARCH NOVELTY AND CONTRIBUTION

The contribution to knowledge of this research can be organized into two contexts which are theoretical and practical. Within the theoretical context, the main deliverable of this study is the framework developed for estimation of the social cost which is defined as the cost of alterations in the daily routine of the people living in the vicinity of building construction site in residential areas.

The development of this framework is the main contribution to the current body of knowledge. This framework is especially a useful tool to estimate the social costs in cases where the building permission regulations are not strict and the contractors do not pay too much attention to lessen or eliminate the construction caused social costs as in north Cyprus and Turkey.

Having estimated the social cost, determining a way to apply these costs in practice is another matter to concern. Therefore, within the practical context first, a cost category and then a compensation method for the social costs are proposed.

The proposed social cost compensation method is discussed with the local municipalities and it was decided to be applied in the major cities of north Cyprus. In this system, the contractors will be enforced to minimize the nuisances of the people residing around a construction site. Otherwise, the contractors will be forced to compensate them through a bonding system.

1.7 GUIDES TO THESIS

In chapter 2, comprehensive literature review about contractors' bid price, social costs associated with construction projects, estimation considerations and methods of the social costs are discussed. Additionally, definitions made on the social costs and the types of the social costs generated due to construction projects are discussed in detail. Additionally, quantification methods from literature are explained in a critical manner.

In chapter 3, construction industries of Turkey and North Cyprus as well as current social cost notions for the Turkish construction market is addressed.

Chapter 4 presents the research methodology of the thesis. In this chapter followed research philosophies and approaches, adopted data collection and analysis methods are discussed in detail. Additionally, phase by phase processes that are followed to perform this principal study is presented within the context of conceptualised research design.

Chapter 5 explains the conceptualised system to estimate and compensate the building construction associated social costs for Turkish construction industry. It discusses the existence of

the social costs for Turkish construction sector and proposes a generic framework to quantify those costs accordingly.

Chapter 6 presents the conducted questionnaire as a part of this research in order to enumerate the alterations in the daily routine of the residents neighbouring construction sites. Additionally, the chapter discusses the procedure followed in designing the questionnaire, how participants involved in the questionnaire are selected, and how the confidentiality of the participants is obtained. The chapter concludes by discussing what each question diverted to respondents intends to achieve.

Chapter 7 is comprised of the data analysis of the questionnaire results. Additionally, interpretations of the findings are discussed thoroughly.

Chapter 8 addresses the application of the developed social cost estimation framework in order to monetise the previously obtained daily alterations in order to reveal the social cost incurred to per house located within the vicinity of construction zone.

In chapter 9, evaluations of the proposed social cost estimation and compensation system for Turkish construction industry is performed via experts' opinions and a case study. Discussions of the experts' opinions and findings of the case study are presented thoroughly.

Finally in chapter 10, conclusions of this specific study as well as the probable recommendations that can be adopted in future studies are addressed.

CHAPTER 2: CONSTRUCTION ASSOCIATED SOCIAL COSTS

2.1 INTRODUCTION

Construction is a large, dynamic and complex sector that accommodates processes for building new structures and engineering projects. Construction works also concern processes for renovation encompassing additions, alterations, or maintenance and repair of existing structures and engineering projects (Behm, 2008).

In order to complete a construction project successfully, it is significant that the structure is delivered at the right time (schedule), within the budget, and expected quality is attained (Ergonul and Yilmaz, 2011). Due to the role of the contractors which is to plan, develop and coordinate the activities which coincide with the building/renovation of the structures and engineering projects, contractors have a very important role for the progress and success of construction projects (Jaskowski, Biruk and Bucon, 2010; Alzahrani and Emsley, 2013; Palaneeswaran and Kumaraswamy, 2001; Yawei et al., 2005). For that reason, selection of a contractor for the intended project is very significant task for the construction clients.

Irrespective to the construction process, in the construction industry direct negotiation and competitive bidding are the two methods followed by the owners (clients) to determine which contractor may be awarded with a construction project (Dikmen et al., 2007; Drew, Sktimore and Lo, 2001). Under normal conditions, public clients prefer to deliver construction projects through competitive tendering in order to make a reasonable justification about which contractor will be given with the job (Harris, McCaffer and Edum-Fotwe, 2013).

On the other hand, private clients are free to select the either bidding methods. In this context, the public clients are those who are Central government departments, public corporations and local authorities and all the other promoters are private clients. In general, the decision about which contractor will be selected for the tendered construction project is made subsequent to receiving several tenders from a number of different contractors.

Contractors become ready for a tender after estimating the costs of tendered construction project. For that reason, estimation; an appraisal, an educated conjecture, and an outlook approximation as to the total cost of a project is one of the primary objectives of contractors at the initial phases

prior to tendering (Woodward, 1997; Gould, 2011; Yu et al., 2006). Estimation is executed with respect to the contract documents prepared by the owner of the project which describes the necessary work to be performed (Harris, McCaffer and Edum-Fotwe, 2013). Ability of construction companies in estimating the costs associated with a construction project with optimum accuracy contributes for obtaining competitive advantage hence, commercial success in the industry. This obligates construction companies to take operation of the marketing practices into account. In order to ensure that a company maintains a significant market profile, it is crucial to precisely comprehend and include all cost constituents associated with a construction project during estimation of bidding price (Apanaviciene and Daugeliene, 2011).

On the other hand, despite the fact that construction projects are designed to support and satisfy the needs of human activities and they are beneficial for the growth of local/national economies (Osei, 2013), the development phases of it, in other words, the required activities to fulfil a construction project can cause a lot of disturbances to the environment (Sev, 2009; Abidin, 2010; Balaban, 2012).

Within the context of this research, the term ‘environment’ refers to the society surrounding the construction sites that are impacted by the operation of these sites in terms of economic activities, traffic problems, damage to natural/built environment, and pollution (Wang et al., 2008; Appeldoorn, 2013).

Especially in urban areas, due to high density of population implementation of construction projects turn out to be the sources of serious environmental nuisances for the adjacent residents and businesses (Gangoellis *et al.*, 2009; Ferguson, 2012). Appeldoorn (2013) put forward that level of construction causative nuisances incurred to the surrounding society is highly dependent on the location of a project. He performed several case studies and determined that in densely populated areas the negative effects of construction activities is greater compared to the areas with lower population.

Construction causative adverse impacts that neighbouring communities are inevitably being exposed to due to implementation of construction projects and for which in traditional practices parties involved in the project such as; owner, designer, contractor, and users are not held accountable is called “social costs” (Kapp, 1950; Boyce and Bried, 1998; Tanwani, 2012).

Social costs while widely acknowledged, are predominantly not considered during estimation process of the project initial cost hence, they are rarely considered in the design, planning or bid evaluation phases of construction projects (Gilchrist and Allouche, 2005). According to Ferguson

(2012), this can be ascribed to the reality that it is rather complicated to measure and quantify the social costs. Three reasons are put forward by Yu and Lo (2005) to explain why the social costs are not considered in traditional construction management practices. At first, the construction social costs are incurred to the public rather than to the parties involved in the project. Therefore, these costs are not included in the bill of quantities or in any construction contractual documents. Secondly, construction social costs are difficult to measure and quantify with the available techniques, since most of them are intangible, rather than visible costs. Thirdly, the public who are incurred by the construction social costs do not participate in the project planning and management process.

By virtue of the difficulties in quantifying the social costs and traditionally applied contractual and bid evaluation practices in which majority of the contractors' goals are limited; to complete the project for the lowest cost, within the time limits, and the quality requirements (Bowen *et al.*, 2012), necessity to take cognizance of the social cost notion is overlooked by parties involved in construction projects.

This chapter is composed by two parts. In the first part cost estimation of construction projects, estimate considerations, composition of contractor's bid prices and the types of bonds are discussed. In the second part definitions of the social costs, types of the construction generated adverse impacts which lead to formation of the social costs, at what phase of the project initial cost estimation process these costs should be considered, proposed methods for compensating the social costs, and potential quantification techniques of the social costs are discussed in detail.

2.2 COST ESTIMATION OF CONSTRUCTION PROJECTS

The process of determining the probable cost of workmanship, equipment, materials, and overheads associated with a proposed construction project is defined as estimation. During estimation process, estimators seek to predict the cost of a construction project and the required amount of materials, labour, and equipment necessary to construct it with optimum accuracy (Peterson, 2007).

The main objectives of the construction companies include survival, growth, and profitability. Ensuring adequate workload is the only way that a construction company can achieve these objectives. Preparing a bid for the tendered construction project is the most common way that construction companies obtain workload (Tah, Thorpe and McCaffer, 1994). For that reason, estimation plays a key role for the surviving of a construction company. However, both under-estimate and over-estimate causes to cease the operation of a construction company. Accurate

estimates are essential for a construction company to be successful in bidding process while maintaining an acceptable profit (Peterson, 2007; Manfredonia et al., 2014).

The estimator is the person who is responsible for preparing the cost estimates. An estimator must possess the following skills to be a good estimator (Peterson, 2007).

- An estimator must have a sound understanding of the construction methods, materials, and productivity of labours and equipment.
- An estimator must possess the basic skills needed to determine the quantities of materials, labour, time, and equipment.
- An estimator must be a good communicator, both verbally and in written form to obtain the prices from vendors and subcontractors.
- An estimator must possess good computer skills since computers are widely used in estimating processes.
- An estimator must be detail oriented for careful and accurate determining the work quantities and costs.
- An estimator must have the confidence to quickly prepare take-offs and make decisions even under pressure. The bid days are always so hectic.
- Finally, an estimator must have a desire for constant improvement.

Even though the specific format adopted by the estimator changes with the type of estimate, type of project, and company procedures, all estimates incorporate the following common traits (Gould and Joyce, 2008).

- Owners want the largest building with the best quality and the highest performance capacity for the least amount of money. Therefore, as project develops, the design and construction team estimates to ensure the expectations of the owner within the available budget, time and quality constraints.
- Estimates are not guarantees of costs. The cost developed during design and even at the bidding stages are almost never the final and completed cost of the project.
- Estimating combines science and art. Inherently, a good artist has the ability to visualize, is creative, and can provide answers to questions never before asked. A scientist is methodical, organised, and technically strong, has strong research abilities, and can perform complex calculations.

- An estimate can only be as accurate as the information upon which it is based. As figure 2.1 depicts, the accuracy of estimate also depends on the time required to complete the estimate. It can be said that, the accuracy of estimate depends on project document completeness, data base for past projects, and the skill and judgment of the estimator. As the design process proceeds, the level of project detail increases and the methodology and procedure of estimating changes from conceptual estimate to detailed estimate as they are discussed in section 2.4.

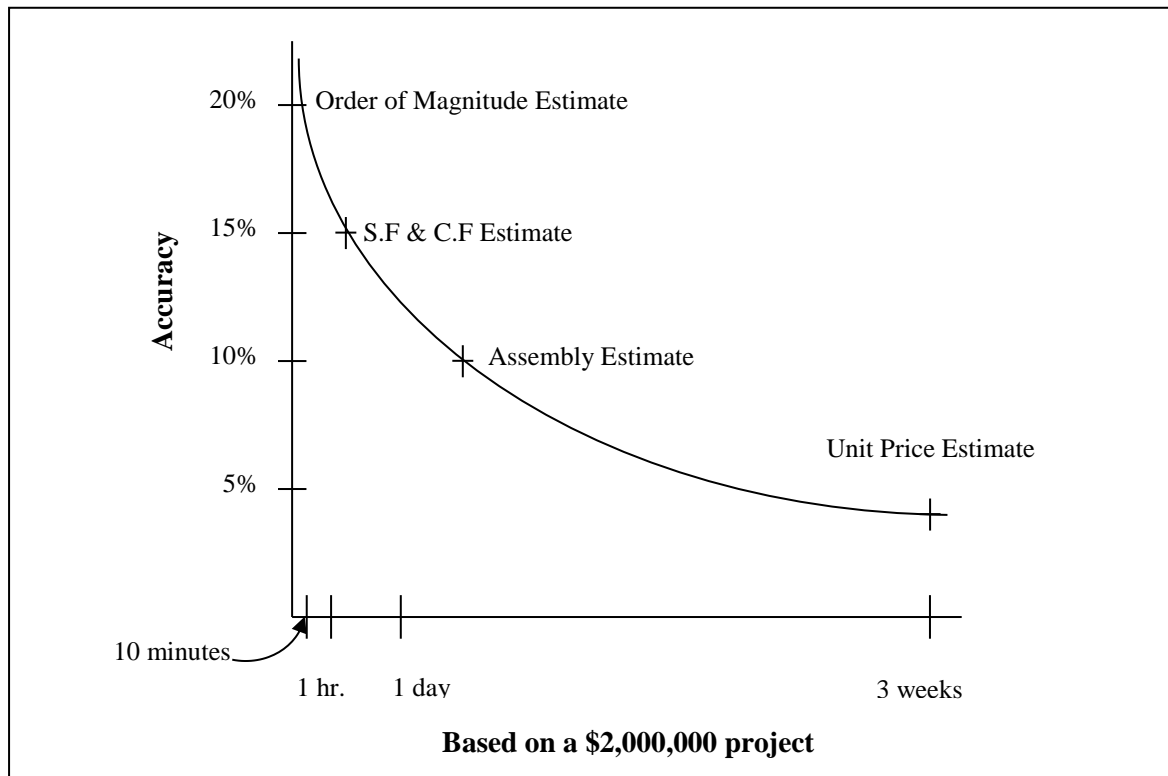


Figure 2-1: Project moves on in time, the time required to complete the estimate and the accuracy provided increases re-drawn (Waier and Chiang, 2007).

In traditional cost estimating procedures bid price prepared by the estimators for the tendered project does not include the social costs because they cannot be calculated using standard estimating methods (Apeldoorn, 2013; Pucker et al., 2006). Additionally Yu and Lo (2005) emphasises that construction social costs are difficult to measure and quantify with the available techniques, since most of them are intangible, rather than visible costs.

Therefore, in order to make social cost estimation, it is necessary to develop a new system in order to estimate the social costs specifically caused by building constructions in residential areas. This system development is explained in detail in chapter 5.

2.3 ESTIMATE CONSIDERATIONS

Irrelevant to the project phase, every estimate considers the same basic issues. These are project size, project quality, project location, construction start and duration, and other general market conditions (Ogunlana and Thorpe, 1991; Gould, 2005; Gould and Joyce, 2008).

2.3.1 Project Size

Bigger the project size is more efficient use of the people and equipment and as a result, lesser unit costs for the works. The reason is that, as people repeat a task they get better, faster and reduce the labour cost. As illustrated in figure 2.2, as the operation continues, workers “learn” thereby the time required to complete the next similar unit lessens (Gould, 2005; Gould and Joyce, 2008).

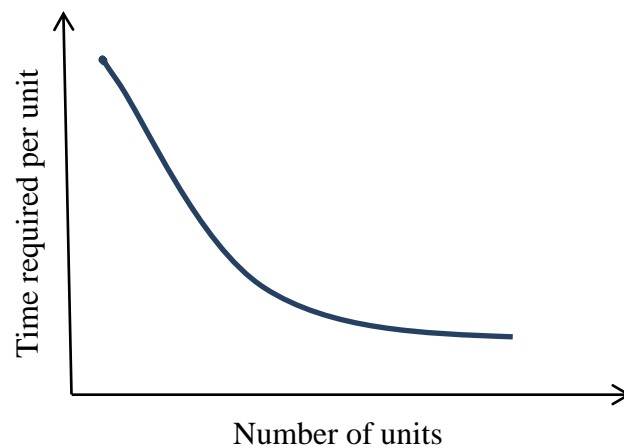


Figure 2-2: Learning curve re-drawn (Gould and Joyce, 2008)

2.3.2 Project Quality

Apart from meeting the planned schedule and cost, maintaining good quality is one of the significant goals of project owners as quality is one of the significant factors when determining the success of a construction project (Belassi and Tukel, 1996; Chua et al., 1999). Required quality of a construction project varies from stakeholders to stakeholders as their expectations are not necessarily the same. An owner may require a high quality project for many reasons.

However, as the quality and complexity of a project increases, so does the project's cost. Cost of quality is defined as all the efforts put by the project management team to attain the quality of the structure. These efforts incorporate every work to meet the project specification and rework (PMBOK, 2000). The tools that the estimator uses to estimate the expected quality get clearer as the design of the project proceeds. At the bidding stage, the quality of the project must be precisely

specified for individual units. This is the reason why estimating requires longer time for bidding purposes (Gould, 2005).

2.3.3. Location

Location of the proposed construction project is considered to be one of the critical elements during estimation process. Depending on the project location, the purchasing cost of materials and delivery, rental or purchase of necessary equipment, and cost of labour may show great dissimilarities.

Availability, competition and access to efficient transportation methods widely affect the cost of materials. If the available numbers and the skill levels of workers required are not adequate locally, labour forces have to be imported from elsewhere at a higher cost. The cost estimation of construction projects can be implemented by using “location indices” for different parts of a country (Gould, 2005).

2.3.4 Time

The time of physical construction of a project has a major impact on the cost of the project. Since estimates, by definition, are prepared in advance of the construction, the estimator must anticipate the future cost of the work. The estimators preferably use “historical indices” to adjust a project future cost by using historical costs. This adjustment also assists an estimator to estimate the cost of a new project today by looking at a similar project built recently.

However, it is difficult to predict the accuracy of what the index will be for a future year. So, the best thing that an estimator can do is to look at the current trends and predict future labour, equipment, and material prices (Baalousha and Çelik, 2011).

2.3.5 Market Conditions

Four of the abovementioned estimation considerations can be incorporated by the estimators in a normal market conditions without any unusual circumstances. However, presuming constant stability for the market conditions is extremely optimistic as market conditions are likely to shift.

For instance, in a market without much work, the contractors may bid a project at the actual cost or with small profit margins to cover their overheads and keep their staff employed. In circumstances where serious future changes in the market conditions are expected, the contractors may bid with significant profit margins to cover future changes (Gould, 2005).

2.3.6 Social Cost Estimate Considerations

The estimate considerations explained above are for the estimation of direct costs and overhead costs of construction projects and these costs are explained further in section 2.4. On the other hand, estimation process of the building construction associated social costs should also concern set of issues that are likely to have an impact on the estimated social cost. Due to the nature of the social cost notion, it is asserted that probable issues in need of consideration during social cost estimation should differ from those considered during direct and indirect cost estimation. The author of this thesis proposes the basic social cost estimation consideration as follows;

- i. Location of the construction site
- ii. The building permission regulations
- iii. Applied construction methods
- iv. Culture, tolerance and way of living of the nearby residents of the site

These considerations are explained in detail in section 2.8.

2.4 COMPOSITION OF CONTRACTOR'S BID PRICE

Work unit of a construction project can be described as an activity, a work-item or a work-package and at least one cost element is present. Cost of labour, material, equipment, and administrative costs are the few examples of cost elements associated with a construction project. As a matter of course, direct correlation of different cost elements with specific construction activities incurring them is very complex.

Alternatively, numerous researchers (Chitkara, 1998; Assaf et al., 2001; Callahan, 2005; Gahlot and Dhir, 2007; Greenhalgh, 2013) indicated that determination of the costs formed by execution of construction activities should be performed by considering them as two different cost groups namely; direct costs and overhead costs (indirect costs).

Aforementioned cost estimation process paves the way to obtain the anticipated direct and indirect costs associated with a construction project. On the other hand, project owners generally choose which contractor will be awarded with the tendered project based on the bid price they receive.

Bid price of a contractor is determined subsequent to estimation process and it is composed of;

$$\text{Bid Price} = \text{Base Cost} + \text{Mark-up}$$

Base cost is composed of two cost categories namely direct costs and overhead costs. Mark-up is considered by contractors as an allowance for profit and risk if the decision to tender is made.

According to Smith (2007), generally in tendering, 90% of the bidding price is composed of the estimated base costs and the remaining 10% is represented by the mark-up of a project. It is obvious that, the amount of mark-up plays an important role in determination of the contractor that will be awarded with the project. In light of this information, constituents of base cost and mark-up are explained in depth in the following sections.

2.4.1 Direct Costs

Subsequent to comprehensive literature review (Chitkara, 1998; Callahan, 2005; Harris, McCaffer and Edum-Fotwe, 2013; Gahlot and Dhir 2007, Greenhalgh, 2013), the author acknowledges that direct costs are composed of cost elements that can be recognized by the implementation of a piece of construction activity. Moreover, in construction contracts, direct costs are the elements that are attributable directly to a labour, material, equipment and probable subcontractor works.

2.4.1.1 Material costs

Determination of material prices for a project is considered to be the most straightforward price computation compared to other units of a project that needs cost evaluation. Suppliers are the most reliable sources for material prices. It is estimator's duty to make sure that price quoted actually covers all the specification requirements.

Harris, McCaffer and Edum-Fotwe (2013) highlights that parameters such as; material quoted being the correct model number, colour, and finish; price quoted by supplier being valid until the scheduled delivery time; price including the delivery cost of materials to project site; supplier giving adequate warranties and guarantees for the purchased material; adequacy of the stock availability; and payment terms, discounts, and credits being well documented needs to be confirmed and approved by the project management team.

2.4.1.2 Labour costs

Determining the price for labour is the most difficult task as hourly wage rate and productivity of the team needs to be considered. Factor of the rates which are paid for a specific trade is called wage rate. The wage rate increases needs to be factored in especially for projects that are run for long-terms.

Subsequent to determining the quantity of work required for undertaking the project and hourly wage rates of the labours, in order to finalise the labour cost estimation, duration of the activities needs to be worked out. Finding out the crew durations and/or productivity depend very much on

the experience and capacity to picturing how the work will be accomplished on site (Harris, McCaffer and Edum-Fotwe, 2013).

It has been widely expressed in the literature that (Stewart, 1991; Sweeting, 1997; Harris, McCaffer and Edum-Fotwe, 2013; Smith, 2007; Ogershok and Pray, 2009) in order to be capable of determining labour costs of a project, estimator should know; the expected efficiency rate of labour; other work occurring at the same time that could interfere with this activity; expected weather conditions; specific conditions of the proposed work: that is, working on ladders or scaffolding versus working on the ground; duration and frequency of overtime.

2.4.1.3 Equipment costs

Relevant equipment required for undertaking the pre-specified tasks, including small tools needs to be covered item by item. Large plants which are being operated such as crane, lift truck and resembling are normally covered on a project basis as they are often used during the job for various activities.

There are two categories for the equipment costs where the equipment itself is the one and the operating the equipment is the other. Lease, rental, storage, interest, ownership, insurances, taxes and license are all covered within the costs of equipment itself. In cases where the plant is owned by the company these costs are determined within the company. If equipment will be hired, these costs are quoted by equipment suppliers.

Operating the equipment costs include gasoline, oil, periodic maintenance, transportation and mobilization of the plant. Plant operator's cost is not included under the cost of equipment but under the labour line item (Harris, McCaffer and Edum-Fotwe, 2013).

2.4.1.4 Subcontractor works

In construction industry starting from 1980s, main contractors started to break down their bidding into work packages in order to obtain tenders for every single package from prequalified subcontractors. Afterwards, in order to mitigate the misunderstandings about the scope of work assumed by subcontractors, literature discusses that (Harris, McCaffer and Edum-Fotwe, 2013; Ng and Luu, 2008) it is very significant to be in close contact with subcontractors during bidding period.

In addition, this also motivates the subcontractor to place a fair bid. It is wise to have debriefing meetings subsequent to received bids from subcontractors with the intention of ensuring that commonly missed points have been picked up. Furthermore, it is significant to separate

subcontractor's work from the contractor's when overhead and profit are being applied at the top of base costs. The reason for this is, tax, insurance, overhead and profit is included in subcontractor prices. Alterations on this price will be dissimilar from the alteration done for the work of the contractor's own forces (Harris, McCaffer and Edum-Fotwe, 2013).

2.4.2 Overhead Costs

Contractors generally categorise overhead costs by approaching from two different perspective; project overheads (site overheads) and company overheads. Project overheads are comprised of costs which can be attributable to a given project but cannot be attributable for a specific construction activity (Chitkara, 1998).

Project overheads are considered to be construction site costs that incorporate costs related with running the construction site such as; field office people, safety, security, scaffolding and gantries, site accommodation, photography, clean-up etc. Generally these costs are itemized according to their types, with amounts and unit prices are figured exactly (Harris, McCaffer and Edum-Fotwe, 2013).

On the other hand, company overheads which are also named as general and administrative overheads incorporate the entire costs incurred due to contractor maintaining the company in business and supporting the construction process. It is noteworthy to mention at this stage that company overheads are not attributable for a specific construction project (Assaf et al., 2001). In addition, company overheads is generally carried out as a percentage and it covers costs such as; office rent, real estate costs, vehicles, engineering support, clerical staff, top management salaries, marketing, legal and accounting fees (Harris, McCaffer and Edum-Fotwe, 2013).

It is also worth highlighting in this stage that, in Table 2.1 a simple comparison that is conducted by Dykstra (2011) is given. This comparison indicates how different costs can be grouped as direct costs, project overheads, or company overheads.

Table 2-1: Comparison of Costs (Dykstra, 2011)

Expenses	Direct Costs	Project Overheads	Company Overheads
Roofing	X		
Superintendent		X	
Home Office			X
Telephone at job site		X	
Telephone at home office			X
Drinking water at job site		X	
Site excavation	X		
Contractor's attorney			X
Meeting minutes		X	
Solar panels on the new building	X		
Solar panels on the home office			X

2.4.3 Mark-Up

Mark-up which is an important bid component is comprised of accumulation of the percentage of profit and the contingency risks considering the market conditions. Mark-up is generally evaluated once the contractor reaches the decision to bid for a construction project (Egemen and Mohamed, 2007).

2.4.3.1 Profit

A company produces and keeps its corporate health depending on its ability to make a profit. Time and energy investment as well as the acceptance of risk inherent in a construction project enhances the importance of adding profit. Subsequent to pricing the labours and equipment participated in the project, profit is added.

Costs related to managing the job on site and the costs of supporting project in the home office are included in overhead costs. Business might stay afloat for some time but it would not grow if no profit were added. Company exclusive of sufficient profit would not be able to survive as the company would not have any financial tolerance for mistakes or unforeseen conditions.

Adding a profit margin for every single project is a must-do for companies. Type of project, size of project, amount of competition anticipated, the desire to get the job and extent of the risks are the parameters that specifies the amount of profit.

If company requires taking the work, strongly desires to form a new relationship with the client amount of profit charged might be small. On the other hand, the company should not have too many small-margin projects on the books simultaneously, so that it has adequate coverage if something happens on one job. Generally projects with higher risks or little competition encourages the company to add a higher profit (Harris, McCaffer and Edum-Fotwe, 2013).

2.4.3.2 Risk contingency

Risk is an uncertain event or condition that if it occurs has an effect on at least one of the project objectives; duration, cost and quality of the project. The reason behind contractor's inclusion of risk contingency is to provide a safeguard against uncertain circumstances that are expected to have adverse impact on the routine of the project such as weather, labour problems, soil conditions and etc. (Harris, McCaffer and Edum-Fotwe, 2013). The general risk contingencies used by the contractors are as follows (Holm et al., 2005):

- Design contingencies to cover the risks resulted from any deficiencies of design.
- Escalation contingencies are used to cover the risk associated with material and labour inflation.
- Estimating contingencies are used for the deficiencies in the cost estimation by estimators. It is common to add the contingencies to the budget estimates.

2.5 SOCIAL COSTS TO BE CONSIDERED UNDER PROJECT INITIAL COSTS

Construction projects' initial cost is defined as the initial monetary investment which is attributed for a specific project and incurred to the owner during the start-up of the project (Coony et al., 2005). Constituents of projects' initial costs include but are not limited to; project management, design, property acquisition, construction, and contingency costs (see figure 5.6 for more details).

Contractor's bid price costs explained under section 2.4 are considered as contractual construction costs and the remaining initial cost constituents are exempted. These exempted costs are categorised as non-contractual construction costs. It is undisputed that the owners are liable to cover both contractual and non-contractual costs associated with a construction project. In this

research, the social costs associated with building construction projects are proposed to be included under the project non-contractual costs. These are explained further in chapter 5.

2.6 CONSTRUCTION BONDS

Construction bonds are normally part of contract documents. The types and the amounts of bonds required by the owner are specified in the project specifications which are part of contract documents. The contractors who are interested in the project and willing to join a tendered project, are required to find a bonding company (a finance institution or a bank) to provide a means of guarantee to the owner on behalf of the contractor.

Contractor submits bonds to the owner to provide a guarantee that in the event the contractor does not perform as stated in the contract documents, bonding company, an independent third party, will cover the owner's damages to the amount of the bond (Gould, 2005; Russell, 2000). The bonding company investigates the contractor's ability and the capacity to perform the work that the bond will be provided.

The project types, the contractor's resources, and the size of the project are only a few of the matters to be considered before bonding is provided by the bonding company. There are three types of bonds most commonly used in construction contracts. These bonds are the bid bond, the performance bond, and payment bond (Benton et al., 2011).

2.6.1. Bid Bond

Bid bond is a kind of guarantee given by the contractors to the client. The guarantee includes the condition that if the owner accepts the contractor's bid, the contractor will enter into a contract with the owner in accordance with the contract terms. Otherwise, either the contractor will lose the guarantee (bid bond) he offered to the client or will require the bonding company to pay the difference between the submitted bid and the next lowest bid (Gould, 2005).

The amount of bid bond may change from project to project however, in most of the project it is normally about 5% of the tender. At the end of the bidding if a contractor is not awarded with the job, the bid bond is paid back to him (Çelik, 2013; Russell, 2000).

2.6.2. Performance Bond

Performance bond is a kind of guarantee given by the contractor to the client that, the contractor will do the job according to the contract signed between the client and the contractor and the quality of the job is guaranteed by the contractor for a specific duration of time after completion of

the project as mentioned in the contract. This duration is one year in many construction projects (*ibid*).

The amount of performance bond may be as much as equal to the contract price (Gould, 2005) however in many projects it is generally about 10% of contract price (Çelik, 2013). In many projects depending on the contract conditions, either all or after providing some part of the performance bond by the bonding company, the rest of it is deducted from interim payments to the contractor.

2.6.3 Payment Bond

This is a guarantee given by the contractor to the owner that, when the contractor is paid by the owner, the contractor will then pay their suppliers and subcontractors. If not, depending on the contract conditions, the suppliers and subcontractors may force the owner to pay them separately. Without a payment bond, the owner would be forced to pay twice for the works not paid off by the contractor. A payment bond would force the bonding company to pay the contractor's debt to suppliers and subcontractors.

The contractors include the bond premium amount in the bid and the premium generally is payable. Contract bonds are wise investment to protect public owners, private owners, lenders, and contractors from the potentially devastating expense of contractor and subcontractor failures (SIO, 2009; Russell, 2000).

2.7 SOCIAL COSTS

Throughout the years researchers proposed numerous definitions of the term “social cost”; however, consensus has yet to be formed. This indicates that there are matters of definition addressed in relation to this concept which are still to be resolved.

However named or described, in order to gain a better comprehension of the “social cost” concept, in spite of nomenclature discrepancies in the existing studies, there is a need to determine a measure for it. This section concerns the existing definitions of the social costs and determines a measure for it by defining the social cost notion within the context of this research.

2.7.1 Social Costs: A Notion In Need Of Definition

Much of the construction associated social cost disputes emanate from economics. According to Button (1994), economics is a very specific subject but in practical terms researchers have a propensity to oversimplification in the interpretation and use of this terminology. He highlights the

importance of being clear about the definition of the terms at the outset. He remarks that having clearly identified the meaning of a term ensures that disputes are executed with as much clarity as possible.

This contributes to avoidance of confusion which occurs as a consequence of some parties applying their own interpretation to terms which have a very exact technical meaning or which belong to a broad subject.

Ormsby (2009) emphasises that social costs which are new to civil engineering / construction management, are well studied subjects in economics with research dating back over a century and a half. On the other hand, Button (1993) states that the term social cost is originated by the economists for use in public policy analysis.

Economists generally have consensus to define the social costs as follows (Field, 1997; Erin et al., 2013):

“Social costs are the overall impact of an economic activity on the welfare of society. Social costs are the sum of private costs arising from the activity and any externalities”.

It is implied in this definition that any cost associated with an activity are encompassed by the term social cost whether generated by the parties who are involved in the activity or incurred on the third parties. Additionally, this definition refers that social costs is equivalent to the total costs of a project and it has two cost constituents: private costs; which stand for the summation of abovementioned project direct and indirect costs and external costs; which represents the costs that are not considered by the parties involved in the project but are incurred on the third parties.

At the end of a comprehensive literature review, it is revealed that many definitions of the social costs particularly associated with civil engineering projects have been proposed over the past 17 years (Boyce and Bried, 1998; McKim, 1997; Rahman et al., 2005; Pucker et al. 2006; Yu and Lo, 2005). For instance, Allouche et al. (2000) defines the social costs as costs generated due to execution of a construction project incurred by the parties involved in the contractual agreement.

For measuring purposes, they encompassed social costs by the costs incurred on the third parties as a result of being exposed to air pollution, noise, vibration, disruption to traffic and increased level of traffic accidents. In their work, they have identified the total project initial cost as the sum of direct, indirect, and social costs.

Gilchrist and Allouche (2005) just as Allouche et al. (2000) proposed that project initial cost should be comprised of direct, indirect and social costs but for measuring purposes distinctively

grouped the social costs based on the area of impact namely: traffic, pollution, economic activities, and ecological/social/health.

On the other hand, other researchers (McKim and Kathula, 1999; Rahman et al., 2005) recognize the economic definition of Field (1997) and Erin et al (2013) and appraise the entire project costs to be encompassed in the social costs. They categorised the encompassing social costs as direct, indirect and intangible costs.

Apeldoorn (2013) offers the following definition: Implementation of construction projects generates disruptions to common life patterns of the society around the construction zones. Equivalent monetary values of these disruptions are called social costs. Contrary to previous researches, they offered two categories for costs associated with a construction project namely, costs incurred to the owner of the project: direct and indirect costs; and costs incurred to the society: quantifiable and non-quantifiable social costs.

One of the most common ways of eliminating differences in the use of a term is achieved by defining it. As aforementioned, in the present case what is intended, or actually is, expressed or indicated by the meaning of “social costs” can be offered in different contexts. Since these definitions will not be adopted for use in this research, there is a need to clearly define the term “social cost” in order to set out the essential attributes of the defined term. Below given definition is offered to demarcate the boundaries of the social cost notion recognized throughout this study, and to underpin the mounted arguments on the scope illustrated by the definition.

Construction social costs defined by the author;

“The people themselves and the environment they live in; their homes and neighbourhoods if located around the building construction zones are exposed to adverse impacts of the construction activities. In return, people react via altering their daily routine to resolve or alleviate the exposed disruptions to their common life patterns. Cost of this reaction is defined as the social costs associated with construction projects”.

Offered definition clearly expresses that “alterations in the daily routine of the people residing near a construction site” is determined to be the particular unit of measure for the building construction associated social costs in this study. In this study, the construction causative adverse impacts which lead to alterations in people’s daily routine hence, formation of the social costs, are limited with the probable traffic problems, damage to natural/built environment and pollution.

However, at which phase of the project these costs should be considered by the projects' decision makers is still a matter that needs to be corroborated. The following section discusses the proposals of past studies concerning the incorporation of the social costs during construction project decision making process. Additionally, the section indicates the proposed concept for this study for considering the building construction associated social costs.

2.7.2 Social Costs: A Notion In Need Of Consideration

In traditional bid estimation practices, bid price prepared by the contractors for the tendered project does not incorporate the social costs (Apeldoorn, 2013). According to Yu and Lo (2005), because the social costs are being undertaken by the public rather than the project participants, these costs are not included in the contractual bid value. Pucker et al. (2006) explained why project participants do not take responsibility for considering the infrastructure related social costs as follows;

“For the most part, social costs are not considered during a construction project’s planning, design and bid evaluation stages because they cannot be calculated using standard estimating methods. In recent years efforts have been made to introduce approaches for predicting social costs associated with utility construction projects. Nevertheless, unit cost data needed for the verification of such prediction methods is lacking.”

In conventional practices parties involved in construction projects are not held accountable for the social costs as these costs are incurred to the public instead of parties involved in the project such as; owner, designer, contractor, and users (Kapp, 1970; Yu and Lo, 2005).

However, during design build and construction phases of a project, only considering needs, wants, and expectations of parties involved in the project and responding to these accordingly without being concerned about the expectations of other interest groups as in the present case, surrounding community of a construction site who are incurred by the social costs, leads to lack of responsibility and improper management of the social costs which can in return result with public objection hence delay the completion date of the project (Yu and Lo, 2005).

To clarify the interest groups of construction projects, Guoqing and Shaojun (2004) referred interest groups to those who have either direct or indirect relation with the development during the project preparation and construction period.

In light of this information, it is deduced that society surrounding the construction sites should also be considered as project stakeholders and broader accountability should be taken by the parties

involved in the project. This outcome is reinforced by the definition made by Ducoff (2013) about accountability. He has defined accountability as taking ownership for the behaviour of others as a result of implementing projects even if others are not directly involved because it occurred on your watch.

In the past, many researchers have come to a consensus about the difficulty in predicting the social costs due to lack of a standard estimating method and in return they attempted to establish one (Boyce and Bried, 1994; McKim, 1997; Gilchrist and Allouche, 2005; Yu and Lo, 2005; Rahman et al., 2005; Pucker et al., 2006; Matthews and Allouche, 2010).

Additionally, Wang et al. (2008) stated that in majority of the conducted researches the social costs incorporated into bid evaluation processes are predicted based on formerly collected data. In his research he highlights the complexity in accurately predicting the future social costs during bidding period.

It is noteworthy to state in this stage that, the author of this thesis is proposing a new social cost compensation method which is explained in chapter 5. According to the generic social cost compensation method, the social costs, as explained in the following section, is considered by asking the contractors to provide another type of bond.

In this method the total social costs incurred by the third parties residing around a building construction site will be estimated by the municipality or whatever the local authority, and charged to the owner at the end of the construction stage, during the final approval of the building by the municipality. This will stipulate the owner to consider the precautions to minimize the social costs caused by his construction.

The proposed instrument is for the use of owners to enforce the contractors to minimize the social costs or let them to pay any created social costs is asking from them to provide a bond from a bonding company before signing the construction contract. This bond is named as the social cost bond. The contractors that are providing a guarantee to pay for the social costs that are caused by their construction sites incurred on the third parties residing around the sites will create enforcement on the contractors to consider the precautions to either minimize or if possible to eliminate them at all.

2.8 SOCIAL COST ESTIMATE CONSIDERATIONS

The basic social cost estimate considerations are as follow.

- i. Location of construction site
- ii. The building permission regulations
- iii. Applied construction methods
- iv. Culture, tolerance and way of living of the nearby residents of the site

2.8.1 Location of Construction Site

The location of a construction site is a significant parameter when the population of the neighbouring community is taken into consideration. As the amount of social costs incurred to the society is highly correlated with the population of the society in densely populated areas the negative effects of construction activities is expected to be greater compared to the areas with lower population.

Appeldoorn (2013) performed few case studies and obtained that in higher density urban environments total social cost generated during development phases of a construction project is greater compared to lower density urban environments.

2.8.2 Building Permission Regulations

The amount of social costs caused by building construction that incurred by the third parties residing around the site depends on the existing building regulations and the building permission conditions. In many developed countries the regulations are so strict that the residents around the construction site are affected at the minimum level and feel less construction caused nuisances. However, in mostly developing countries, like Turkey and north Cyprus, the regulations are loose and the residents are affected by the construction caused nuisances at a higher level.

For example, in the UK regulations do not allow the trucks to leave the site without washing out the dirty tires for not to make the asphalt road mad and dirty. Some heavy construction equipment or material delivery vehicles are allowed to run on the public roads only during the limited times of the day in order not to affect the existing traffic adversely. The site is surrounded by fence and the building under construction is covered by clothe to control the dust pollution and improve the safety for both the workers on the site and the people passing near to the site. However, these kinds of regulations are far away from the reality in developing countries.

Another typical example is that, in some cases all the workers come to the site by their private cars and occupy the available park spaces in the region. On the other hand, in many countries the workers cannot afford to come to the site by private cars and come to the site either by using public transportation or by walking and create no extra load for the available parking spaces. Therefore, the existence and the amount of the social costs depend on the culture, regulations of the country and the way of living the people in the region.

2.8.3 Applied Construction Methods

Either infrastructure or building construction project adopted construction method plays a critical role for the generated social costs. Over the past years, many scholars (Gangavarapu et al., 2003; Apeldoorn, 2013; Matthews and Allouche, 2010) compared open cut and trenchless infrastructure construction methods with respect to the generated total social cost and remarked that adoption of open-cut construction method generated greater social costs.

For instance, Woodroffe and Ariaratnam (2008) stated that on an open cut project, social costs can be as high as several times the value of the overall project where in trenchless projects this figure is only about 30% of the total project cost. Social costs are expressed on daily basis and therefore duration of construction is also important.

According to Herbsman and Glagola (1998), the construction companies can shorten the project duration significantly by applying innovative contracting methods that are developed with the intention of reducing construction projects' social costs. All these indicate that adopted construction method is highly correlated with the generated social cost.

2.8.4 Culture, Tolerance and Way of Living of Nearby Residents

From region to region culture, tolerance and way of living show variations. This raises the importance for not standardising the social cost indicators. For instance, according to the figures of The World Bank (2014), number of motor vehicles per 1,000 people in San Marino is 1,263 where this number is 28 in Afghanistan.

Based on this information if an estimator in San Marino identifies additional fuel cost of road users (public) due to traffic detour as a social cost indicator, it would not be a rational approach to use the same social cost indicator for Afghanistan. On the other hand, way of living also shapes with the available resources of a person.

Where in the present case, instead of driving a personal vehicle, people of Afghanistan use mainly public transportation for transit. This is why when establishing a social cost estimation the three parameters given above should be considered primarily.

2.9 SOCIAL COSTS OCCUR THROUGHOUT A CONSTRUCTION PROJECT

In the literature, many social costs which occur due to execution of construction projects are discussed. Some of the scholars attribute social costs to specific type of construction processes namely assembling of infrastructures or buildings, where some of the researchers attribute social costs regardless of the type of construction processes, but the construction itself.

Read and Vickridge (2004) showed an approach for quantification of social costs through considering public utility works hence, considering their research, types of social costs identified are only related to infrastructure works based on construction projects. They determined eleven social costs for public utility projects, namely traffic; diversion route effects, noise; over pumping; vibration; air pollution; dust, dirt and mess; visual intrusion; plant and materials; and safety.

Yuan et al. (2013) classified social costs in four main categories for residential building constructions, namely impact on the community, impact on the economy, impact on the environment and public property, and these categories consist of eleven social costs such as; the cost of damage on health; the cost of civil damage rights; effect on the transportation costs; decision-making errors costs; loss of income; loss of decreased productivity; loss of revenues; the cost of pollution; resource costs; property damage; and the destruction of the original building by any effect of the adjacent construction.

Wang (2011) analyses the urban underground expressway constructions based on social costs and determine specific social costs for these types of constructions. The social costs determined by Wang (2011) are pollution, traffic delays, access restrictions, other costs, safety and pavement damage.

Up until now in literature there have been many studies concerning various types of construction projects and incorporating the determination of social costs. Depending on the type of construction projects focused, construction activity related social cost types do not show immense variations, for instance, during both road construction and residential building construction in specific neighbourhood air pollution in terms of dust will occur.

For that reason, it can be said that social cost parameters more or less will be the same in any type of construction project, but the intenseness of it will vary. This is why some of the scholars

classify social costs in general instead of focusing on specific project types. For instance, Yu and Lo (2005) mentioned that there are three types of social costs occurred in all construction projects, namely traffic impacts, environmental impacts, and business impacts. They consider traffic impacts as the vehicles and the road user costs emerged due to construction works. Environmental impacts are the daily environmental costs to the public due to the execution of construction works, such as daily noise pollution cost, daily air pollution cost. Business impacts are the daily loss of local business due to the construction operations, such as productivity loss and loss of income. Ferguson (2012) also classified the construction social costs in similar way.

In addition to these, Chung and Poon (1997) mentioned about loss of amenity and aesthetic values as construction social costs, however they determined that the social costs occurring due to these impacts are difficult to quantify.

Gilchrist and Allouche (2005) mentioned that there are four types of construction social costs, namely traffic, economic activities, pollution and ecological/social/health, and they elaborate this classification by inserting sub categories, namely adverse impact and social cost indicators. The proposed classification is shown in Figure 2.3. This classification together with self-experience and observations is used as a road map during the brainstorming sessions which were performed to determine the adverse impact types to be used for this specific research (see chapter 5 for details).

The Figure 2.3 depicts the breakdown structure of construction social costs. The construction social costs are classified under four categories: traffic, economic activities, pollution and ecological/social/health. These categories consist of sub-categories. These sub-categories are being considered under two main headings, namely adverse impacts and social cost indicators.

Adverse impacts can be pondered as the negative effects of the construction activities on the environment. Social cost indicators can be defined as the results of one or more adverse impacts of social costs which occur due to the execution of a construction project on the environment. In addition, these effects are defined primarily so that they can be used in the next phase, which is quantification of social costs in terms of monetary units.

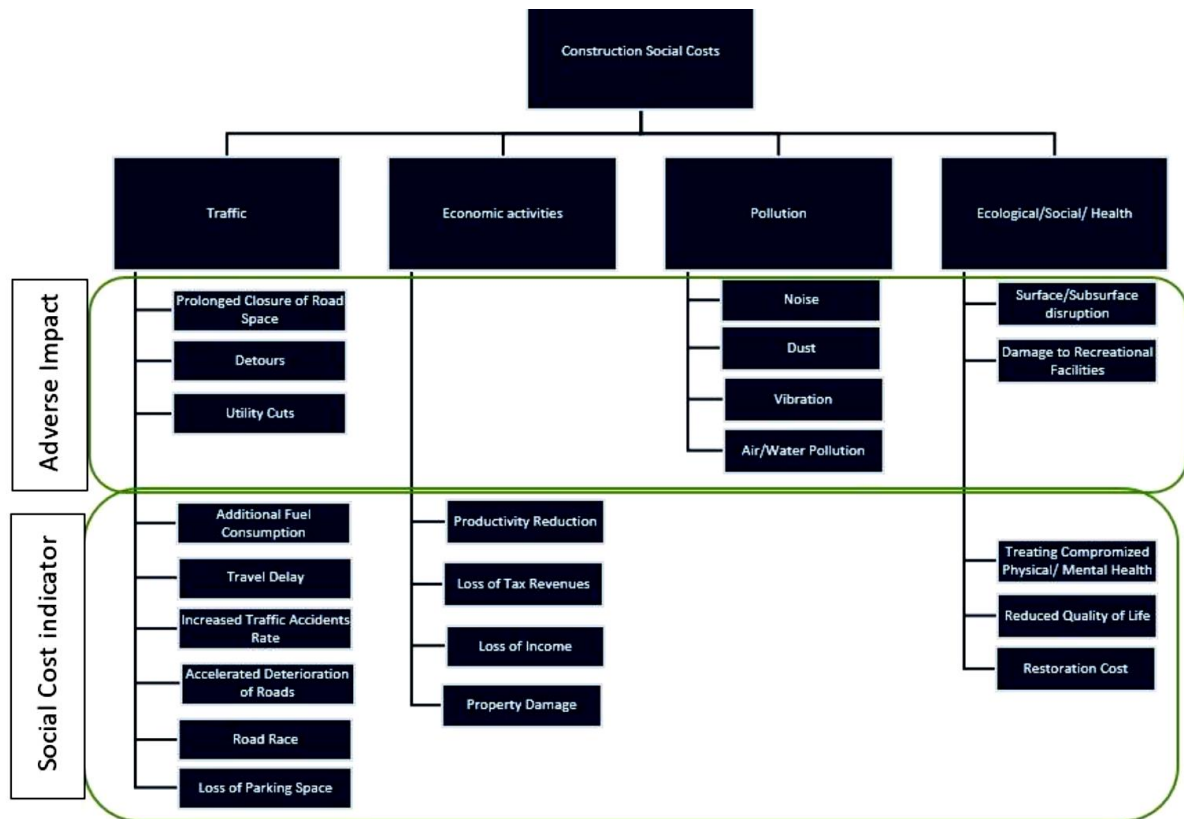


Figure 2-3: Potential construction adverse impacts which lead to formation of the social costs re-drawn (Gilchrist and Allouche, 2005)

2.9.1 Potential Adverse Impacts of Construction Related Activities

Each type of the social cost that is elaborated into this specific research has its own adverse impacts hence they are clustered under a typical social cost. These adverse impacts needs to be clearly understood and discussed as they are the actual parameters that needs to be considered during the quantification of social costs in terms of monetary units.

2.9.2 Traffic

The negative effects of construction projects on the traffic was stated widely in the literature (Jiang, 1999, Lee et al., 2005). Especially, the highway renovation projects directly affect the traffic, and cause social costs to the road users due to the reduced speed, lane closures and alteration of traffic circulation patterns.

However, the construction projects in urban areas can also affect the traffic as it is illustrated by figure 2.4; therefore the construction social costs related to traffic should be considered not only in highway renovation projects but also in the construction projects in urban areas. Gilchrist and



Figure 2-4: Traffic congestion in an urban area due to construction works (DjCoregon, 2010)

Gilchrist and Allouche (2005) mentioned about three adverse impacts, namely prolonged closure of road space, detours and utility cut.

2.9.2.1 Prolonged closure of road space

Although most of the construction activities are performed within the border of the construction site, some of the activities can require space outside the construction site, such as movement of machineries while performing the construction activities and entry/exit corridors. Especially, in urban areas, the entry/exist corridors can affect the traffic flow intensely, since the manoeuvre capacity of the construction vehicles are so limited when compared with the vehicles used in daily life.

Therefore, traffic congestion, loss of parking spaces and changes in traffic patterns can be observed in the roads close to the construction sites as depicted by Figure 2.5. These could lead to time delay costs, extra oil combustion, increase in number of traffic accidents, vehicle loss cost and environmental pollutions (Mao et al., 2012).



Figure 2-5: Loss of parking spaces due to manoeuvre space provided for the lorry (MERA, 2010)

2.9.2.2 Detours

As mentioned before, due to the construction activities, the roads can be closed for a while, therefore the vehicles can be diverted to the secondary roads designed for light traffic loads in order to avoid excessive delays. This can create problems related to deterioration of road pavement due to overloading which decrease the economic life of the pavement structure, therefore the pavements should be resurfaced and repaved earlier than planning period. In addition, the detours can cause a greater cost to the drivers in terms of increased mileage, time, and fuel consumption.

2.9.2.3 Utility cuts

Due to the construction activities or to provide the utilities to the construction site, electricity, telephone, water, gas, internet etc. can temporarily be cut.

2.9.3 Economic Activities

Throughout a project, the businesses placed in the neighbourhood of the construction sites can be affected negatively, since, the customers can be confronted with difficulties to reach these business due the closure of the roads and detours. In addition, the customers do not prefer spending their spare time in an environment where dust and noise exist, in other words they will prefer other markets to shop.

Consequently, these companies can lose their income. In addition, the householders close to the construction site can lose their income. Firstly, the value of their properties decreases significantly due to high noise and dust levels, and lack of aesthetics. Secondly, the householders can lose the rent revenue. Even, in some situations, the governments have to mitigate the loss of the householders, for instance, Manchester airport provides financial assistance to the householders for installation of sound proof glazing and home relocation (Manchester Airport, 2013). Finally, the properties adjacent to construction projects can be damaged hence, additional necessity in terms of cost occurs, in order to repair and maintain the damaged properties.

The construction can also affect the employees' productivity rate adversely due to dust and noise, and construction related nuisances. In addition, the efficiency level of the equipment that are sensitive to the high level of noise and vibration can be reduced which can cause fatal consequences. Finally, traffic congestion can affect the mood of the employees which affect their productivity indirectly.

The loss of income of businesses is also likely to affect the economy of governments indirectly due to the reduction in tax revenue. Consequently, the impact of the construction on business and public agencies should be considered as one of the construction social costs.

2.9.4 Pollution

The negative impact of construction projects on the environment has been addressed in the literature (Wong and Yip, 2004, Teo and Loosemore, 2001). In addition it is discussed that the environmental impacts of construction activities have become an important concern of governments and public agencies. Consequently, Gilchrist and Allouche (2005) considered pollution as a construction social cost. They considered four leading pollution sources due to construction activities, namely noise, dust, vibration, air/water pollution.

2.9.4.1 Noise

Noise is defined as any sound that has potential to cause psychological or physiological symptoms such as high blood pressure, cardiovascular disease, anxiety, restlessness, irritability, sleep disturbances and difficulty in concentrating (Akan et al., 2012, Gilchrist and Allouche, 2005). Bein (1997) stated that noise can affect social behavioural, mental and physical health of people. In other words, high decibel noises should be considered seriously by the government, especially in urban environment.

Unfortunately, construction is one of the main sources of noise. Noise will be generated by site operations including heavy earth moving and paving equipment, operator pumps, generators, and demolition activities. The effects of noise are not limited only with psychological and physiological symptoms, but also the economic effects of noise are also observed.

2.9.4.2 Dust

The other adverse effect of construction on the environment is dust. Throughout the construction activities, the high amount of dust can be observed on the construction site. The dust can cause damage to the electronic and mechanical equipment. In addition, the governments should spare funding for cleaning and maintenance.

The dust reduces the fertility of the agriculture and lowers the aesthetic quality of the environment. Finally, high concentration of dust in the air can lead to declination in lung function, increase in respiratory hospitalization and increase in mortality from respiratory and cardiovascular causes (Woskie et al., 2002).

2.9.4.3 Vibration

Around the construction site, a damaging vibration can always be felt throughout digging, pile driving, compacting, blasting and operation of heavy construction equipment. The vibration can create social costs, since these vibrations can damage structures adjacent to the construction site. In addition, it can affect the sensitive equipment that is used in the businesses and hospitals. This situation can lead to fatal and unexpected results.

Finally, high frequency vibration can create psychological trauma due to lack of safety psychology, even low frequency vibration can have a psychological impact on people (Read and Vickridge, 2004).

2.9.4.4 Air pollution

The machines used in the construction have high power engines which produce harmful air emissions causing serious damages to human beings and other living organizations. These harmful emissions not only affect the lower layer of atmosphere, but also affect ozone layer which absorbs the sun's harmful ultraviolet radiation

2.9.5 Ecological/Social/Health

The construction projects can affect the ecological systems, especially the groundwater table, surface water areas and the recreational areas are vulnerable against the construction activities. In

addition, the quality of life of the residents close to the construction site is significantly decreased due to the environmental pollution and traffic.

The environmental pollution can lead to fatal diseases, such as respiratory illness, cardiovascular diseases, allergies, anxiety and annoyance. Gilchrist and Allouche (2005) mentioned two adverse impacts associated with damage to ecological systems, namely; surface/subsurface disruption and damage to recreational areas.

2.9.5.1 Surface/subsurface disruption

The negative impact of construction on the ground is obvious, however the construction does not only damage the ground but also it affects the natural water that exist around the construction site and groundwater. The construction activities can affect the natural structure of the water which lead to bank erosion, flooding, alterations of the normal course of rivers and streams and damage to the aquaculture (Gilchrist and Allouche, 2005).

In addition, in order to facilitate construction, the ground water level placed under the construction area is lowered by using different methods, such as deep wells, wellpoints and horizontal drainage. However, this operation can lead to serious consequences, such as deterioration of green life, and reduction of water required for agriculture.

2.9.5.2 Damage to recreational facilities

Due to the presence of heavy equipment, noise, dust, vibration, and visual pollution, the usability of recreational facilities can be affected temporarily or permanently. If the required precautions are not taken beforehand, refurbishment may be costly.

2.10 QUANTIFICATION OF CONSTRUCTION SOCIAL COSTS

The quantification of social costs is a method that is being undertaken subsequent to defining the types of social costs. Most of the studies for quantifying the social cost are conducted in highway construction projects. For instance, Jiang (1999) developed a model for estimating excess user costs at highway work zones. He determined that the highway work zones can cause additional travel time, consumption of extra fuel and oil, and wear and tear of vehicle parts due to the traffic bottlenecks where accumulation of these lead to traffic delays and congestions.

Lee et al (2005) developed an innovative approach to development of construction and traffic management plans for I-15 Devore project constructed in Southern California. They used CA4PRS (Construction Analysis for Pavement Rehabilitation Strategies) software for scheduling analysis.

They mentioned about the negative effects of construction activities on the traffic flow of the roadways above or near flow capacity. They compared the different scenarios in determination of optimum solution for this project and obtained an optimum solution by considering construction cost, road user cost, and agency cost. In addition to these, there are studies that have developed innovative contracting methods which consider social costs in the literature.

Herbsman (1995) evaluated A+B bidding method which consists of two parts. First part, namely A, is the construction costs which can be considered as the traditional bidding method. The second part composes of project duration time and this part was calculated by considering the road user cost which is basically social cost.

Herbsman and Glagola (1998) mentioned about lane rental method which used in United Kingdom. In the lane rental method, the contractors have to pay the cost of the delays for peak and off-peak periods for those periods of time when traffic is obstructed through lane or shoulder closures and other damages to the public.

Yu and Lo (2005) develop a time-dependent construction social costs (COSCO) model to quantify the comprehensive construction social cost. In their model, they tried to integrate three social costs. Gilchrist and Allouche (2005) proposed a model based on abovementioned four types of social costs they categorized with the intention of quantifying the social costs associated with the construction projects. They considered seven methods for valuation of social costs, namely; loss of productivity, human capital, replacement cost, lane closure cost, hedonic pricing, user delay costs, and contingent valuation technique. They identified that different methods are suitable for valuation of different social costs.

For instance, they concluded that the loss of productivity method should be used for valuation of loss of income, productivity reduction, reduction in taxes revenues and health costs. In addition, different methods can be used for valuation of one social cost. For instance, travel time social cost can be quantified by using lane closure cost and user delay costs valuation techniques.

It can be concluded that, in the literature the majority of the attempts to quantify the social costs, have been focused on the construction projects incorporating infrastructure works. It is obvious that, the majority of the infrastructure projects, such as highways, railways, airports, etc. are being accomplished mostly out of the congested residential areas. Therefore, inherently the social costs of those projects are less involved with the residents.

However, attempts to investigate the social costs of building constructions in urban residential areas are still insufficient due to probable difficulties and complexities of including the third

parties. In line with the abovementioned definition of the social costs, it can be said that consequences of executing the construction activities in residential areas are also important to be investigated due to higher population of third parties.

Additionally, it is noteworthy to mention at this point that, subsequent to a comprehensive literature review about the social costs, the author of this research has drawn out a conclusion that up until now the social cost quantification techniques suggested by researchers are superficial and need to be elaborated more. The methods and techniques developed so far have not managed to go beyond a conjecture. Still more investigations and researches are required to corroborate the effects of social costs especially building construction social costs in the residential areas. Up until now, the developed formulas and models for social cost calculation are scholarly hypothesis based on their investigations.

As the definition of social cost implies, there are costs caused by constructions that are to be paid by the third parties. Therefore, the estimation of construction based social cost still needs to be investigated further. Additionally, it is not true to presume that the amount of social cost will be the same in all parts of the world. The reason behind this is the fact that people's perception about the nuisance varies according to their culture and manners of the society hence, the proposed social cost quantification methods cannot be generalised or global.

Even though it is not possible to include all members of the society into social cost calculations, some researches that are conducted in this manner can be used as a road map during further investigations.

As aforementioned, up until recently different methods are suggested by scholars concerning the quantification methods of the social costs and many scholars have discussed the difficulties/complexities in doing it. In majority of these studies, there are attempts with the intention of expressing the social costs in terms of monetary units.

The only common part among the numerous methods suggested by scholars for quantifying the social costs is the aspect that drivers of these costs are evaluated on daily basis for the duration of the construction project. This indicates that even though elements of the social costs may act upon the third parties at different intensity level on each day, an average daily cost of the nuisances occurring due to existence of construction site in the neighbourhood can be taken into consideration during quantification of the social costs.

Additionally, it is acknowledged that quantifying the social costs on construction activity basis is not practicable. For instance, the third parties who are being exposed to nuisance are normally not

aware of which specific construction activity is the driver for the exposed nuisance. Within this context, the type and characteristics of specific construction activities is not accepted as an important driver on the intensity of their social costs in this study. Also, this is the reason why the social costs have been preferred to be quantified on daily basis by scholars as well.

For that reason in this research, as discussed in chapter 9, two alternative construction methods have been compared in terms of construction duration for the evaluation purposes. The intensity of social costs on lightweight steel and reinforced concrete construction methods has been examined with respect to construction duration in this study.

Moreover in this research, unlike what other scholars have done, the author has approached quantification of the social costs from a different perspective. In this research, a questionnaire is conducted with the intention of investigating the intensity of the building construction causative nuisances that residents in the area are inevitably exposed to. Then, the quantification of those nuisances that are ascribed as important are performed in terms of monetary units. The respondents are selected through the actual people, who reside next to a construction site and who are being exposed to various nuisances.

With the help of this questionnaire which is further discussed in chapter 6, a platform is formed so that academic conjecture and real life practice are compared and the social costs occurring due to building construction in residential areas can be estimated.

CHAPTER 3: CONSTRUCTION INDUSTRY IN TURKEY AND NORTH CYPRUS

3.1 INTRODUCTION

Civilizations are built by construction efforts. Construction industry is generally known to be one of the most challenging industries in many countries. It is essential to the development of communities, residences, industry, and ultimately the country. The economy relies on construction activities for progress and growth.

Construction plays an important role in Turkey's economic development, accounting for well over 6% of GDP and employing some 1.8 million people. When the direct and indirect impacts on the other sectors are taken into account the share of the construction sector in the Turkish economy reaches 30% and the employment rate reaches to 10% (Çelik, 2008).

Construction industry in north Cyprus has similar effects on the economy. In fact, there is great similarity between Turkey's construction industry and north Cyprus's construction industry. The construction materials, workmanship and methods, the culture and the way of living of the people and the building permission regulations are quite similar. Therefore, the similar social costs are caused in building construction projects in residential areas. It was investigated that the people residing in the proximity of building construction sites are suffering of nuisances.

In this chapter the construction industries in Turkey and in north Cyprus are briefly analyzed and evaluated in terms of the social costs caused by the building constructions in the residential areas.

3.2 TURKISH CONSTRUCTION INDUSTRY

The Turkish Construction industry is one of the leading sectors in Turkey. Construction sector has great potential for growth since demand for housing, commercial and institutional construction projects has been continuously increasing parallel to social and economic needs of citizens in Turkey (Ozcelebi, 2014). Construction sector has also influenced the macroeconomic variables of countries since it has had impact on the sub-sectors like building construction, civil engineering works constructions and other sectors of economies (Ozcelebi, 2014).

According to the publication of Eurostat (2008) which concerns General Industrial Classification of Economic Activities within the European Communities, construction sector comprises three main sub-sectors; (i) Construction of buildings, (ii) civil engineering and (iii) specialized construction activities.

Construction of buildings sub-sector is divided into as development of building projects for residential and non-residential buildings, and construction of residential and non-residential buildings. The civil engineering sub-sector includes construction of roads, railways, dams, tunnels, and other civil engineering works constructions. The third sub-sector includes the specialized construction activities such as demolition and site preparation, electrical, plumbing and other construction installation activities, building completion and finishing and other specialized construction activities.

Growth of construction sector has accelerated since 1980's as a result of the economic, political, social and demographic changes in Turkey. As a matter of fact, structural change and development of building construction sector in Turkey has become rapid after TOKI (Republic Of Turkey Prime Ministry Housing Development Administration) has been established in 1984. The TOKI has especially specializes in housing and urbanization fields by providing informational flow through international institutions.

The share of total construction sector activity in gross domestic product (GDP) has been 6% approximately for the period of 1990 to 2010 with an employing number of people of 1.8 million in Turkey (Gul et al., 2014).

The financial crisis in 2007 caused a recession of construction sector in Turkey. However, some economic measures were taken by government to overcome the crisis, maintain price stability and sustain the economic development. The considered macroeconomic policies resulted by falling of inflation and interest rates, and a mortgage system began to be applied.

The new system resulted with expanding housing opportunities to meet the needs of lower income households and booming the construction sector by channelling funds into real-estate and especially into the housing sector. However, the 2008 global financial crisis that resulted from the spread of the financial crisis aroused by non-return mortgage credits in the USA showed its effects all over the world as of the year 2008.

Thus, construction sector activity in Turkey decreased by 8.71% and 11.97% in 2008 and 2009, respectively since financial crises have become more spreadable related to financial globalization process (Eurostat, 2008).

The construction industry also has a significant impact on level of employment, particularly unskilled labour force, as it is a highly labour-intensive industry. In many of developing countries, the growth of the construction industry is used as an instrument to accelerate the overall growth in the economy. For instance, governments are inclined to implement policies that enhance and support construction investments to achieve a more stable economy.

Turkish contractors are quite successful in international projects. In 2013, 38 Turkish contracting companies ranked among “The World’s Top 250 International Contractors” announced by the leading international industry magazine "ENR - Engineering News Record" (TCA, 2014b). With this number as it is shown in Table 3.1, Turkey ranked second in the world after China.

Table 3-1: Ranking of top international contractors (TCA, 2014b)

	2013*	2012	2011	2010	2009
China	55	52	51	54	50
Turkey	38	33	31	33	31
USA	34	26	22	20	25
Italy	17	19	23	22	26
Japan	15	14	13	13	15
Spain	15	12	13	11	11
South Korea	12	12	11	12	13
India	4	5	5	3	2
France	4	4	5	5	5
England	4	4	4	4	5
Germany	4	4	4	4	4
Other	48	40	43	44	38
Total	250	225	225	225	225

* ENR has expanded the list of the top international contractors up to 250 from 225 in 2013.

Turkish contracting companies currently are competing in 4 continents and in 103 countries successfully. Turkish contractors are open to improve international partnerships in contracting field as well as in construction industry investments, such as production of building materials, housing, industrial plants and tourism projects in the African, Eurasian and Middle Eastern countries (TCA, 2014b).

However, in internal market, as it is shown in figure 3.1 Turkish construction sector has fluctuated over the past few years, but still it has become a leading sector of Turkey’s economy by showing generally a higher rate of increase than the rate of increase of GDP. Furthermore, the sector has

had great potential for growth since demand for housing, commercial and institutional construction projects has been continuously increasing parallel to social and economic needs of citizens in Turkey (TCA, 2014a).

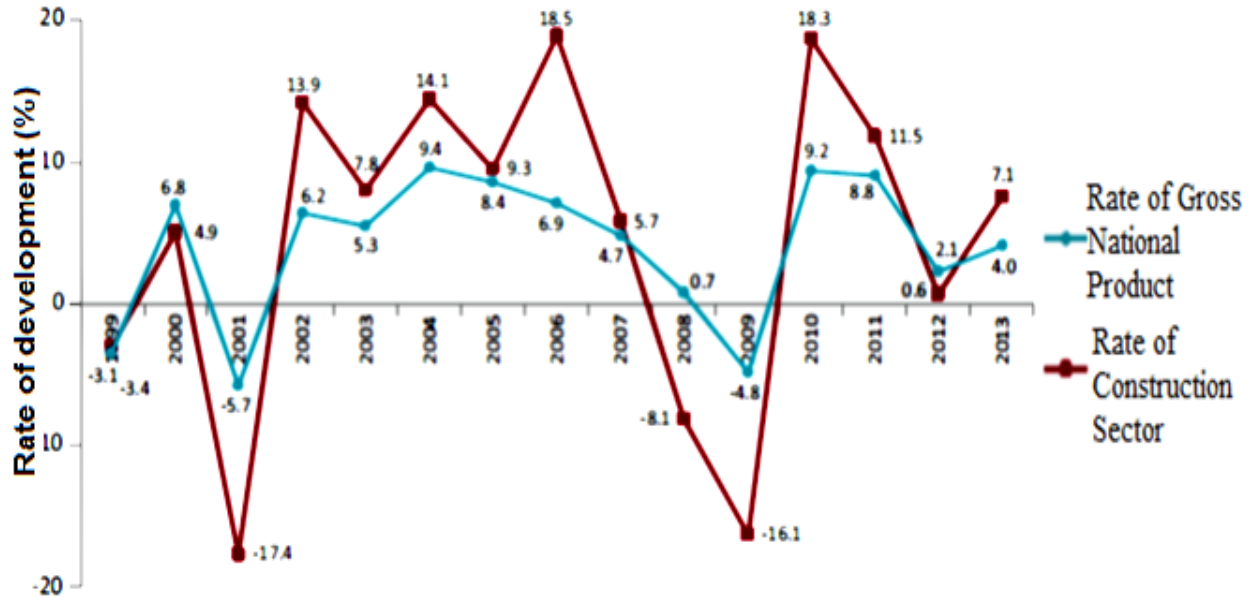


Figure 3-1: Increase in Turkish construction sector (TCA, 2014a)

Since this thesis is focusing on the estimation of the social costs caused by building construction, here it will be considered mainly building construction statistics. According to the statistics published by the State Statistics Institute, the increase in the building permits in the last few years is shown in Table 3.2 (TCA, 2014a). In 2013 compared to the previous year, there is 11.9%, 15.6%, and 8.4% increase in the number of the buildings, values, and the number of apartments respectively. In 2013 the total area of building permits was 168,207,842m² out of which, 97,330,942 m² , (57.8%), was residents and 70,876,900 m² (42.2%) was buildings other than residents.

Table 3-2: Building permits in Turkey (TCA, 2014a)

	Years		
	2013	2012	2011
Number of Buildings	116,525	104,151	101,900
Area (m²)	168,207,842	152,952,913	123,621,864
Value (TL)	121,339,464,571	104,964,630,420	80,755,662,747
Number of apartments	814,031	750,922	650,127

Turkey is a swiftly urbanizing country; the cities are growing in size and in population rapidly. The share of population living in cities were 24.8%, 59.0%, 73%, in 1950,1990, and 2014 respectively and it is estimated to reach 84% in 2050 (UN DESA, 2014).

Therefore, there is a great challenge in front of the building construction sector in Turkey. It is noteworthy to mention here that, Turkish building construction sector will be required to pay attention to minimize the disturbances of the people residing near to the construction sites to reduce the social costs.

3.3 NORTH CYPRUS CONSTRUCTION INDUSTRY

In Turkish Republic of Northern Cyprus (TRNC), just like in Turkey, the buildings are mostly constructed by using reinforced concrete structures. In TRNC most of the buildings in rural areas are 2 stories and in urban areas are 4-5 stories. However, there has been less number of researches on the construction industry in (TRNC).

Construction industry was at low profile in Cyprus up to 1960's. The first considerable movement in the construction industry in Cyprus had been observed in the late 1960's mainly on the tourism resorts especially in Famagusta and Kyrenia (Yorucu and Keles, 2007). The Turkish intervention in 1974 resulted with an economic stagnation hence reducing the construction industry in Cyprus. In the second half of 1980's higher education sector started to expand in TRNC stimulated by excessive demand in higher education in Turkey.

Currently 11 universities were established and the number of higher education students reached to 65,000, one-fifth of population of TRNC. Increase in higher education sector contributed the booming of especially building construction. On the other hand, after long and complex negotiations between Turkish Cypriots and Greek Cypriots a UN Peace plan, popularly known as Annan Plan (Annan 2004), named after the Secretary-General, came out to be put to referenda separately. One of the significant provisions of that plan was to make an important impact on the construction market which resulted with a real boom of construction industry in north Cyprus. The recent building permits obtained from the State Planning Organization of the TRNC (SPO, 2012) in north Cyprus is shown in Table 3.3.

Table 3-3 : Building permits in north Cyprus (SPO, 2009)

Years	Area of buildings (m²)
2001	224,000
2002	204,000
2003	234,000
2004	253,000
2005	340,000
2006	715,000
2007	789,000
2008	818,000
2009	722,000
2010	NOT AVAILABLE
2011	879,000
2012	784,000

According to Cyprus Turkish Construction Contractors Association, the number of contractors registered to their association increased from 171 in 2003 to 378 in 2008. Moreover, Turkish Cypriot Chamber of Artisans and Craftsmen reported that the number of subcontractors increased from 58 in 2003 to 131 in 2008. From 2007 to 2008 the percentage of housing construction sites out of total construction sites increased from 68.4% to 71.1% (Okan, 2011).

These numbers shows the general tendency of the construction sector in north Cyprus. It is obvious that, the majority of the construction is in building construction. As it was depicted in the Table 3.3 especially after the merging of the Annan Peace Plan, a rapid boom was noticed in the construction industry. Yorucu and Keles (2007) found out that, these rapid construction activities created significant social impacts, including pollution of the environment and damage to natural

and historical sites. It is claimed by Balkiz and Therese (2014) that, the project management practice was at infancy stage in north Cyprus.

On the other hand, construction industry is an industry that delivers products and services that are often of inappropriate quality, and that fail to meet client demands for price and guaranteed delivery (Lu and Sexton, 2006). In the combination of all above negative factors, it is necessary to pay more attention to the construction industry and to mitigate its negative impacts on the society in the TRNC. The building construction caused nuisances is accepted as another negative impact in the TRNC, therefore, it is found crucial to make a study on the social costs in building construction.

3.4 SOCIAL COSTS IN TURKEY AND NORTH CYPRUS

There is great similarity between Turkey's construction industry and north Cyprus's construction industry. In north Cyprus there is only few construction materials produced locally, hence almost all the construction materials are imported from Turkey. Many of the qualified and unqualified construction workers are coming from Turkey.

Both countries have the same education and training systems in all construction areas. Both countries are in the similar earthquake region so the same earthquake regulations are used. The same construction standards and code of practices are used. Therefore, there is a great similarity in the construction materials, methods, techniques, and practices used in both countries.

The only practical difference is that, in cities of Turkey the building regulations allow to construct high rise buildings which are limited in north Cyprus. The common number of building stories in north Cyprus is 4-5. The sociological understanding, way of living, and the culture of people are quite similar in both countries. Therefore, considering the social cost estimates as explained in section 2.8, it can be stated that, there will be the same social costs caused by building construction in both countries.

Figure 3.2 shows two photographs, one was taken from Famagusta, north Cyprus, and the other one from Ankara, Turkey. As it can be seen from both photographs, the construction materials are spread on the sidewalk or in the road and some of the construction activities are performed so that, the pedestrians and vehicle traffic are affected adversely. These photographs also underline the necessity of investigating the building construction caused alterations in the daily routine of the people residing in the proximity of sites.



Photograph (a)



Photograph (b)



Photograph (c)



Photograph (d)

Figure 3-2: Photographs (a), (c), and (d) are from Famagusta, north Cyprus, photograph (b) is from Ankara, Turkey.

3.5 NECESSITY OF INVESTIGATION ON THE EXISTENCE OF THE SOCIAL COSTS

As it was defined in chapter 2, the estimation of social cost in this thesis is actually a measure of alterations in the daily routine of people residing in the proximity of building construction sites especially in residential areas.

After a comprehensive literature review it was obtained that, there is not any literature attempting to monetize or describe the, so defined, social costs in Turkey and north Cyprus. Therefore, an investigation was conducted to identify and monetize the alterations in the daily routine of the people residing near to the building construction sites in residential areas. A questionnaire was

conducted in April 2012 in three major cities of north Cyprus namely, Nicosia, Famagusta, and Kyrenia where the selected 266 respondents were residing within 150m from a building construction site. The target was to identify the adverse impacts of the on-going building construction sites on the House, Households, and Neighbourhood.

The questionnaire is explained in chapter 6. According to the results and discussions of the analysis of the questionnaire as given in chapter 7, each respondent stated complains for the nuisances created by the building constructions. Those results necessitated the investigation on the identifying and monetizing the alterations in the daily routine of the people residing in the proximity of building construction sites in north Cyprus as well as Turkey.

In this thesis, the proposed social cost estimation method and the way of compensation are considered to be applied in both countries. It is noteworthy here to mention that, since countries, north Cyprus, and Turkey, have similar building regulations in construction practices the expected building construction caused social costs in residential areas will be the same. A framework is developed for the estimation of the social costs.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 INTRODUCTION

It is synthesized that proper research methodology is a procedure where relevant data with the study is collected, analysed and validated systematically. Up until now there have been many concluded researches and many more still under progress however, for both situations no recipe yet exists to guide the researchers for the purpose of helping them to adopt the “*best fit*” research methodology. This is due to the variations of the needs and circumstances of each individual research. This extraction from the literature can be supported by Saunders et.al (2009) statement;

“Inevitably your own beliefs and feelings will impact up on your research. Although you might feel that your research will be value natural... Practical consideration such as access to data and the time and resources you have available will also impact upon your research process.”

On the other hand, it is worth highlighting the difference between method and methodology. According to Castro et al. (2010), research methods are clustered as the instruments of data collection that incorporates surveys, interviews, questionnaires and etc. and these are not research methodologies. As mentioned by Collis and Hussey (2009), the term research methodology

“...refers to the overall approach to the research process from the theoretical underpinning to the collection and analysis of the data”

Accordingly, the vision of understanding the methodology phenomena in this research has been shaped in accordance with the following points;

- Stance of researcher from philosophical point of view
- Methods adopted throughout the research that covers data collection and analysis tools.

In line with the abovementioned facts, in this chapter of the thesis, by indicating how adopted research methodology and research methods shaped the data collection, analysis, and the development of the theory process that this specific study is benefitted from are discussed in detail. With the intention of dealing with the research methods or research methodology successfully, the meaning of research itself should be clearly identified.

For that reason, descriptions concerning the definition of research, research philosophy, and research methods are explained in detail. Moreover, described parameters are elaborated in the axis of the specific requirements of the conducted research forming the followed “*research design*”.

4.2 ASPECTS OF RESEARCH

Undertaking a research, in other words being part of a process with the purpose of performing an enquiry and investigation about a specific subject can be achieved through developing a new knowledge and/or benefitting from existing knowledge in an inventive way hence, generation of “*new concepts*”, “*understandings*” and “*methodologies*” can be executed (Neville 2005; Australian Government, 2012).

One of the acquisitions of a research is enhanced stock of knowledge about a certain field. In this way, improved knowledge can be benefitted with the intention of creating new applications (OECD, 2002).

According to Collis and Hussey (2009), the rationale of research can be listed as follows;

- To review or synthesize already developed knowledge
- To examine existing problems or conditions
- To make solutions to existing problems available
- To investigate and analyse more general issues
- To develop or create new procedures or systems
- To explain a new phenomenon
- To produce novel knowledge
- Or to make a combination of any of the above.

In his work on research methodology, Neville (2005) identified four different types of research, “*exploratory*”, “*descriptive*”, “*analytical*”, and “*predictive*”.

Among these research types “*exploratory research*” is used when the number of previous studies is not adequate. This kind of research finds hypothesis, examples that can be tested and become the building blocks of the new research. Case studies, observations and reviews of previous studies are the typical examples of exploratory research.

“*Descriptive research*” is performed with the intention of identifying and classifying the aspects or features of the subject (i.e. types of construction causative social costs that third parties are inevitably being exposed to). This research type frequently benefits from quantitative techniques to collect, analyse and summarise data (*ibid*).

“*Analytical research*” broadens the descriptive research and adds questions of why [and] how something is happening (*ibid*). In other words analytical research tries to find out the causes of a situation (i.e. underlying why and how people are adversely affected due to ongoing constructions in their neighbourhoods). This research type also identifies and locates different factors (or variables) involved.

As its name implies, “*predictive research*”, is undertaken to make predictions of a future probabilities of a situation based on close analysis of available evidence of cause and effect (Neville, 2005).

In line with these definitions, it is noteworthy to mention at this point that this specific research is “*exploratory*”. As the definition of the exploratory research implies this type of research generates when the existing knowledge or practice is inadequate.

Within the context of this research, one of the critical issues is to determine a cost category for consideration of the building construction associated social costs during project initial cost estimation process. In the existing studies majority of the scholars proposed to include estimated social costs into project bidding. However there is a lack of a standard social cost estimation method and as a result many researchers who are proposing inclusion of the social costs in project bidding perform their estimations on the basis of formerly occurred social costs. Besides undermining the accuracy of the obtained social cost value, this process may lead to unfair contractor selection.

Alternatively, in this research has a proposition to estimate the social costs subsequent to completion of construction projects so as much social cost as generated is compensated to people. To propose this approach, observations, brainstorming sessions and review of existing literature is performed. Once the proposed approach is applied it is tested seeking to form solid building blocks for new researches.

Moreover, throughout some stages of this research “*descriptive*” method is applied. For instance, descriptive method is overlapped with the research during the identification of the building construction related social cost types and classification of the social costs types this specific research will be descriptive.

Last but not least, at certain stages of the research, for instance during the quantification of the social costs, to what extent (how/why) the third parties are getting affected due to the on-going construction in their neighbourhoods is questioned. Obtained results will form the basis for this research also to be “*analytical research*”.

4.3 RESEARCH PHILOSOPHY

The concept of research philosophy refers to the progress of scientific practice based on people's views and assumptions regarding the nature of knowledge. According to Saunders et al (2011), adopted research philosophy reveals the researcher's opinion in establishing knowledge hence, indicates the followed methods of the researchers.

On the other hand, it is rather significant for the researchers to comprehend the philosophical issues very well due to the fact that this issues will be helping the them to form the necessary research designs in the most convenient and efficient way (Easterby et al., 2008). According to numerous authors (Easterby et al., 2008; Saunders et al., 2007; Collis and Hussey, 2009; Hussey and Hussey, 1997; Neville, 2005), two major drivers of the knowledge are: phenomenological paradigm and positivism paradigm.

In circumstances where the positivist philosophy is adopted, knowledge is to be gathered only from direct investigations and experience. If a research is motivated by positivism philosophy reality is discovered objectively by the social scientists as they tend to remain neutral and objective from cover to cover of the study (Robson, 2012). In general, this type of philosophy is comprised of quantitative data collection and analysis as well as very well structured research methodologies in order to ease the reproduction (Saunders et al., 2003).

In general, the scientific studies grounds on positivistic research philosophies. Positivistic approach has a detached attitude to human behaviours like in natural sciences. The methodologies of positivistic approach try to explain the research subject statistically, from the objective perspective of the participants and in a rational manner (Neville, 2005).

Contrary to positivistic approach, according to Easterby-Smith (2008), studies driven by phenomenological approach seeks to comprehend and clarify a phenomenon instead of examining the exogenous drivers of the subject. In phenomenological studies, with the intention of acknowledging the truth, it is necessary to determine the drivers of the subject (Saunders et al., 2003). It is stated by Neville (2005) that phenomenology suggests that human behaviour cannot be understood as in natural sciences. It is more complex than this because human are driven by forces that are not easily observable.

Unlike positivistic approach, phenomenological ones are used to design the study from the subjective perspective of the participants. Differences between positivist and phenomenological philosophies are itemised and given by table 4.1.

Table 4-1 : Distinctions between positivist and phenomenological philosophies (adopted Easterby-Smith *et al.*, 2008)

Theme	Positivism	Phenomenology
The observer	Must be independent	Is a part of the examined subject
Human interests	Should be irrelevant	Are the main drivers of science
Explanations	Must demonstrate causality	Seeks to enhance the general comprehension of the condition
Research progress through	Hypotheses and deduction	Collecting many data from the induced ideas
Concepts	Need to be operationalized in order to get measured	Should be comprised of stakeholder perspective
Units of analysis	Should be reduced to simpler terms	May include the complexity of whole conditions
Generalisation through	Statistical probability	Theoretical abstraction
Sampling requires	Randomly selected large numbers	Few cases chosen for a specific reason

Additionally, several other authors (McNeill et al., 2013; Shanks and Parr, 2002; Armstrong, 2012) have drawn attention to major characteristics of the aforementioned philosophies where among them the best fit philosophy with this research is chosen to be “*positivism paradigm*” due the nature of the conducted research that seeks to objectively discover the reality.

In the context of this research, objectively discovering the reality refers to measuring the existence of the social costs in North Cyprus and Turkey construction industries. This measurement is made via incorporating the actual people who reside within the vicinity of construction zones. In this way, the social cost notion defined and adopted for use in this research is examined independent of the subjectivity of the researcher.

Additionally, it is significant to collect and analyse the collected data in an objective manner as the proposed generic social cost estimation system requires measurements of the alterations in the daily routine of the people as a result of being exposed to construction generated adverse impacts.

Meanwhile, it is asserted in this research that social cost indicators cannot be standardised for all regions of the world because people's social and cultural manners plays a critical role in the way they perceive a nuisance. This is why typical social cost indicators examined in this study are designated not only considering the literature and views of the author but also incorporating experiences and observations of the people from the same region.

Research methods used in this research to obtain the overall goal of this research are adopted within the positivism philosophy framework, and these are elaborated in the upcoming sections of the chapter.

4.4 RESEARCH APPROACHES

According to Neville (2005), there are three different groups of research approaches which are; quantitative/qualitative, applied/basic and deductive/inductive. Researchers can combine different kinds of approaches. To explain briefly quantitative research looks for statistical, mathematical data. Quantitative research designs are highly structured and the researchers who use this method judge qualitative methods as being not well structured. Qualitative research has a more subjective nature than quantitative. Unlike quantitative methods, qualitative data is harder to analyse and interpret.

While in basic research the researcher only tries to develop his/her knowledge in a broad way; in applied research it is planned from the beginning to apply its findings to an existing state. In general, deductive approach is a theory testing process which commences with an established theory. This approach target to develop a theory based on existing knowledge (Hyde, 2000; Neville 2005; Wilson, 2010).

Monette et al. (2005) remarked that deductive approach is comprised of a hypothesis which is derived from the propositions of the existing theory. On the other hand, inductive research's point of departure is a specific position and it reaches to general theories from this point (Neville, 2005). In other words, researcher tends to develop generalisations based on empirical data towards the end of research as a result of observations (Goddard and Melville, 2004).

According to Lancaster (2005), inductive approach reverses the process followed in deductive research as no proposition can be made at the initial phases of the research. In other words, when

an inductive approach is adopted by the research there is no need to test the known theories during the research process (Neuman, 2003). According to Cavaye (1996) both deductive and inductive research approaches can be combined together and used in the same research. This has also confirmed to be practical by Perry (2001), who has suggested that finding the midpoint between the two approaches can lead to confirming/disconfirming of the proposed theory.

In accordance with these, it can be said that in this specific study midpoint between the inductive and deductive approaches. For instance, in the existing literature social cost notion concerning the civil engineering projects is a known issue. Difficulties in considering the social costs during bidding process are another issue yet to be resolved.

In light of this, the author of this research in the sense of conforming/disconfirming the proposition of excluding the social costs from the bidding process and considering it as project non-contractual costs that are incurred to the owner has benefitted from deductive approach. Assertion to segregate the social cost indicators with respect to the community's possessed components (see figure 5.3) in order to minimize the difficulty in estimating the social costs falls into inductive approach category, as researcher intends to generalise a knowledge with respect to the collected empirical data.

In addition to these, in this research it is proposed that social cost estimation process cannot be standardised for all parts of the world and accordingly this study proposes a generic social cost estimation system for North Cyprus and Turkey construction industries. Again in this case, the author of this research due to the lack of existing literature concerning the construction associated social cost estimation in Turkish construction industry, intends to develop a new knowledge based on the empirical data.

Last but not least, by accommodating the essence of inductive approach, the author has proposed a social cost compensation method. These are all explained in detail in chapter 5.

4.5 RESEARCH METHODS

Any method that is adopted by the researcher during the course of study to find a solution for the identified problem can be named as "*research methods*". During this process, from the researcher's point of view, collected data and unknown aspect of the problem have to be relevant to each other in a way so that the possible solution can be identified. In line with this, research methods can be put into three major categories which are as follows (Caracelli and Greene, 1993);

- Methods which are used to collect relevant data, "*data collection*"

- Statistical methods which are used to create relationships between the collected data and unknowns, in other words “*data analysis*”
- Methods that researcher benefits in order to evaluate the accuracy of the obtained results, “*evaluation of data*”

Moreover, in this research the author has conducted the research methods in a manner of cross-sectional time horizon, as cross-sectional studies are appropriate for the researcher due to not having enough time and requirement of a snapshot of the existing situation.

This specific research benefitting from cross-sectional time horizon will provide the researcher the medium to investigate the differences between subjects at a specific time period. Last but not least, with the help of cross-sectional study, the author of this research will be able to work on multi-task at once (Neville, 2005; Hyde, 2000)

In circumstances where already available data to solve the predefined problem is not sufficient, researcher must collect data relevant to the research problem so that collected data can assist the researcher to identify a solution. It is necessary to highlight at this point that there are two types of data gathering; “*primary data*” and “*secondary data*” (Heaton, 1998).

Primary data does not actually exist until and unless it is generated through the research process by the researcher as a part of finding an answer for predefined problem. On the other hand, secondary data is the information that already exists in some form but which was not primarily collected (*ibid*).

4.5.1 Adopted Data Collection Tools

In this study, the author of this research majorly used questionnaire, interviews and case study to obtain the relevant empirical data.

Questionnaire;

In general, social science based researches are undertaken through the information supplied by the target population chosen by the researcher so that relevant analysis can be carried out. In this conducted research, target population for the questionnaire are people who reside within a 150 m radius to construction site so that nuisance indicators due to construction activities for the people and cost of it can be fixed and analysed (please chapter 7 for details).

According to Babbie (1990), questionnaire can be defined as a document comprising of questions and other types of items to provide solicit information that can be used to undertake appropriate

analysis. On the other hand, deVaus (1996) defined questionnaire as a data collection tool which accommodates numerous participants where each of them is diverted with the same set of questions that are ordered forgone. In this way, great amount of data can be very economically collected from the targeted population.

Questionnaire design is very critical and significant part of the research due to the risk of misleading the research if it is being undertaken in an inappropriate way. For that reason, after a comprehensive literature review about social cost, set of adequate and appropriate questions in a sequential order has been prepared as a part of this research in order to provide the researcher with the required data to identify a solution (Robson, 2011).

Additionally, questionnaire was considered to be an appropriate data collection instrument in gathering the necessary information for this research as it is rather simple and fast to perform it. (Floyd and Fowler, 2002; Moser and Kalton, 1979).

Structured and unstructured questionnaires are the two most common types of questionnaire methods. Structured questionnaires include pre-coded questions with well-defined skipping patterns to follow the sequence of questions. When researcher carries out structured questionnaires, management of the data is easier and answers are more consistent. When unstructured questionnaires are being undertaking by the researcher during the data collection process, open ended and vague opinion-type questions takes place.

On the other hand, it is common to come across with the mixture of both questionnaire types which is called —quasi-structured questionnaire during the data collection process, especially if the research is social science based. It is worthwhile to mention at this point that the author of this research has adopted quasi-structured questionnaire in this study (please see chapter 7 for details) (Robson 2011).

Case Study;

It is stated by Yin (2003) that researchers carry out case studies during a study with the intention of doing an in-depth exploration of territory so that phenomena can be identified and described as well as the key concepts. Moreover, Yin (2003) remarked that, detailed inquiry during a case study is frequently part of a research design or, at a minimum, requires the utilisation of data.

Furthermore, depending on the availability, multiple case studies serve to strengthen the results by replicating the pattern matching, thus increasing the level of confidence in the robustness of the theory Yin (2003).

According to Suárez Bello (2003), reasons for undertaking conduct a case study is as follows;

The exploration of a question, program, population, issue or concern in order to determine appropriate research questions to facilitate future research.

- The explanation of linkages between causes and effects.
- The description of the real-life context in which an intervention has occurred.
- The description of the intervention itself.
- The exploration of those situations in which the intervention being evaluated has no clear set of outcomes.

Additionally, case study process comprises three stages which are; defining and designing, preparing, collecting and analysing and analysing and concluding (Gray, 2009).

Within this context, researcher has conducted a case study targeting the evaluation of the proposed social cost estimation system which identifies social costs on daily basis. For the case study evaluation purpose, lightweight steel construction and reinforced concrete construction in are compared including the generated social costs in terms of project initial cost incurred to the owner. Please see chapter 9 for details.

4.5.2 Data Analysis Tools

Subsequent to gathering the necessary data for this research through the help of the abovementioned data collection instruments, collected data are analysed in order to give a response to the raised research question in chapter 1.

Through the cost estimation methods discussed in chapter 2, case study data are analysed. On the other hand, with the help of SPSS; a computer program that is capable to conduct the relevant analysis of the quantitative data, analysis of the results obtained from the conducted questionnaire is undertaken expressing the gathered information from the respondents numerically. Through the SPSS, three main measures of central tendency: the mean; the median; and the mode described how obtained data clustered together about a central point.

Furthermore, measure of dispersion took place concerning the range, variation ratio, and standard deviation of the obtained results in order to form the platform to observe whether the participants 'opinions in certain conditions are similar to each other or dissent.

4.5.3 Evaluation of the Data

After gathering the necessary data through performing several field works, proposed social cost estimation system for North Cyprus and Turkey construction industries are evaluated through eliciting experts' opinions. Experts have been informed about the proposed system, and findings obtained as a result of implementing the system are asked for their written consideration. On the other hand, with the help of case study evaluation technique, social costs which are obtained in daily basis have been examined.

4.6 RESEARCH DESIGN

In line with the above introduced research methodology, research design that the author of this research has developed is illustrated in figure 4.1. The figure itself depicts how the embedded processes undertaken throughout this study overlap with the research themes in addition to the methods/tools engaged with the each stage of the process. Furthermore, after a comprehensive literature review about the research methodology, researcher's adopted research philosophy, approach and method is also demonstrated by figure 4.1.

This specific study is divided into 7 main phases in terms of research design. These phases are spread into the overall research and mentioned phases comprise of 8 stages of research process. In this part of the report 8 stages, which are expressed in few words and illustrated in figure 4.1, is further discussed.

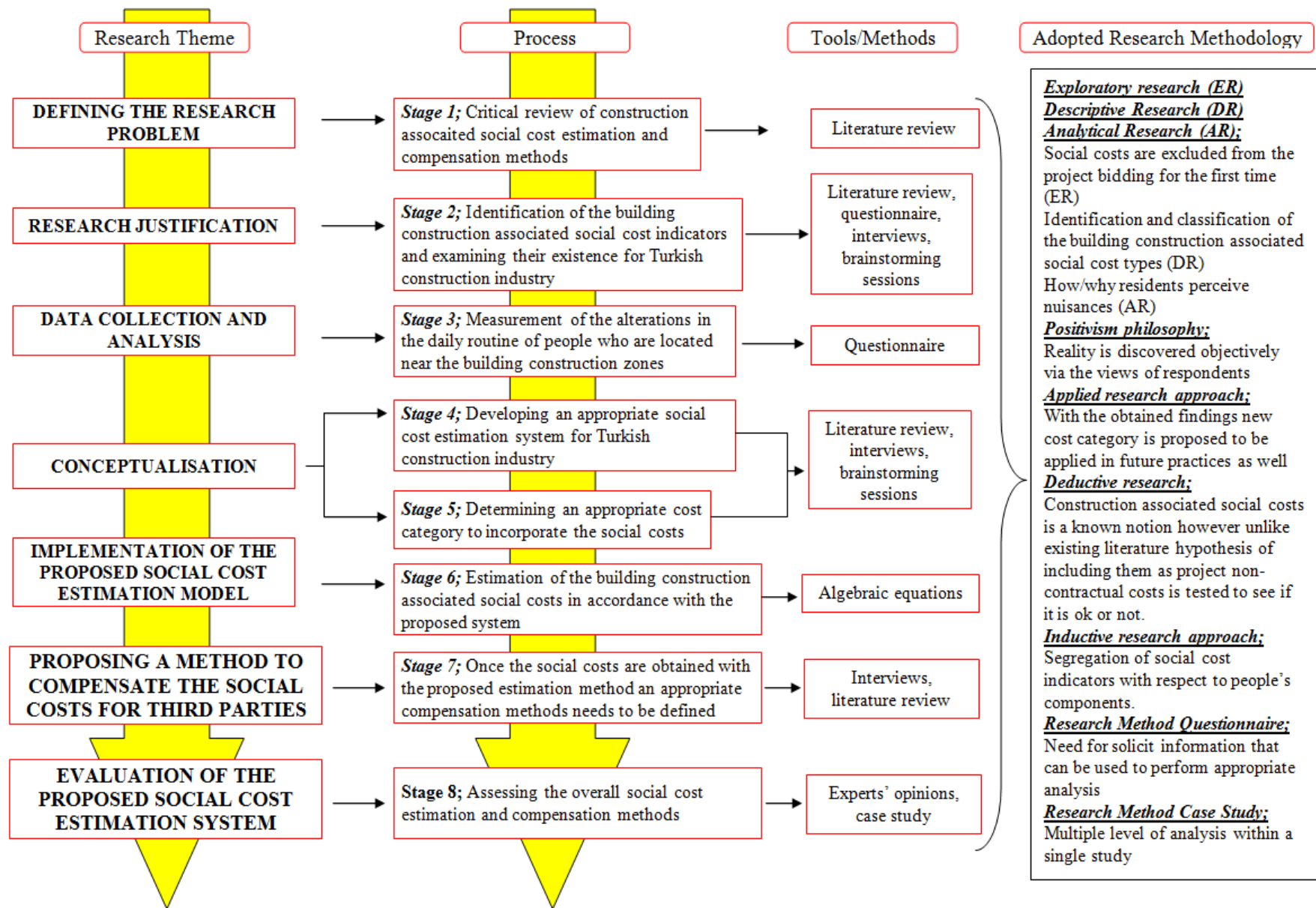


Figure 4-1: Research Design

Stage 1; with the intention of obtaining broad and depth contextual knowledge about the construction associated social cost estimation practices, comprehensive literature review has been conducted initially. On the other hand, through this method of knowledge acquisition, how professionals compensate building construction related social costs is examined. In line with these, research question together with the aim and objectives of the research has been set forming the solid foundation for filling the identified gap in the literature.

Stage 2; subsequent to completion of stage 1, it is obtained that estimation method of social costs can be standardised for all parts of the world as peoples cultural and social manners as well as the way of living plays an important role during estimation of the social costs (the way people perceive or react against a nuisance varies from region to region). On the other hand, in existing literature many of the social cost indicators are identified for infrastructure associated social costs. For that reason, it was necessary to examine if the social cost indicators associated with building construction projects would vary or not. Accordingly, the need to identify the social cost indicators for North Cyprus and Turkey has emerged and with the help of literature review, observations, self-experience, brainstorming sessions and interviews with the experts, typical social cost indicators for this region are identified.

Stage 3; in accordance with the obtained social cost indicators via implementing stage 2, people who reside within the vicinity of building construction zones are questioned with the help of a questionnaire so that alterations in their daily routine as a result of being exposed to adverse impacts of construction projects can be measured numerically. These numerically obtained values will pave the way for monetising the social costs.

Stage 4 & 5; Many scholars have remarked the difficulty in quantifying the social costs and as a result of this difficulty they stated that professionals abstain from including these costs into project bidding. Additionally, at the end of literature review it is obtained that standardisation of estimation system does not provide precise results. In line with these, an appropriate social cost estimation system and appropriate cost category for considering the social costs is proposed at the end of interviews and brainstorming sessions.

Stage 6; Subsequent to the collection and analysis of the questionnaire results (stage 3) set of mathematical equations have been developed for monetising the social costs perceived by each house in the neighbourhood. People's alterations in their daily routine due to the ongoing construction in their neighbourhood have been put into the generated algebraic equations hence; monetised social costs have been gathered to be put into the proposed social

cost category. During the development of mathematical equations, literature review about the algebraic equations has been conducted. Additionally, some brainstorming sessions with the local statisticians and academics have been performed to confirm the reliability of the developed equations.

Stage 7; with the help of questionnaire and literature review an appropriate and applicable cost category for considering the social costs, which is project non-contractual costs that are incurred to the owner, is determined.

Stage 8; in this stage, the reliability of the proposed social cost estimation system is measured through set of evaluation techniques. Firstly, two experts have reviewed the implemented generic social cost estimation system and give feedback on it. Afterwards, by using the data obtained from the conducted case study, building construction costs for two alternative construction methods calculated with respect to the time – social cost correlation and results have been critically reviewed for the justifiability of the proposed system.

CHAPTER 5: A CONCEPTUAL SYSTEM FOR BUILDING CONSTRUCTION ASSOCIATED SOCIAL COSTS IN TURKEY AND NORTH CYPRUS

5.1 INTRODUCTION

Civilizations are built by construction efforts. Construction industry is generally known to be one of the most challenging industries in many countries. It is essential to the development of communities, residences, industry, and ultimately the country. The economy relies on construction activities for progress and growth.

However, every type of construction causes considerable disruptions and inconveniences, which cannot be easily quantified, to the general public. These costs are typically called social costs. In residential areas a building construction site works generate nuisances which are inversely affecting the life of quality of the community. In many developing countries like Turkey and north Cyprus, the building construction regulations are not rigid to enforce the contractors to mitigate if not eliminate the building construction caused social costs.

This chapter focuses on a developed generic system for building construction associated social costs to be used in Turkish construction market in Turkey and north Cyprus. The system is composed by three sections.

In the first part, investigations on the existence of the social costs in the Turkish construction market are explained. For that purposes a questionnaire is conducted in north Cyprus and it was obtained that, the people residing in the vicinity of building construction sites have strong objections of the construction caused nuisances which denotes the existence of social costs.

In the second section, in accordance with the performed investigations a framework is developed to assist the estimation of building construction associated social costs in the Turkish construction market and development of it is explained in detail. The developed framework displays variety of functions in a logical sequence and prioritises them by six

phases. In phase 1 the social impact types are identified. In phase 2 the social cost components are described. In phase 3 the social costs sub-components are fixed. The first three phases are deemed to be global since they are to be used in everywhere. In phase 4 the perceivable nuisances are determined. In phase 5, the formula to estimate the total social cost is given and the calculations are made. In phase six the implementation and validation of the framework are performed. Phases 4 and 5 of the proposed framework necessitate field surveys performed at project's geographical location. By using the developed formulas given in phases the social cost of the components can be calculated. By adding up all those components' costs, the estimated total social cost of a construction site in a residential area can be calculated.

As a third stage of the system, a generic compensation method for the building construction caused social costs in Turkey and north Cyprus is explained in detail. In this compensation method, first a proposed social cost category, and then the way of compensating the people incurred by the social costs are discussed.

5.2 THE EXISTENCE OF SOCIAL COSTS IN TURKISH CONSTRUCTION INDUSTRY

In this thesis the social cost is defined as the cost of the alterations in the daily routine of people residing in the proximity of building construction sites in residential areas. In comprehensive literature review it was obtained that no research has performed so far on the social costs for Turkish construction industry market that are applied in Turkey and north Cyprus.

Therefore first, it was necessary to investigate the existence of the social costs in practice. For that purpose three questions were inserted into the questionnaire that was conducted in April 2012 in three major cities of north Cyprus namely, Nicosia, Famagusta, and Kyrenia as explained in detail in chapter 6. These questions are B1, B2, and B3 in the questionnaire form where a copy of it is given in Appendix A.

The questionnaire survey included 266 respondents residing within 150m of building construction sites and the results of the survey are given in chapter 7 in detail. The previously obtained social cost nuisances through the brainstorming sessions with professionals, observations, and self-experience, as it was explained in section 5.3.4 have been grouped into three categories as house, households, and neighbourhood.

The obtained criteria were asked in the questionnaire to understand to what extent the on-going building construction sites affected them. The grouping of criteria is given by Table 6.1.

The adverse impacts of on-going building construction sites on the house, households, and neighbourhood are given in table 7.2, table 7.3 and table 7.4 respectively. It is obtained from those tables that, the respondents' evaluations for the existence of the nuisance criteria for house, household and neighbourhood are given on average as 7.13, 4.2, and 6.63 respectively out of 10. In other words, the respondents were complaining of those building construction caused nuisances at a ratio of equal to, for house 7.13/10, for households 4.2/10 and for neighbourhood 6.63/10.

This clearly implies that, the respondents are pointing out the existence of the building construction caused social costs in those north Cyprus cities.

5.3 DEVELOPMENT OF A GENERIC FRAMEWORK FOR QUANTIFICATION OF SOCIAL COSTS

A plethora of adverse impacts can result from the execution of construction activities (Gilchrist and Allouche, 2005). In urban areas members of the community who are exposed to wide range of construction causative adverse impacts are integrally residents and businesses in the neighbourhood of a construction site (CLG, 2011).

In the questionnaire performed in north Cyprus cities as explained in section 5.2 the people who were residing in the vicinity of building construction sites clearly pointed out the existence of the social costs. In this study focuses on estimating the cost of building construction causative nuisances exposed to only local residents.

With regards to focal point of this study, a framework which displays variety of functions in a logical sequence and prioritises them by six phases is developed. Phases 4 and 5 of the proposed framework necessitate field surveys performed at project's geographical location. The framework and social cost estimation equation which are interrelated is depicted by Figure 5.5. In the following sections, development phases of the proposed framework together with the derivation process of the proposed standardised social cost estimation equations are discussed in detail.

5.3.1 Phase 1: Identification of the Social Cost Impact Types

In harmony with the past studies (Gilchrist and Allouche, 2005; Yu and Lo, 2005; Lee et al., 2005; Najafi and Gokhale, 2005; Florez et al., 2012; Apeldoorn, 2013), building construction-borne adverse impacts have been determined as shown in figure 5.1. These adverse impacts are clustered as; damage to natural and built environment, pollution, and traffic problems.

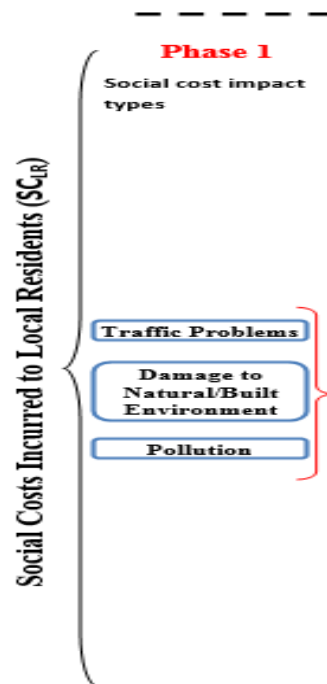


Figure 5-1: Phase 1: Identification of building construction causative adverse impacts

Alterations in the daily routine of construction site's surrounding community during the development phases of construction projects are essentially the social cost indicators. Measuring the intensity and frequency of each itemised daily alteration contributes to the revealing process of social costs associated with the building construction.

For that reason, it is crucial to primarily identify the adverse impacts in order to pave the way for itemising alterations in the daily routine of the people hence measuring the consequences residing near a building construction site.

5.3.2 Phase 2: Segregation of Social Costs Components

Researches indicate the difficulty and complexity in estimating the social costs (Yu and Lo, 2005; Gilchrist and Allouche, 2005; Apeldoorn, 2013). In existing practices scholars firstly segregates the construction causative adverse impacts types. Subsequently they determine the

social cost indicators for each adverse impact type and perform the evaluation of the social costs with respect to the determined indicators.

However, due to inherent correlation among the adverse impact types, so among the determined social cost indicators, existing approaches turn out to be abstruse and intricate in precisely estimating the total costs incurred to third parties.

In this research, it is asserted that difficulty in evaluating the project social costs can be minimized through segregating the impact types of the social costs with respect to community's possessed components.

According to a research undertaken in University of Toronto (Raphael et al., 1996), people measure their quality of life by considering broad range of determinants including their physical belongings such as homes and neighbourhood. Thereby, it is interpretable that when people's homes and neighbourhoods are exposed to adverse impacts of the construction activities, they are likely to show reaction to resolve or mitigate the perceived impairment on their quality of life via paying some additional costs.

Inference obtained from the literature, brainstorming sessions with professionals, observations, and self-experience enlighten the way to identify the possessed assets of the third parties. Consequently, possessed assets of the third parties are interpreted as social cost components. These components are identified as households, house, and neighbourhood as it is illustrated by phase 2 of figure 5.2.

A social cost formula to cover the local residents for the components of Phase 2 is proposed as given in equation 1.

$$SC_{LR} = SC_N + SC_{HH} + SC_H \quad (\text{equation 1})$$

Where: SC_{LR} = Social cost per local residents

SC_N = Social cost for neighbourhood

SC_{HH} = Social cost for households

SC_H = Social cost for house/car(s)

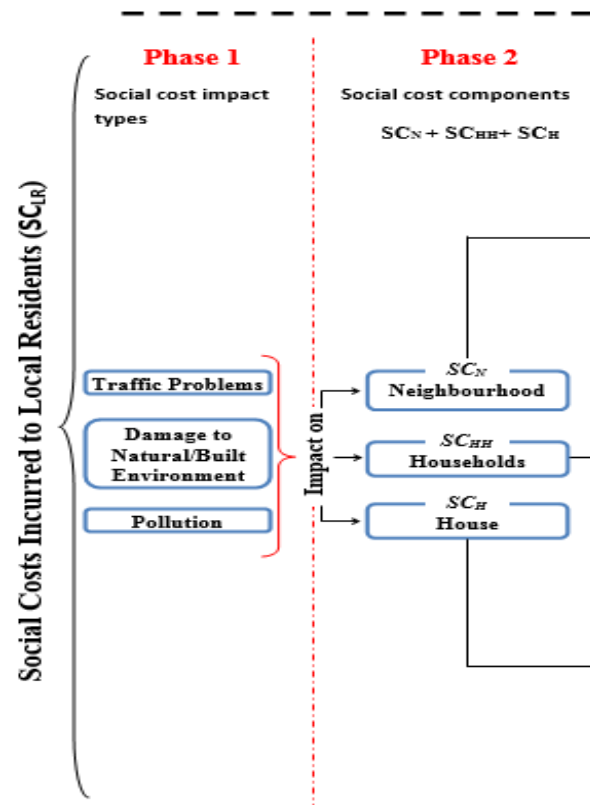


Figure 5-2: Phase 2: Segregation of building construction causative adverse impacts in terms of the social cost components.

5.3.3 Phase 3: Segregation of Social Cost Sub-Components

In this phase, the described social cost components in phase 2 are segregated into subcomponents and represented with an equation in order to facilitate the calculation of social costs for each component as shown in Figure 5.3. During implementation of this process, in addition to inference obtained from the literature, brainstorming sessions with professionals, observations, and self-experience also contributed to crystallization of segregating the components of social costs into subcomponents. The brainstorming session was performed with 15 MSc Construction Management students studying in the Civil Engineering Department, Eastern Mediterranean University. The author of this thesis was the mediator and the session lasted 4 hours. The explanation of subcomponents is given below.

Subcomponents of Neighborhood

- i. **Cost of traffic problems (C_{TP});** Due to functioning of the construction site, mobilization of construction machineries and equipment in and out of the construction site as well as within the neighbourhood it is likely that road safety and cleanliness of the roads in the area will be lessening. As a consequence of these, traffic detours, prolonged closures,

and/or traffic delays leading to alterations in the standard flow of traffic is expectable which will lead to costs being incurred on people.

- ii. **Cost of car park problems (C_{CP});** Due to closure of some roads or excess traffic in the neighbourhood residents may have either difficulty or no chance in finding a convenient on street car parking space in their area. This problem will result by incurrence of costs on the residents.
- iii. **Cost of deficiency in using recreational facilities of the neighbourhood (C_{RF});** Due to formation of various nuisances because of the on-going construction activities in the neighbourhood, access to some of the recreation facilities in the area may be temporarily unavailable or serviceability standards of those facilities may decrease. This will lead residents to seek for solutions and because of this there will be costs incurring on them.
- iv. **Cost of alterations in the ambient standard of the neighbourhood (C_{AS});** Accumulation of possible vicissitudes in the neighbourhood's standard due to the peculiar operations such as; uprooting or cutting of trees, serviceability of parks, peace and quietude and parameters alike will incur costs on residents as they will react to maintain their standard.

Neighbourhood which is a social cost component is calculated by implementing Equation 2.

$$SC_N = C_{TP} + C_{CP} + C_{RF} + C_{AS} \quad (\text{equation 2})$$

Where: SC_N = Social cost for neighbourhood

C_{TP} = Cost of traffic problems

C_{CP} = Cost of car park problems

C_{RF} = Cost of deficiency in recreational facilities

C_{AS} = Cost of alterations in the ambient standard

Subcomponents of Households

- i. **Cost of having a delay in meeting daily necessities (C_{DN});** Due to the negative bringing of the ongoing construction in the neighbourhood, food, grocery, or any other deliveries to might delay so that alternatively individuals might prefer not to wait for delivery and pick them up themselves. Change in daily routine of residents will therefore end up by cost incurrence.

- ii. Cost of maintaining standard health/personal care (C_{HP});* considering the probable effects of the perceived nuisances such as becoming uncomfortable due to noise pollution, residents might alter their daily routine in terms of the hours they rest during the day. Sleep disturbances and excessive noise in the area may lead to tiredness, not feeling well, hypertension, emotional disturbances, abnormal behaviour and etc. For that reason, standard of residents' health-wellbeing might get affected. On the other hand, due to construction activities related pollution such as dust, dirt, debris, and/or spillages of materials, residents' standard of personal care such as their hair care, make-up, skin care, polish of their shoes and etc. might get affected. Residents who will seek to maintain their standard health/personal care will make additional spending.
- iii. Cost of limitations in the use of outdoor areas (C_{LO});* Due to construction activities related environmental pollution such as; noise, dust, dirt, debris, and/or spillages of materials the time residents use the outdoor areas of their house and neighbourhood facilities might be restricted. This will lead residents to seek for alternative solution and any possible solution will result with cost incurrence.

Household which is a social cost component is calculated by implementing Equation 3.

$$SC_{HH} = C_{DN} + C_{HP} + C_{LO} \quad (\text{equation 3})$$

Where: SC_{HH} = Social cost for households

C_{DN} = Cost of delay in meeting daily necessities

C_{HP} = Cost of health/personal care

C_{LO} = Cost of Limitations in use of outdoors

Subcomponents of House/Car

- i. Cost of alterations in the standard cleanliness of the outdoor areas of the house (C_{OC});* Because of the construction activities oriented dust, dirt, debris and/or spillages of materials, cleaning standards of the house yards might have decreased. In return, residents will be incurred by additional costs so that they can maintain the standard cleanliness.
- ii. Cost of alterations in the standard cleanliness of the indoor areas of the house (C_{IC});* On-going construction is likely to affect the state of the house in terms of being clean and free from dirt due to debris, dirt, and dust formation in the neighbourhood being above

the standard during the construction. For that reason, process of achieving and maintaining the routine cleanliness standard of the house may require extra cleaning than usual and create incurrence of cost on to residents.

iii. Cost of alterations in the standard cleanliness of the cars (C_C); for the houses that do not have a closed car park space/garage, construction activities causative dust, dirt, and/or spillages may lead to additional cleaning of the cars in order to maintain the standard cleanliness. Additionally, while the residents drive by the construction site or within the neighbourhood, this could also affect the cleanliness standard of their car. In return, there will be cost incurrence on residents who wish to maintain standard cleanliness of their car(s).

House which is a social cost component is calculated by implementing Equation 4.

$$SC_H = C_{OC} + C_{IC} + C_C \quad (\text{equation 4})$$

Where: SC_H = Social cost of house and/or car(s)

C_{OC} = Cost of cleanliness outdoor areas

C_{IC} = Cost of cleanliness indoor areas

C_C = Cost of cleanliness of car(s)

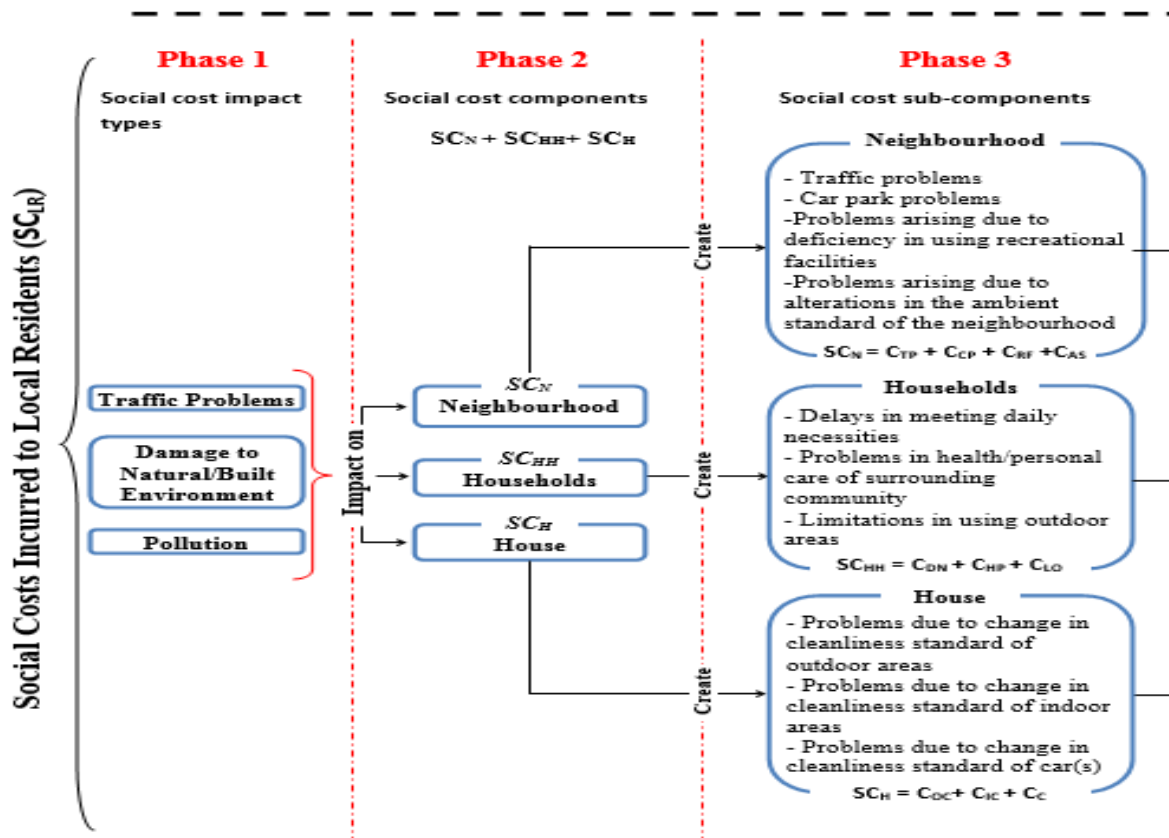


Figure 5-3: Phase 3: Identification of the social cost sub-components

5.3.4 Phase 4: Identification of Perceived Nuisance Criteria

This study asserts that, proposed social cost estimation equation for measuring the costs incurred on local residents accommodates omnipresent nuisance parameters. However, in order to obtain the values of these parameters it is a must for professionals to perform field survey at project's geographical location so that, they identify which parameters set off a reaction in people surrounding a construction site as a result of perceiving these omnipresent nuisances.

This is critically essential because, the world's cultural heterogeneity and variability of communities in terms of social manners set the boundaries for the type of alterations in the daily routine of a community. In other words, type of reaction given by the community for resolving/mitigating the impairment on their quality of life as a result of being exposed to construction causative nuisances will intrinsically be different.

Because of this, identification of the adverse impacts' consequences incurred on the third parties cannot be standardised for global implementations. This case can be discussed further by making an analogy from estimation perspective between the social costs and traditionally

performed direct or indirect costs. When professionals estimate the direct or indirect costs associated with a construction project, they know which parameters are needed to be evaluated just as the above given parameters that represents social cost sub-components. However, at every time they perform surveys to estimate the costs of the materials, equipment, workmanship, subcontractor, and project or head-office overheads locally.

As it is previously explained in section 2.7, the perceived building construction caused nuisances by the residents depend on the existing building regulations and building permission conditions which inherently changes from country to country if not from region to region. In developed countries the building construction permission regulations are strict and their disturbances to their environment are less.

On the other hand, in mostly many developing countries like north Cyprus and Turkey those regulations are loose and therefore the incurred social cost is high. Therefore, it is proposed here that, in order to quantify the social costs in money, first the local nuisance criteria are to be identified by undertaking some local surveys.

To identify the perceived nuisance criteria, the applied local survey methods include brainstorming sessions with professionals, observations, and self-experience. In this study, a brainstorming session was performed as it was explained in section 5.6.3. However, the identified nuisance criteria were also included into the questionnaire as explained in chapter 6 in order to be confirmed by the residents living near to the building construction sites. In this way, the already identified nuisances as explained above are re-evaluated by the respondents.

The perceived nuisance criteria obtained in this phase are illustrated in figure 5.4.

5.3.5 Phase 5: Estimation of the Social Costs

The defining nuisance criteria to be acquired via implementing phase 4 are an important link to enumerate probable alterations in one's daily routine. Due to the nature of this research, conducting a questionnaire in the location of the construction site is considered to be the most convenient tool for performing this enumeration. For instance, in phase 4 "change in the standard cleanliness of cars" is identified as a typical nuisance criterion. Based on this, in phase 5 with the help of a questionnaire residents will be questioned in a certain way so that the additional number they take their car into carwash during construction to maintain standard cleanliness of their car can be revealed. This enumeration process will enable to obtain a monetary value for the nuisance criteria via implementing some empirical equations.

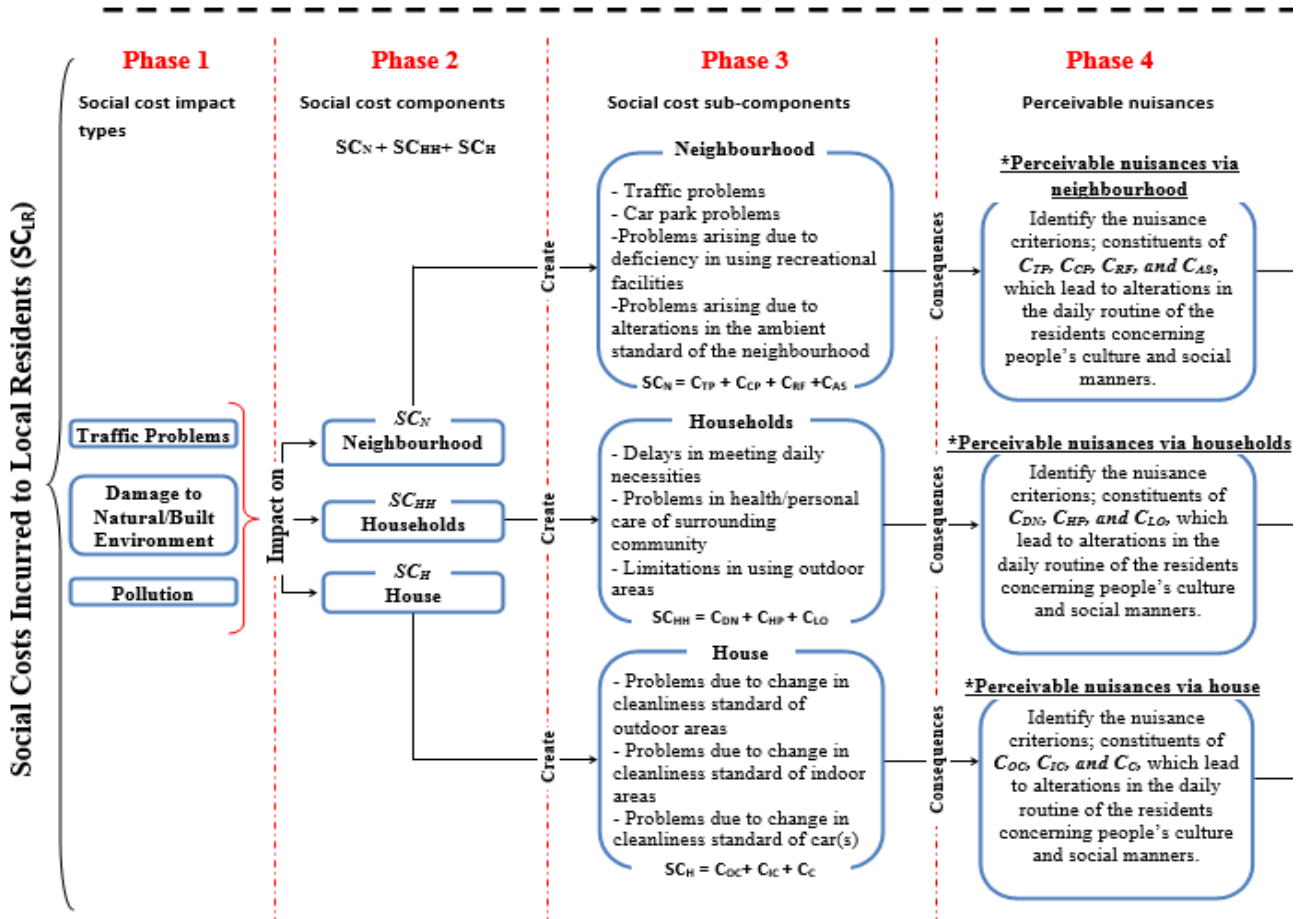


Figure 5-4: Phase 4: Identificatioun of the perceivable nuisance criteria

* Perceivable nuisance criteria shown in Phase 4 are to be identified by a local survey and explained in the next chapter.

Accumulating the consequences of the entire nuisance criteria perceived by the residents in monetary units will output the social costs associated with the building construction project. Processes to be performed in phase 5 are explained further in the following sections.

On the other hand, equation 5 is the expanded version of equation 1. In this equation, equations 2, 3, and 4 are combined into one equation so that all the necessary parameters that are needed to be evaluated for revealing the social costs incurred on local residents are expressed together.

Therefore, equation 5 which is the derivative of equation 1 is the main equation that needs to be adopted by the professionals during social cost estimation. Figure 5.5 illustrates the overall proposed framework to estimate the building construction causative social costs.

$$SC_{LR} = [C_{TP} + C_{CP} + C_{RF} + C_{AS}] + [C_{DN} + C_{HP} + C_{LO}] + [C_{OC} + C_{IC} + C_C]$$

(equation 5)

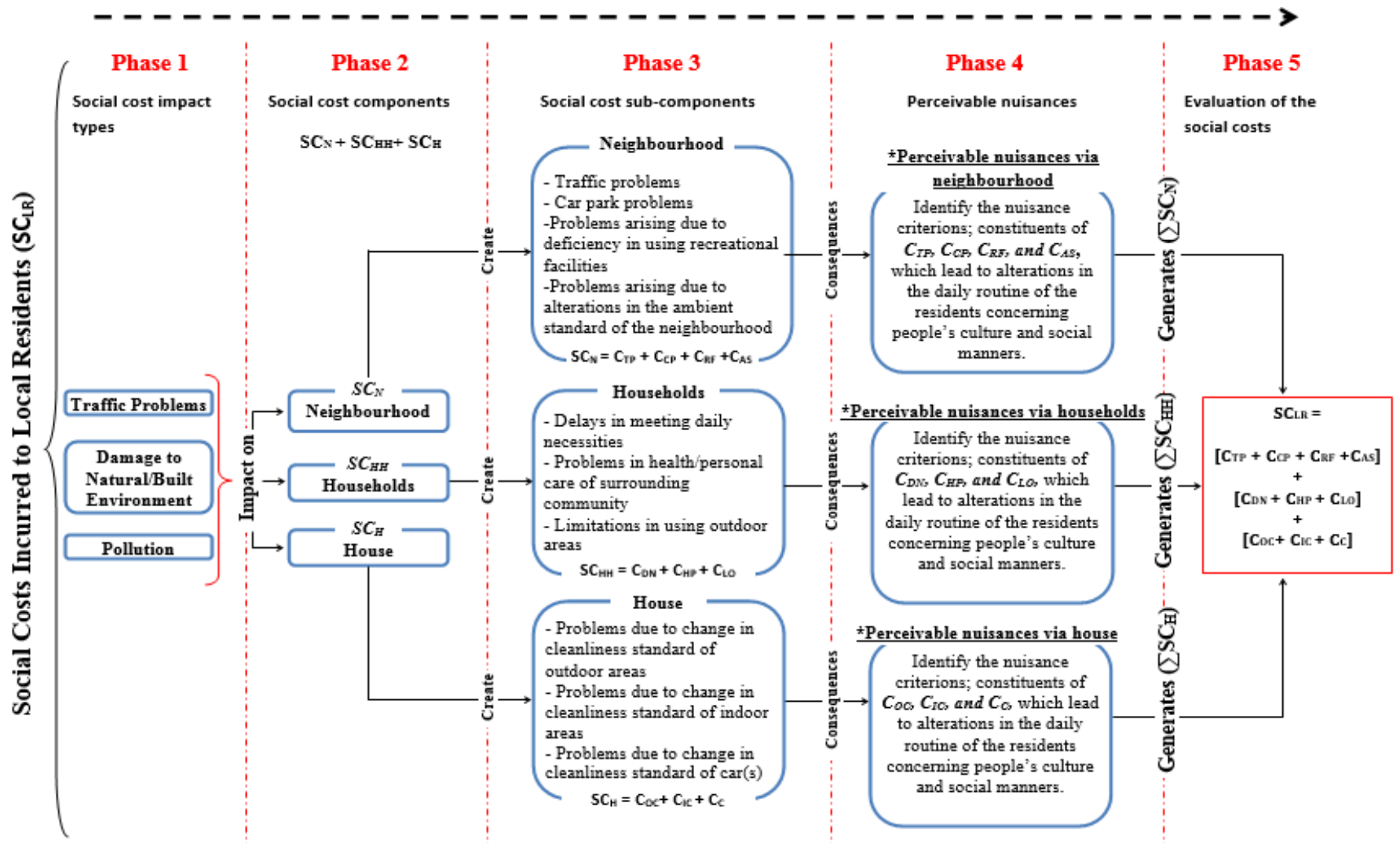


Figure 5-5: A framework to estimate the social costs associated with a building construction project

*Perceivable nuisance criteria shown in Phase 4 are to be identified at the end of a local survey.

5.3.6 Phase 6: Implementation of the Proposed Framework

In order to test the practicability of the proposed framework, set of field surveys as necessitated by Phase 4 and 5 are performed in north Cyprus. In this section, procedures to obtain typical social costs generated due to execution of building construction projects are explained sequentially.

5.3.6.1 Identification of the perceivable nuisances in relation to phase 4

For this specific study, the nuisance criteria are identified by a field survey performed in north Cyprus. In that respect first, observations and self-experience methods have been applied to identify the perceivable nuisance criteria and then a brainstorming session has been organised with local residents to finalize them.

At the end of this process considering the cultural and social manners of the locals, 17 different perceivable nuisance criteria are identified. Afterwards, designated nuisance criteria are separately categorised under pre-identified social cost components and each criterion is associated with the abovementioned social cost sub-components as illustrated by Table 5.1.

Table 5-1: Association of perceivable nuisance criteria with the social cost sub-components

House	Households	Neighbourhood
Cleanliness of the walls of the house $\approx C_{OC}$	Meeting daily necessities $\approx C_{DN}$	Road safety standards of the neighbourhood $\approx C_{TP}$
General cleanliness of the house $\approx C_{IC}$	Maintaining their standard health/well-being/personal care $\approx C_{HP}$	Road cleanliness of the neighbourhood $\approx C_{TP}$
Cleanliness of the curtains $\approx C_{IC}$	Time they use the outdoor areas of their house $\approx C_{LO}$	Standard flow of traffic in the neighbourhood $\approx C_{TP}$
Cleanliness of the windows $\approx C_{IC}$		Standard cleanliness of the ambient/neighbourhood $\approx C_{AS}$
Cleanliness of the car(s) $\approx C_C$		Preservation of the habitat/parks $\approx C_{AS}$
Cleanliness of the house's yard $\approx C_{OC}$		Finding a convenient car parking space in the area $\approx C_{CP}$
		Serviceability standards of the playfields/parks/hiking trails $\approx C_{RF}$
		Standard peace and quietude of the neighbourhood $\approx C_{AS}$

5.3.6.2 Measuring the effects of nuisances perceived by local residents (phase 5)

In order to measure the consequences of perceived nuisances on local residents surrounding a construction site, a questionnaire survey was conducted in three major cities of north Cyprus namely; Nicosia, Famagusta, and Kyrenia in July 2012. In each city five building

construction sites were randomly selected in the residential areas and the residents living within 150m of those building construction sites were visited.

It is noteworthy here to mention that, according to Watkins (1980) and Hunt et al (2014), construction projects causative additional dust formation significantly disturb the residents within 150 m of a construction site. Additionally, some researchers made an attempt in measuring and quantifying the noise pollution through people residing within 120 m of a construction site (Gilchrist and Allouche, 2005). Therefore, in this study it was decided to investigate people who reside within 150 m of construction sites.

The total number of participants to the questionnaire survey was 266 with a combination of 101 residents from Nicosia, 83 residents from Famagusta and 82 residents from Kyrenia. In chapter 6, further information is given about the conducted questionnaire. The analysis and discussions of the questionnaire are given in chapter 7.

5.4. SOCIAL COSTS COMPENSATION METHOD

This section is composed by two parts. In the first part the proposed social cost category will be explained and in the second part a method is proposed on how to compensate the people that social cost is incurred on.

5.4.1 Proposed Social Cost Category

The total cost of a construction project to the owner is composed by a contractual cost and a non-contractual cost. The contractual costs include all the costs that take place in the bid value of the contractor. Bid value includes all the direct costs and a mark-up to the contractor.

On the other hand, non-contractual costs include all the costs that will not take part in the bid value (contract value). These costs include project land acquisition cost, project feasibility report expenditures, project design fee, building permission fee paid to municipality, etc. In fact some of these costs depend on the project procurement method used. For example, if turnkey project procurement method is selected, the project design fee will not be counted in the project non-contractual costs but, it will be included in the contractual costs.

Rahman et al. (2005) stated that the social costs, either themselves are direct or indirect costs related to a project, do not form part of construction contract bid. There are different views in the literature about the cost category of the social costs. Will it take place in the bid value in the direct cost or indirect cost category?

The author of this thesis conducted interviews with 9 construction contractors located in New York in April 2014. The interview with each contractor took about 20 minutes. All of those contractors were doing construction works at the national level in USA. In the interviews having the contractors given information about their companies, they were first asked about their familiarity with the social costs and then what cost category the social costs should be included in.

It was obtained that, all of the 9 contractors are familiar with the social costs. They all recommended that, the social costs should not be part of the contractual bid value in terms of direct cost or indirect costs. Social costs have not been described and calculated in a widely accepted standard method yet. So it will create an unfair medium in competition of the contractors in the bidding. The social costs will affect the bidding negatively and cause to avoid the selection of the best alternative contractor. Both the contractors and the owners will adversely be affected with such an application. Therefore, they all recommended the social costs to be counted out of the bidding value. Due to the results of this interview and considering the literature, the author of this thesis resulted that the social cost cannot be in the bid direct cost since it is not part of construction materials, labor, equipment or subcontractor cost. Similarly it is not part of risk cost or profit or overheads to be tendered in bid mark-up. Therefore, the author of this thesis proposed that, the social costs of a construction project should be included to the project non-contractual costs to the owner in terms of project total cost as it is shown in figure 5.6.

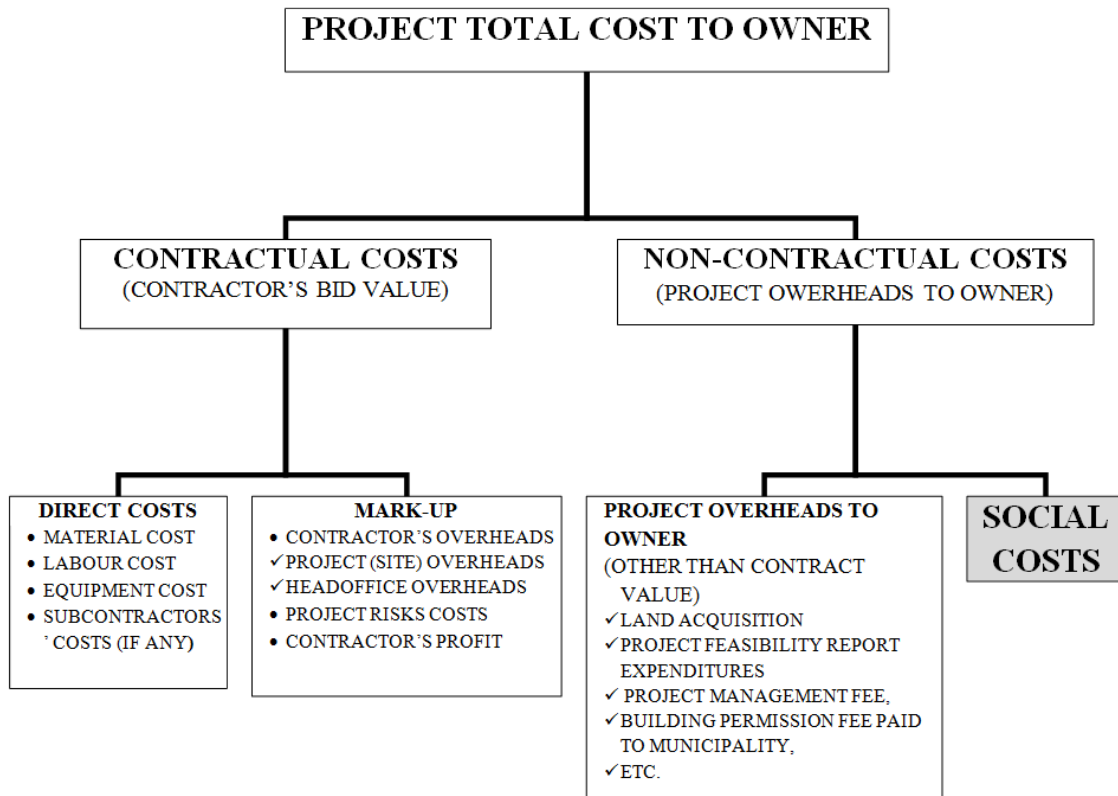


Figure 5-5: Cost category for the social costs

5.4.2 Proposed Social Cost Compensation Method

In especially developed countries as it was mentioned in section 2.7, the building construction regulations or the permission conditions within a residential area is so strict that, the contractor is forced to consider many precautions in order to lessen the disturbances of the residents around the site. In other words, the contractor includes into his tender the costs of those precautions as well. In this case, the third parties may be disturbed less, however, the contractor's expenditures are somehow paid by the owner.

On the other hand, if in a country those regulations are loose, as in most of the developing countries like north Cyprus and Turkey, then the third parties will be incurred all of the social costs and these costs are to be compensated somehow. Therefore in this thesis it is proposed that, the building construction caused social cost changes from country to country and is to be estimated at the end of a local investigation.

Just like in other countries, in Turkey and in north Cyprus every construction projects prior the starting of construction on the sites are required to get building permission from the municipality/ local authority. After completion the construction works on the site, the owner

applies to get “final approval certificate” in order to formally occupy the building from the relevant municipality/ local authority.

In this thesis a generic method to pay the social costs by the owner is proposed. The professionals of the municipality/ relevant local authority that are entitled to give the “final approval certificate” for the new building will estimate the social costs according to the proposed method as explained in chapter 5.

The amount of the social cost is expected to be highly realistic since it will be estimated just after the completion of the construction works. The construction caused social costs that are incurred on the residents near to the construction site are realised quite recently and the residents most probably remember them all to help to the social cost estimators more realistically (Wang, 2008). The estimated amount of construction caused social cost will be charged to the owner by the municipality/ relevant local authority while issuing the “final approval certificate” of the new building. As a result, paying the calculated social cost will be a condition, in addition to the other requirements of the authorities in order to issue the final approval certificate. In this way, the estimated amount of the social cost will be paid to the municipality/ local authority by the owner.

The municipalities/local authorities are normally responsible to provide a better environment for the society in the neighbourhood to live in comfort, peaceful, easy and calm. The municipality will use this money to compensate the effects of construction based nuisances on the affected people by means of created traffic problems, dust or sound pollutions, ecological/social/health problems and reduced economic activities of commercials if any. The municipalities can develop their own systems to compensate the building construction caused disturbances for the residents in the construction neighbourhood. The types of building construction caused nuisances are widely explained in section 5.3.

The probable method to compensate the affected people was discussed by the authorities of the two largest city municipalities in north Cyprus, namely, Nicosia, and Famagusta. The senior directors in those municipalities stated that, they can compensate the affected people in the way of deductions from their municipality taxes or other relevant bills.

In this proposed method the owner will be responsible to pay the estimated social costs. However, the amount of social costs very much depends on the construction methods, used materials and management of the construction operations. These are all under the control of the contractor.

By considering the necessary precautions whether it is written in the building regulations of the country or not, the contractor can mitigate if not eliminate the social costs at all. Therefore, in order to apply the proposed compensation method satisfactorily, it is believed that, there must be an instrument in the hand of the owner to enforce the contractor to consider appropriate precautions to mitigate the occurrence of the social costs.

This instrument is proposed to be a kind of bond, named as “social cost bond”. So the contractor will be enforced to provide another type of bond in addition to the other types of bonds such as performance bond or payment bond. This enforcement should be done through the specifications of the project. “Social cost bond” will provide a guarantee to the owner through the bonding company that the contractor will consider all the necessary precautions to reduce or preferably eliminate all the social costs.

In the contract documents it should be clearly stated that, any social cost charged by the municipality to the owner during getting the final approval certificate of the building will directly be compensated by the previously provided “social cost bond”. In this way, the contractor will be compelled to pay attention to avoid the occurrence of the social costs.

No information could be obtained in the literature about the ratio of the social costs to the total building construction cost. However, according to the study explained in chapter 8, the obtained social cost was £6/day/house. Assuming that for example in Nicosia there are about 20 houses around the 150m distance of a 4 storey building construction sites in a residential area, and using the unit rates of buildings published by north Cyprus authorities, the calculated social cost is about 10% of the total building cost. Therefore, the percentage of the social cost bond is recommended to be around 10% of the bid value.

Obviously, the contractors will be in a need to consider the premium of the social cost bond and the probable risk to pay an amount for the social costs at the end of the construction. These kinds of marginal expenditures can be included into the mark-up as discussed before. The premium of social cost bond can easily be obtained from the bonding companies (financial institutions or banks). The risk of the contractor to pay an amount of money to the owner to compensate the social cost that he paid to the municipality is a matter of risk management practice. If the contractor describes the risks at the beginning, they will not be risk any more, but just a matter of managing them.

Therefore, it is in the hand of the contractor to estimate the social costs and to manage the construction so that the social costs would be eliminated. If he cannot eliminate them all, he will accept to pay them through his social cost bond.

The contractors can also use the proposed social cost estimation method proposed in section 5.2 and consider the necessary precautions to reduce them accordingly. In long run, it is believed that, the local authorities will be able to develop this method further, standardise it, and probably periodically publish it for ease of access and use by the estimator professionals.

It is assumed that the residents within 150 m distance from the site will be entitled to get benefit from the calculated social cost. Obviously the intensity of effects of the nuisances within 150 m is not uniform. Therefore, it is recommended to provide the benefit to the residents within 150 m in pro rata based on their distances to the construction site.

CHAPTER 6: CONDUCTED QUESTIONNAIRE TO ENUMERATE ALTERATIONS IN THE DAILY ROUTINE OF RESIDENTS

6.1 INTRODUCTION

As aforementioned, up until recently, scholars have attempted to developed techniques with the intention of expressing the social costs in terms of monetary units. Additionally, referring to the section 5.3 of this thesis, adverse impacts of construction activities, in other words, drivers of the social costs have been identified by some scholars.

It was very obvious that, majority of the studies concerning the identification and quantification of the social costs, has been focused on infrastructure constructions and until now not much work has been carried out for measuring the impacts of the building constructions on the neighbouring community. On the other hand, conducted studies about the social costs did not incorporate the conceptions of the third parties so far, even though they are actually the ones that are being exposed to construction based nuisances. Instead, developed models and formulas to quantify the social costs were more like of an industry professionals' hypothesis based on their scholarly investigations.

As the definition of the social cost implies (given in section 2.6), these are the construction based nuisances that third parties are inevitably being exposed to and these are the costs that are paid by them. For that reason, in this study, it is asserted that somehow and some way third parties should be integrated into the determination and quantification process of the social costs hence, existing studies concerning the effects of the social costs on the neighbouring communities can be corroborated.

Concordantly, as distinct from previous researches, in this thesis, a questionnaire has been conducted targeting the people who were actually residing near to a construction site. First of all, the purpose of the questionnaire was to identify the types of building construction related social costs in accordance with the respondents' remarks concerning to what extent the on-going construction affects; them, their houses and the neighbourhood they live in. This task is performed in line with the unit segmentation framework which is explained in Chapter 5.

Once the adverse impacts of the on-going construction for the respondents were identified through the formed questionnaire, enumerations of these impacts have been accomplished on daily basis so that a platform for quantifying the social costs occurring per day could be developed. In light of the enumerations obtained via respondents, building construction related social costs that have led to behavioural changes of the people living in the residential areas have been quantified in chapter 8.

Referring to Chapter 4 of this thesis, due to the nature of this study, methodological triangulation has been applied to the overall research which involves using more than one method of gathering data, such as interviews, observations and questionnaire. For that reason, from researcher's point of view, it was highly important to take notice of the practicality of the research such as; ease of access to data, time constraints and resources that are available. Considering these facts, the relevant questionnaire was conducted in north Cyprus (hometown of the researcher) and the participants were the local residents residing near a construction site.

In this chapter, the design process of the questionnaire, the contents of it, profile of the respondents, and procedure followed in conducting it have been explained in detail.

6.2 DESIGN OF QUESTIONNAIRE

Prior to designing the questionnaire, professional advice from the Department of Psychology and the Department of Applied Statistics at the Eastern Mediterranean University, as well as from a locally expert statistician (who is the director of one of the leading statistic and research company in North Cyprus) was obtained on the number and type of questions that could be reasonably handled by the participants.

In light of the obtained advices and with the intention of facilitating unbiased responses, rational questions were prepared so that the opinions of the community could be accurately assessed. Within this context, prepared questionnaire accommodated three different types of questions.

With the intention of measuring participants' attitudes and behaviours on the perceived daily nuisances of the on-going construction near their home, Likert-type scale has been used.

Additionally, as the residents' general perceptions and behaviours about the on-going construction was rather significant to identify which type of nuisances affect them most; Likert-type scaling helped to uncover their degrees of opinions.

Because observing the respondents' probable behavioural changes in their daily routine due to on-going construction was aimed in quantifying the social costs, open-ended questions, which provided more textual information, were used. With the help of open-ended questions better insight about the adverse impacts of the social costs has been obtained.

At some stages of the questionnaire, in order to get precise answers such as; whether the participants has been exposed to any behavioural change in their daily routine because of a specific nuisance or not, few polar questions (yes/no questions) have been used.

Eventually, prepared questionnaire was seeking to identify the adverse impacts of the building construction on the neighbouring community in residential areas with the intention of evaluating how much the nuisances of the community costs are. The questionnaire (a copy of it is enclosed in Appendix) is comprised of four parts (A, B, C, and D).

Last but not least, as formerly discussed in chapter 5, with the help of a fieldwork comprised of brainstorming sessions, author's observations and literature review, the social cost drivers which were asked to participants in the sense of nuisance criterions have been justified hence, robust grounding for the questionnaire has been formed.

6.2.1 Part A of the Questionnaire

It is widely discussed in literature that (Gilovich et al., 2002; Bazerman and Moore, 2008; Pronin, 2007) most of the time, individuals are not objective and precise at perceiving themselves, the circumstances they live in, and people around them due to the fact that, people's; beliefs, expectations and context, needs, motives and desires may lead their perceptions to be biased. Such biases will inevitably have an adverse impact on the quality of individuals' judgement, decision making, and will end up with misunderstanding and conflict. Additionally, probable biases of people prevent them from observing something objectively.

Considering the importance of perceived reality of participants in measuring the effects of ongoing construction in their house, neighbourhood and on the households, the questionnaire initiated with Part A, that was comprised of Likert-type scaling question targeting to measure participants' general perception about the on-going construction hence, objectivity of participants and reliability of the responds could be observed. Think of a scenario where your perceptions will be in accordance with your expectations, for instance;

You live in a neighbourhood where the majority of the youths are unemployed and looking for a job. Meanwhile there is an on-going huge supermarket construction in your area. After the construction finishes, company will be recruiting many full-time and part-time staff, and people who reside in the area are in the priority for recruitment or you are already recruited by this company. In this case, due to your expectations the way you perceive the nuisances arising due to on-going construction, compared to a person who lives in the same area and who is not going to be recruited by this company will be different.

Or, you are a conservative Christian and there is a mosque construction in your neighbourhood. Depending on your beliefs, the way you perceive the nuisances of mosque construction will be different compared to a conservative Muslim residing in the same area. This difference is the thin layer between objectivity and subjectivity.

Due to the nature of this study, contrary to previous researches, through this research quantification of the social costs needed to be corroborated and this was to be achieved by incorporating the actual people who reside near the construction area into the study. For that reason, to start the questionnaire by measuring the participants' general perception was thought to be the key for preventing the consideration of the respondents with bias as a part of this study during the analysis of the results. In this way, it is asserted that the objectivity of the study can be enhanced hence, more accurate and reliable quantification of the social costs could be accomplished.

Part A of the Questionnaire

This part of the questionnaire included one question, concerned with the general perceptions of the people about the on-going construction in their area with regards to the following criterions where each criterion concerns different parameters;

- i. **Economic activities in the area;** activities involved by neighbouring community in producing goods and services in an attempt to meet neighbourhood's supply and demands. i.e. grocery stores, butcher shops, coffee shops etc.*
- ii. **Landscaping standards;** changes in the neighbourhood such as replacing or removing; trash barrels, street furniture, street lights, phone boxes, street post boxes, street signboards, street flower pots etc.*
- iii. **Safety hazards in the area during construction;** these are the risks occurring due to construction in the area such as; the probability of enhanced accident risks caused by*

construction machineries being in neighbourhood traffic, spill of construction related material on the roads during transportation of materials into/out of the construction site, additional hazards that are possibly to occur during the actual construction which may result as injuries of the residents, construction wastes/residuals forming threats on the residents' health, possible crime incidents of construction workers, etc., traffic jam in the area and etc.

- iv. **Ambient conditions' standard in the area;** possible vicissitudes in the neighbourhood such as; uprooting or cutting of trees, serviceability standards of parks, increased population of the neighbourhood, peace and quietude of the area, construction waste and etc.*
- v. **Neighbourliness/human relations standard of the area;** possibility of someone from your family and/or someone you are familiar moving into your neighbourhood subsequent to completion of the project, or someone congenial moving into the area so possibility of enhancing the human relations hence, neighbourliness in the area.*
- vi. **Standard quality of life in the area;** during/after the construction, possibility of an increase or decrease on the general quality of the residents' life in the area in terms of health/wellbeing/personal care, formation of additional expenditures of the residents due to construction in the area, loss of productivity, possible variations in physical/psychological/spiritual being of the residents.*

It was agreed that the answers to this question depend on subjective criteria. However, it was found useful to improve the concentrations of the respondents into the subject to answer more objectively for the further questions.

Part B of the Questionnaire

This section seeks to identify the level of building construction causative nuisances on the residents. Part B is prepared to understand the level of disturbances of the residents in order to conclude whether the social cost exists in that case. The social cost drivers in the sense of nuisance criteria obtained via brainstorming sessions with professionals, observations, and self-experience, as it is explained in section 5.3.2 have been grouped into three categories as house, households, and neighbourhood.

Those criteria are asked for the consideration of the respondents through scale rating so, to what extent the on-going construction affected them could be measured. In this way, the

previously obtained criteria are re-evaluated by the respondents. This grouping of criteria is given by Table 6.1.

In this section of the questionnaire, nuisances that residents are exposed to in terms of themselves, their houses, and the neighbourhood they live in are examined by three different questions, B1, B2, and B3 as shown in the sample questionnaire form given in Appendix A. As each question focuses on different segmented unit, due to the assertion of the researcher in easing the quantification process. This statement is discussed more detailed in section 5.2.

Table 6-1 : Grouping of nuisance criteria

House	Households	Neighbourhood
Cleanliness of the walls of the house	Meeting daily necessities	Road safety standards of the neighbourhood
General cleanliness of the house	Maintaining their standard health/well-being/personal care	Road cleanliness of the neighbourhood
Cleanliness of the curtains	Time they use the outdoor areas of their house	Standard flow of traffic in the neighbourhood
Cleanliness of the windows		Standard cleanliness of the ambient/neighbourhood
Cleanliness of the car(s)		Preservation of the habitat/parks
Cleanliness of the house's yard		Finding a convenient car parking space in the area
		Serviceability standards of the playfields/parks/hiking trails
		Standard peace and quietude of the neighbourhood

In each question of part B respondents were asked to rate to what extent the on-going construction affected them in terms of the below given criteria;

Nuisance criteria concerning the house;

- *Cleanliness of the walls of the house; because of dust, dirt, debris and/or spillages of materials such as concrete from neighbouring construction site either the interior or exterior walls of the house may have required additional wiping, sweeping, brushing, dusting, vacuum cleaning. Additionally, if there was any wallpaper in the house they*

may attract a lot of dirt and dust because of the on-going construction's possibility of increasing the air pollution in the area, and may have required additional cleaning.

- **General cleanliness within the house;** on-going construction is likely to affect the state of the house in terms of being clean and free from dirt due to debris, dirt, and dust formation in the neighbourhood being above the standard during the construction. For that reason, process of achieving and maintaining the cleanliness standard of the house may have required extra cleaning than usual.
- **Cleanliness of the curtains and blinds;** construction activities causative dust, dirt, and/or spillages may lead to additional cleaning of the curtains and blinds in order to maintain standard cleanliness.
- **Cleanliness of the windows;** this criterion has concerned the possibility of decrease in the cleanliness standard of windows due to construction activities causative dust, dirt, and/or spillages.
- **Cleanliness of the car(s);** For the houses that do not have a closed car park space/garage, construction activities causative dust, dirt, and/or spillages may lead to additional cleaning of the cars in order to maintain the standard cleanliness. Additionally, while the residents drive by the construction site or within the neighbourhood, this could also affect the cleanliness standard of their car.
- **Cleanliness of the house's yard;** because of the construction activities related dust, dirt, debris and/or spillages of materials, cleaning standards of the house yards might have decreased.

Nuisance criteria concerning the households;

- **Meeting daily necessities;** concerns of this criterion has been explained above.
- **Maintaining your standard health/wellbeing/personal care;** Because of the climate being hot, in North Cyprus it is quiet usual that people takes a siesta to rest especially in summers. Considering the possibility of nuisances occurring in the neighbourhood such as noise pollution residents might have altered their daily routine in terms of the hours they rest during the day. These sleep disturbances and excessive noise in the area may lead to tiredness, not feeling well, hypertension, emotional disturbances, abnormal behaviour and etc. hence, the standard of residents' health and wellbeing

might get affected. On the other hand, due to construction activities related pollution such as dust, dirt, debris and/or spillages of materials, residents' standard of personal care such as their hair care, make-up, skin care, polish of their shoes and etc. might get affected.

- **The time that residents use the outdoor areas of their house;** as the weather is normally hot in North Cyprus especially in summer, most of the time people sit at the balcony, terrace and/or in the yard in order to maintain their comfort in the sense of freshening up/air temperature. Due to construction activities related environmental pollution such as; noise, dust, dirt, debris and/or spillages of materials the time they use the outdoor areas of their house might be restricted.

Nuisance criteria concerning the neighbourhood;

- **Road safety standards in the neighbourhood/area;** the probability of enhanced accident risks due to construction machineries circulating in the neighbourhood/area, spillage of construction materials on the roads during transportation of materials into/out of the construction site, other construction wastes/residuals and etc. may cause traffic congestion, closure of the road, and detours due to probable lessened road safety standards. On the other hand, excess traffic on minor residential area roads may reduce the safety standards of the roads.
- **Road cleanliness standards in the neighbourhood/area;** the cleanliness of the roads in the area may get affected because of the on-going construction in the area. Probable spillage of construction materials on the roads during transportation to construction site can be considered as one of the driver for this criterion. Construction related wastes, additional dust formation in the area, construction wastes/residual and demerits alike are considered to be prospective road cleanliness standard lessening factors.
- **Standard flow of traffic in the neighbourhood;** due to the construction related activities in the neighbourhood such as utilisation of mobilised crane, the routine traffic flow of the neighbourhood may get affected. Detours, prolonged closures of the road, traffic congestions have been considered as the possible drivers of this criterion.

- ***Preservation of habitats/parks;*** in order to prevent fragmentation, lessening and/or loss in the existing parks and habitat in the area/neighbourhood, land management concerning habitat conservation is necessary for the construction projects. However, due to probable deficiencies of the contractor in land management, habitats/parks of the area may be damaged.
- ***Finding a convenient car parking space in the neighbourhood/area;*** due to closure of some roads or excess traffic in the neighbourhood residents may have either difficulty or no chance in finding a convenient on street car parking space in their area.
- ***Serviceability standards of playfields/hiking trails/parks;*** due to formation of various nuisances because of the on-going construction activities in the neighbourhood, access to some of the recreation facilities in the area maybe temporarily unavailable or serviceability standards of those facilities may decrease.
- ***Standard peace and quietude of the neighbourhood;*** due to construction causative additive noise in the area, excess traffic flow in the minor roads of the residential area and factors alike, standard peace and quietude of the area may decrease.

Part C of the Questionnaire

In this part of the questionnaire, with the intention of enumerating the probable alterations in the daily routine of the residents due to on-going construction in their area, participants are asked with aforementioned nuisance criterions where each criterion was considered to be a consequence of a social cost type. There are six questions in Part C.

In question 1 of part C, alterations in the daily routine of the residents because of various nuisance criterions that concerned ‘the house of the residents’ were given to respondents and they are asked to write if they had any behavioural change.

They are asked to write for each criterion in what frequency they were undertaking cleaning before and during the construction.

Respondents are also asked to remark for each criterion, how much time is needed to undertake the cleaning so that the calculation of the social costs can be performed. Monetisation of each nuisance set; house, households and neighbourhood, depending on the

alterations in the daily routine of the participants has been performed. This is discussed in detail in chapter 8.

For instance, if before the construction general cleanliness of the house is being performed for 2 days in a month, and if during the construction this frequency is increased to 4 days in a month, the cost of additional 2 days of cleaning will be evaluated and identified as one of the social cost elements of the people due to construction causative exposed adverse impact on the house.

In question 2 of part C, pre-identified nuisance criterion in the households set, alterations in meeting the daily necessities of the households due to being exposed to ongoing construction is questioned. If there have not been any alterations in their daily routine, they were asked to proceed for the next question.

If they had any alterations, they were asked to identify the additional distance travelled by them in order to maintain their daily necessities. In addition, for the respondents who had alterations in their daily routine in meeting their daily necessities, they were asked to respond in what frequency they have performed the alteration.

For instance, households initiated to go to a market which is 400 meters away to do their grocery shopping due to the fact that hawkers are no longer visiting the area due to ongoing construction. Additionally, assuming that in the frequency they go to the market is 2 times a day. This will prompt an additional cost for the 1,600 meter of distance travelled each day.

In question 3 of part C, pre-identified nuisance criterion in the households set, alterations in going to a doctor or a specialist more often than they used to go in order to maintain their standard health/well-being/personal care is questioned. If they have started to go more often, from the obtained number a platform is formed in order to quantify the additional cost of ongoing construction on people for this nuisance criterion.

In question 4 of part C, participants were asked if the time they use the outdoor areas of their house has been altered due to the on-going construction. For the ones who had alteration in their daily routine of using the outdoor areas of their houses in order to maintain their comfort in the sense of freshening and air temperature, the additional hours of air-conditioning usage is questioned.

For instance, if due to on-going construction and reduction in the possibility of using the outdoor areas of their houses, households started to use additional 2 hours of air-conditioning, from the cost of additional air-conditioning usage the cost of this specific nuisance criterion is

to be evaluated. As this is the method set in monetising this nuisance criterion, participants who select the option that they do not have any air-conditioning in their houses will be exempt from the monetisation process.

In question 5 of part C, pre-defined nuisance criteria for the neighbourhood are asked to the participants to attain the enumeration of the alterations in their daily routine. As a consequence of each perceived nuisance, participants were asked the additional distance travelled by them in meters/day and the frequency of doing the task hence, the obtained numbers can lead to monetisation of the neighbourhood based cost occurrence for the third parties.

For instance, if a person is travelling additional on average 200 meters a day in order to find a convenient car parking space, from the additionally travelled distance the cost of this nuisance criterion for the third parties is evaluated.

In question 6 of part C; participants were asked to mention any other nuisance perceived by them but that has not been asked in the questionnaire. In this way it is expected to factor in the any overlooked nuisance criterion occurring due to the on-going construction in the area.

Part D of the Questionnaire

This part of the questionnaire is comprised of the demographic questions in order to reflect the characteristics of the participants which took place in this study. In three different questions, they were asked to state their gender, age, and literacy level. This section of the questionnaire is used to examine the demographic structure in order to determine the homogeneity of the respondents.

6.3 SAMPLING

In researches where public opinion is essential, it is frequently impractical and not possible to examine the whole population. For that reason, it is necessary to investigate a representative number of people so that a consideration of what most people think can be made. In other words, general findings concerning the public opinions need to be made through an examination of only samples (Li, 1998). This motivates the need of preparing very comprehensible, neat and organised questionnaire for the participants.

Therefore, in order to ensure that the designed questionnaire is practical for the targeted population in this perspective, a pilot study is conducted with randomly selected 10 residents

living near to building construction sites in Kyrenia. During the pilot study the previously prepared questionnaire questions were asked. Some of them pointed out the two questions difficult to understand and these questions were reworded. These alterations were comprised of particular phrases used in the questionnaire with the intention of avoiding ambiguity hence, escalate clarity of the questions.

Referring to the discussions in section 5.3, author took notice of previous studies and decided to narrow down the samples by integrating people who reside within 150 m of a construction site for this specific study.

Last but not least, it was a must for the participants of the questionnaire to be at 18 years of age or over and permanently living at the visited address. This was due to fact that, participants' mindfulness needed to be well enough so that they can give out reliable responses on behalf of the other households when needed. For example, if a teen living with his/her parents opens the door, he/she should be able to answer how many times their parents take the car into a carwash in a month.

Subsequent to the pilot study in three major cities of north Cyprus namely, Famagusta, Nicosia, and Kyrenia 4 building construction sites were selected from each of them. While selecting those construction sites the attention paid so that, there are more residents within 150m of them. Having fixed the sites, the residents that are eligible to participate in this principal study, the abovementioned questionnaire is performed with a total of 266 respondents in July 2012.

- I. **Famagusta;** it is known as the student city of north Cyprus because about 30% of the population is composed of students. It is one of the fastest developing cities due to continuing needs for residential/commercial buildings. In the beginning, in various residential areas/neighbourhoods of this city, 4 different on-going construction sites have been selected. Afterwards, for each construction site, about 21 people residing within 150 m of the construction site was participated. Total number of participants for this study in Famagusta was 83.
- II. **Kyrenia;** it is known as the tourism city of north Cyprus. It has many hotels and crowded residential areas (many people have summer houses in this city). Like the other cities of north Cyprus it is still a developing city. Many hotels, residential and commercial building construction are in progress. Just as the participants of Famagusta, within 150 m of each of 4 construction sites, about 21 different people

participated into the questionnaire. Total number of participants for this study in Kyrenia was 82.

III. Nicosia; it is the capital city in north Cyprus. It is known as the civil servant city and it is very crowded both in terms of the population and the residential areas. There are many ongoing constructions in Nicosia. Again four construction sites in residential areas of the most populated neighbourhoods have been selected for this city. Roughly about 25 people residing within 150m of each of 4 construction sites participated in to questionnaire. Total number of participants for this study in Nicosia was 101.

In order to reach as high response rate as possible, the author collaborated with one of the leading polling companies in north Cyprus. By supplying 10 pollsters at each city to undertake door to door questionnaire on behalf of the researcher was a factor that minimised the effect of time constraint.

For each city, pollsters have been given a map that was beforehand prepared by the author indicating which neighbourhoods/streets they should go and look for participants. Prior to undertaking the questionnaire, author has given a 30 minutes presentation to the pollsters and explained to them how to deal with the possible questions of the participants, and with whom to conduct the study. For instance, pollsters have been informed that the participants must be a person who is 18 years of age or above hence, is aware of the daily behaviours of the rest of the house members.

It was highlighted to the pollsters that, participants' gender, ethnicity, profession and/or health condition is not important in terms of the inclusion/exclusion criteria. Within the specified criteria, by door to door visits, pollsters conducted the filling out of the questionnaire forms. Pollsters have initially provided the participants with the invitation letter given in Appendix B, and then they were asked to read and sign the participant consent (attached in Appendix C) form if they agree to attend to this study.

Pollsters have read out the questions to the participants in order to lessen the duration of the questionnaire so that the participants do not get bored hence, their responses do not get affected or questions are not left blank. Each questionnaire has lasted for about 30 minutes.

6.4 VOLUNTARY NATURE OF THE STUDY / CONFIDENTIALITY OF THE QUESTIONNAIRE

First of all, through the participant invitation letter and the participant consent forms, respondents have been informed that this questionnaire is entirely voluntary and they may refuse to complete the study at any point during the questionnaire and/or refuse to answer any questions that they may feel uncomfortable to share. They were also notified that they can stop at any time and ask the pollster any question they may have.

As stated by Goddard and Melville (2004), respondents have a right to privacy and the responses given by them should not be identifiable by others. Within this context, participants have been told that their names will never be connected to their responses; instead, a number will be used for identification purposes. In addition, participants' information that would make it possible to identify them will never be included in any sort of report. The participants have been made aware that the data collected from them will be accessible only to those working on the project (researcher and supervisor) and it will not be shared with any other organisation or individual.

CHAPTER 7: ANALYSES AND DISCUSSIONS OF THE QUESTIONNAIRE RESULTS

7.1 INTRODUCTION

It is discussed in chapter 6 that, with the intention of monetising the building construction causative social costs those third parties are inevitably being exposed to, a questionnaire has been conducted. With the help of the performed questionnaire, prospective behavioural alterations in the daily routines of the people due to being exposed to adverse impacts of the on-going building constructions in their neighbourhoods is measured.

Obtained data from the questionnaire is inserted into the social cost quantification equations given in generic framework to estimate the social costs associated with building construction projects as depicted in Figure 5.5 in order to monetise the total social costs perceived by the third parties. This process is explained further in chapter 8.

The importance of how the measurements are classified should not be underestimated due to the fact that, the way that measurements are classified has an impact on the type of numerical analysis that a researcher can accomplish.

According to Stevens (1946), level of measurements are comprised of four different categories namely; nominal, ordinal, interval, and ratio measurements. Nominal measurements reveal the qualitative variances instead of the quantitative ones. Nominal measurements are the obtained responses that cannot be listed as an element of more than one category.

Obtained data from part C & D of the conducted questionnaire fell into nominal measurement category. With the help of ordinal measurements collected data can be ranked, rated or ordered so that researchers can interpret that one value is greater or lesser than the other value even if no information exists about how in part A, and part B gave out data which fell into ordinal measurement category. Throughout the questionnaire, part C also accommodated variables that fell into ratio measurement category. In this category variables are comprised of ordered intervals where the measurement scales of them are of equal length and potential absolute zero value also exists (Fife-Schaw, 2006).

In this chapter, relevant analyses conducted for this research and the results are discussed in four sections just as it is formed in the questionnaire. In order to examine the appropriateness of the collected data in terms of the heterogeneity of the respondents, analyses initiated with the data related to demographic structure of the participants.

7.2 DEMOGRAPHIC STRUCTURE OF THE RESPONDENTS (PART D)

In order to determine the demographic structure of the respondents, a section which consists of three questions is inserted into the questionnaire. The questions are composed of the gender, age group and level of education of the respondents, respectively.

The demographic structure is examined in order to determine the heterogeneity of the respondents. A community is formed by different groups who have different views and perspectives about life, therefore their reactions can be different at the same situation, in other words, with the intention of quantifying the social costs precisely, the views of all groups are considered. Consequently, in this study, more heterogeneity in the sample is tried to be obtained in order to capture the different perspectives from different groups. Figure 7.1 shows the demographic structure of 266 respondents in three cities based on their gender. According to this figure, 52.26% of the respondents were man, and 47.74% of the respondents were woman, therefore it can be said that the views of both genders about the social costs are taken into account in this study. Six different age groups shown in figure 7.2 are determined and according to the distribution of these age groups, it can be said that the views of different age groups are captured. Lastly, the level of education of the respondents is examined in figure 7.3. The level of education is considered in 8 categories, namely; I am Literate, Primary School, Secondary School, High School, 2 Year College, 4 Year College, Master and Doctorate levels. Although majority of the respondents' education level fell into high school category (34.59%), it can be said that the other views from different education levels are also involved in this study. For that reason, these figures indicate that this study reveals the different views from different demographical backgrounds.

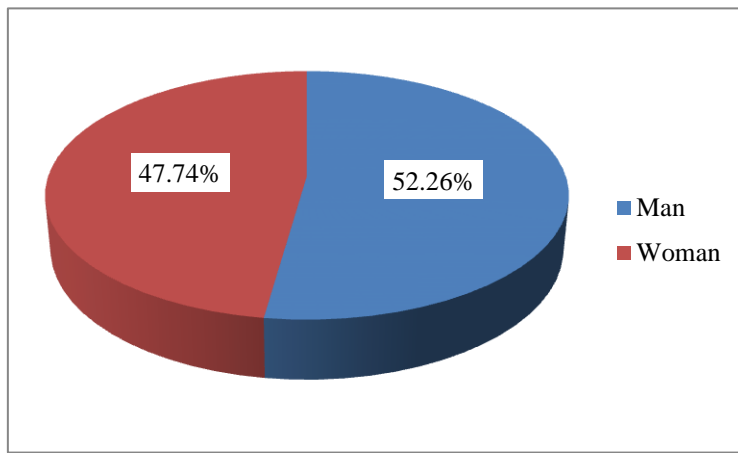


Figure 7-1: The distribution of 266 respondents based on their gender

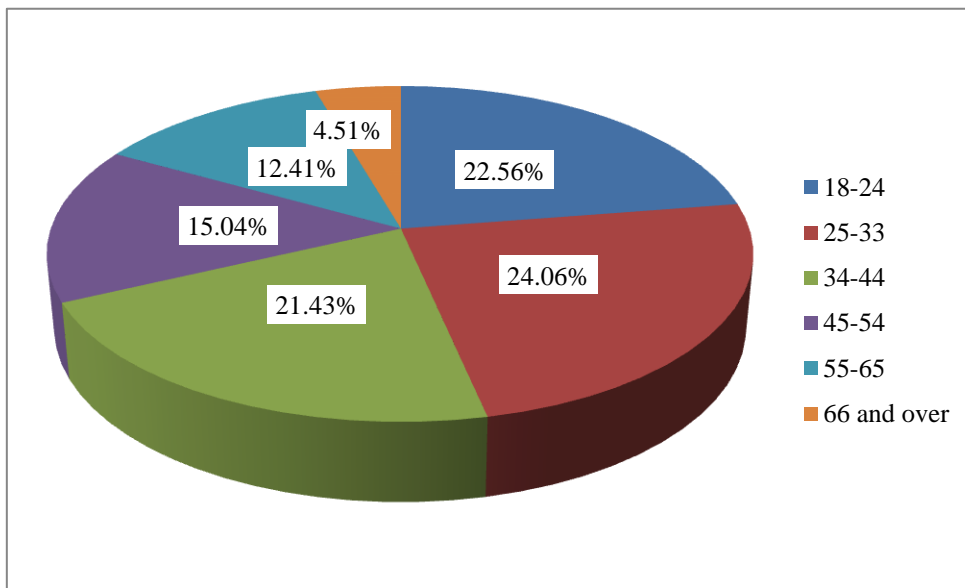


Figure 7-2: The distribution of 266 respondents based on age groups

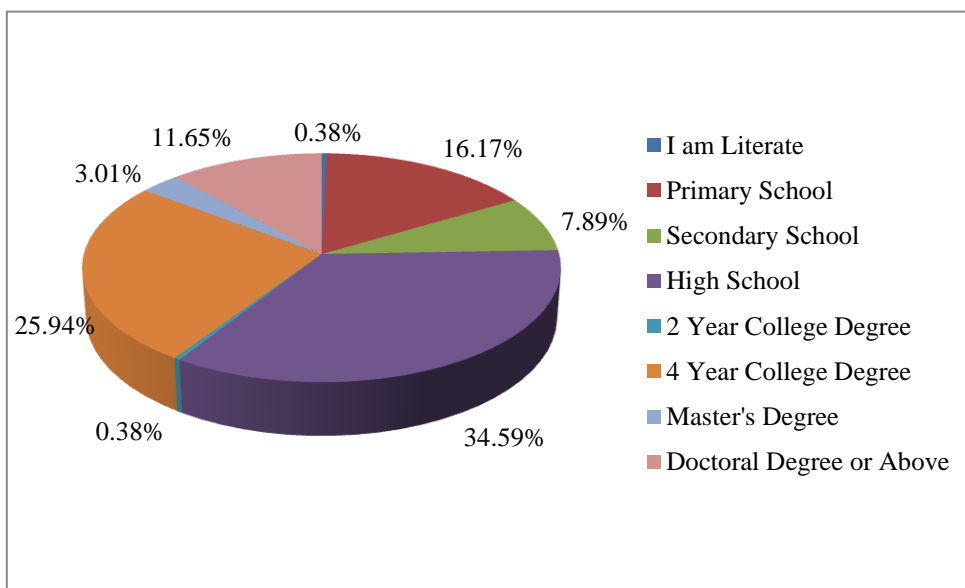


Figure 7-3: Distribution of 266 respondents based on the level of education

7.3 GENERAL PERCEPTIONS OF THE RESIDENTS ABOUT THE ON-GOING CONSTRUCTION (PART A)

The part of the results is related to the general perceptions of residents, who reside near a construction site about the on-going construction in north Cyprus. The question in this section is about how the on-going construction projects affect the life in the area. This question is also aimed to concentrate the respondents to the subject to answer the further questions.

Six criteria are determined in this question, namely economic activities in the area, landscaping standards, safety hazards in the area during construction, ambient conditions' standard in the area, neighbourliness/ human relations standards of the area, standard quality of life in the area.

The respondents evaluated these criteria based on Likert scale, according to this scale; 0, 5 and 10 indicate very unfavourable, neither unfavourable nor favourable and very favourable, respectively. Firstly, Cronbach's alpha reliability analysis is performed for determining the reliability and internal consistency of the data related to this section. The Cronbach's alpha is calculated as 0.877 for the question, which is higher than the threshold value (0.7) recommended by Nunnally (1978).

However, Hair et al (2006) recommended that the data set whose Cronbach's alpha is higher than 0.6 can also be considered as reliable. Then, a descriptive analysis is performed by using SPSS Statistics 20, in the descriptive analysis, mean value, standard error of mean, median, mode and standard deviation of the criteria in accordance with the responses of the participants are calculated. The obtained results are tabulated in table 7.1.

According to this table, 'the standard of ambient conditions' is affected mostly in an adverse manner among all criteria according to the respondents. This finding is also verified by the median (2.00) and mode (0.00) of this criterion. They also consider that an on-going construction enhances the safety hazards in the area. This may be due to the reason that increased traffic in the area, possibility of construction materials' spillage into the area may lead them to think in this way.

On the other hand, they consider that the economic activities are not affected by an on-going construction. This can be explained by the target population. This research is conducted by considering the people, who are residing in a residential area and not performing any economic activity, therefore the effect of the construction on the economic activities in that area performed by the respondents can be very limited. This statement can also be supported

by the fact that, in north Cyprus, there are not many businesses such as; markets, cafes, butchers etc. within the residential areas but they are gathered mainly in specific market places. Also, they consider that the on-going construction is not likely to have an impact on their neighbourliness and relationships between their neighbours.

Table 7-1: Descriptive statistics of criteria of standards

Nuisance Criterion	Mean	Std. Error of Mean	Median	Mode	Std. Deviation
Economic activities in the area	4.99	0.210	5.00	5.00	3.424
Landscaping standards	3.26	0.206	2.00	0.00	3.363
Safety hazards in the area during construction	3.26	0.206	2.00	0.00	3.360
Ambient conditions' standard in the area	2.67	0.189	2.00	0.00	3.078
Neighbourliness/human relations standard of the area	4.48	0.202	5.00	5.00	3.287
Standard quality of life in the area	4.00	0.214	4.00	0.00	3.493

Overall, as it is shown by the table 7.1, the residents' perceptions about the on-going construction in their area are far from perceiving it favourably. It is clearly shown that for each nuisance criterion, obtained mean values concerning residents exposure to adverse impacts of the on-going construction is between getting affected unfavourably and neither unfavourable nor favourable.

On the other hand, it is clear that standard deviation factor obtained from the responses is slightly high indicating for instance, while some people get very favourably affected from landscaping standards contrary to this view, some people may get very unfavourably affected. In spite of the split in participants' opinion about a certain criterion, averagely they are all close to being unfavourably affected.

7.4 IDENTIFYING THE ADVERSE IMPACTS OF ON-GOING CONSTRUCTION ON HOUSE, HOUSEHOLDS AND NEIGHBOURHOOD (PART B)

In this section, to what extent the adverse impacts occurring due to execution of construction activities in the neighbourhood affects third parties' houses, households and neighbourhoods is measured. The results of this section will be used to justify the existence of the social costs caused by building constructions in those areas.

The variations between these criteria before the construction and those during the construction can create nuisances leading to occurrence of the social costs for the house owners, since they have to spend money to eliminate the effects of the construction on these criteria.

10 point Likert scale is used in evaluation of these criteria. 0, 5 and 10 indicate “none”, “moderate” and “very high”, in other words if the respondent considers that the on-going construction affects their house in terms of any criterion intensively, they will assign this criterion with high value.

Firstly, the reliability of the data set is determined by conducting a Cronbach’s alpha reliability test, and the data set is determined as reliable since Cronbach’s alpha is calculated to be 0.888. Secondly, a descriptive analysis is performed and the results of this analysis are tabulated in table 7.2. In addition, the mean effects of the on-going construction on these criteria are illustrated in figure 7.4 **Error! Reference source not found.** According to table 7.2, a construction has high impact on the cleanliness of the house, since all variables have means higher than 5, in addition the modes of all variables are determined as 10 which means that most of the respondents think that the effect of on-going construction on the house is very high. This shows that the determined criteria are important factors which lead to occurrence of the social costs. Especially, the respondents state that an on-going construction causes to soil the windows of their house, in other words cleanliness of the windows is considered as an important constituent of the social costs. This is an expected result, since the outside of the house is confronted with the pollution created by the construction, such as dust, dirt and etc., more than the other parts of the house.

Table 7-2: Descriptive analysis of the adverse impacts of on-going construction on the six criteria of house. **Error! Reference source not found.**

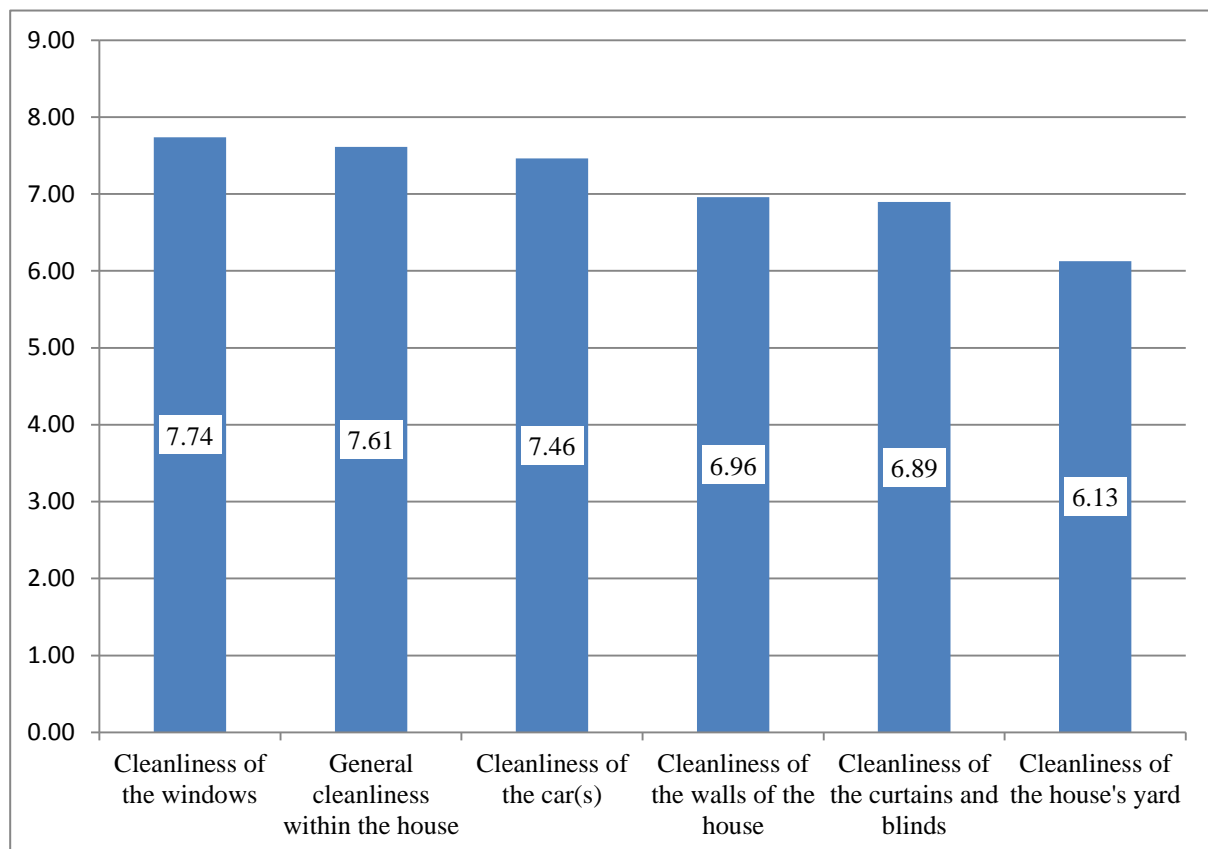


Figure 7-4: Mean values of the adverse impacts of on-going construction on the six nuisance criteria of the house

In the second question, the effects of on-going construction on the households are evaluated. As mentioned before, three criteria are determined for identifying the adverse impacts created by the on-going construction on the households.

10 point Likert scale similar to the used method for identifying the adverse impacts of on-going construction on house is used in this question.

Firstly, the reliability of the data set related to this question obtained at the end of questionnaire study is checked by using Cronbach's Alpha reliability test. The Cronbach's Alpha is calculated as 0.615. This value is still higher than the recommended value of Hair et al (2006) to consider the data as reliable. The descriptive analysis performed for this question is shown in Table 7.3. In addition; the means of adverse impacts of on-going construction on each criterion of the households are shown in Figure 7.5. According to this figure, the respondents have different opinions on the impacts of the on-going construction for each criterion, namely, although the respondents consider that the adverse impacts of the on-going

construction in terms of the time they spend in the outdoor areas of their house is very high, those on maintaining their standard health/ well-being/personal care is close to “none”.

In addition to these, according to mode of these criterions, most of the respondents consider that the adverse impacts of the on-going construction in terms of meeting their daily necessities and maintaining their standard health/well-being/personal care as “none”. On the other hand, they consider that the adverse impacts of the on-going construction on the time they spend in the outdoor areas of their house are very high. In order to examine the differences among the perceived adverse impacts by the residents due to on-going construction, figure 7.6 is prepared that illustrates the percentage of the adverse impacts of on-going construction for each criterion is formed.

As aforementioned, spending time at the balcony, terrace and/or in the yard of the house is an important part of the culture of Turkish Cypriots, therefore, the respondents can be affected in terms of this criterion due to the nuisances created by the construction intensively. Moreover, the adverse impacts of the construction related to this criterion can be observed easily, however perceiving the other effects of the construction concerning the standard health/ well-being/personal care of the residents can be understood later in long period.

Table 7-3: Descriptive analysis of the adverse impacts of on-going construction on the three criterions of households

Nuisance Criterion (Households)	Mean	Std. Error of Mean	Median	Mode	Std. Deviation
Meeting your daily necessities	3.82	0.257	2.00	0	4.198
Maintaining your standard health/ well-being/personal care	2.472	0.216	0.00	0	3.520
The time you use the outdoor areas of your house	6.30	0.248	8.00	10	4.043

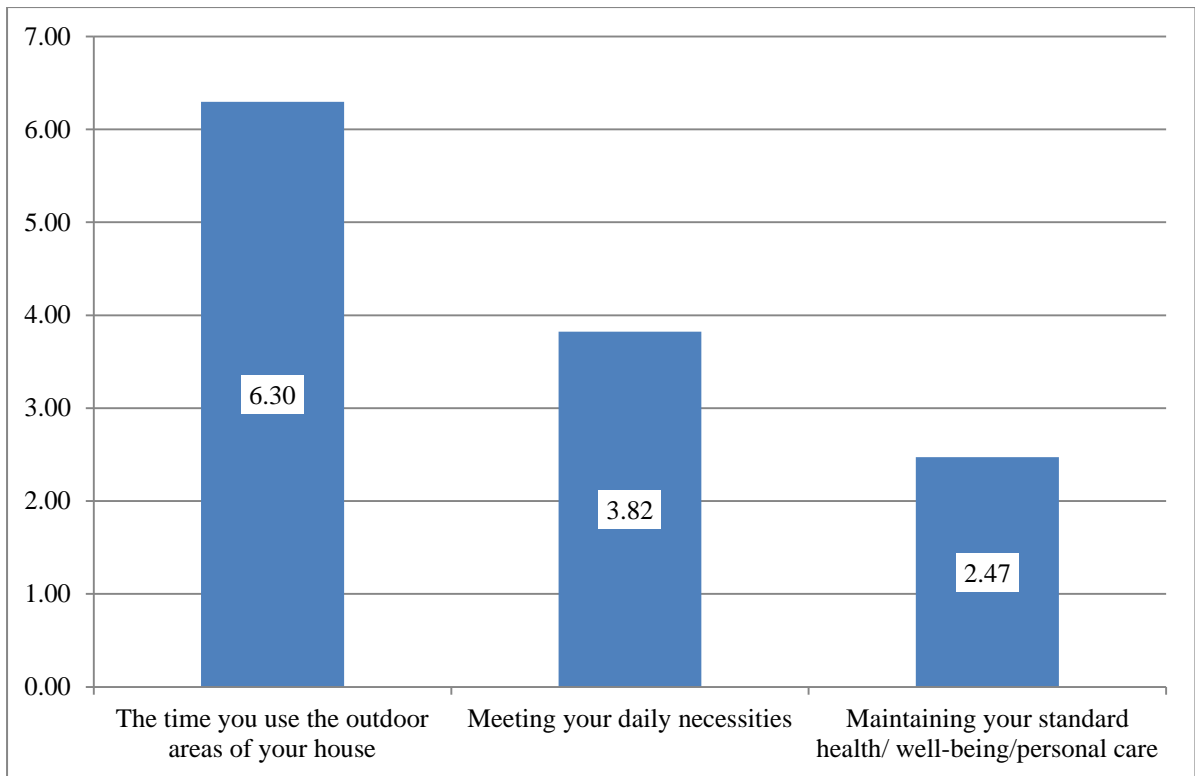


Figure 7-5: Means of the adverse impacts of on-going construction on the three nuisance criteria of the households

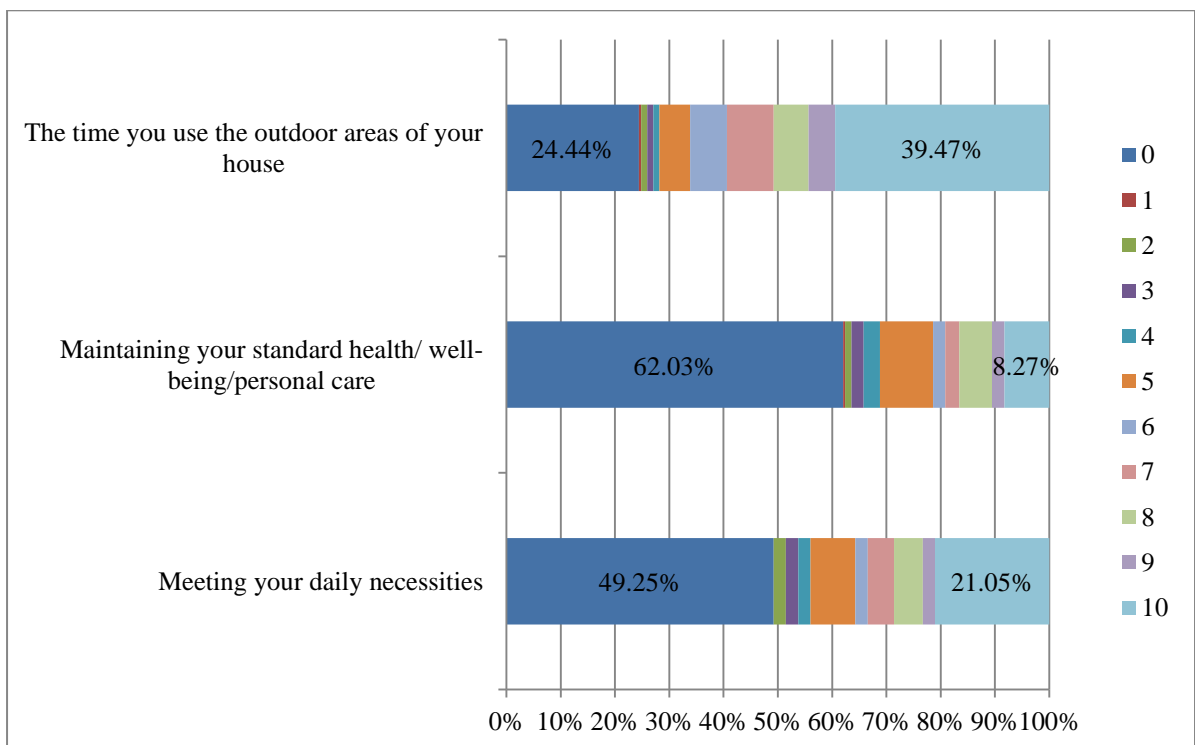


Figure 7-6: Percentage of the adverse impacts of the on-going construction on each nuisance criterion related to households depending on the exposed

Lastly, the adverse impacts of the on-going construction on neighbourhood are examined. For this purpose, 8 criteria are considered by the respondents. They evaluated these criteria based on 10 point Likert scale. The reliability analysis is performed, and Cronbach's alpha is calculated as 0.879.

Therefore, the data set can be considered as reliable and internally consistent. After that, a descriptive analysis shown in

is prepared. According to this table, the on-going construction creates adverse impacts on the neighbourhood in terms of all the criteria. Except from finding a convenient car parking space and serviceability standards of playfields/hiking trails/ parks, the median of all criteria are higher than 7.

In other words, all of these criteria are important and they should be considered in calculation of the social costs occurring because of a construction. However, some of the criteria are determined as more effective on the neighbourhood than other criteria. For instance, the respondents consider that the on-going construction affects the standard peace and quietness of the neighbourhood very intensively. The on-going construction seems to affect the general cleanliness of the neighbourhood extensively.

On the other hand, the respondents think that the adverse impacts of the on-going construction in terms of finding a convenient car parking space in the neighbourhood is less important compared to the other nuisance criteria as it is shown in Table 7.4.

Table 7-4 : Descriptive analysis of the adverse impacts of on-going construction on the eight criteria of neighbourhood

Nuisance Criterion (Neighbourhood)	Mean	Std. Error of Mean	Median	Mode	Std. Deviation
Road safety standards in the neighbourhood/area	6.19	.241	8.00	10	3.923
Road cleanliness standards in the neighbourhood/area	6.73	.225	8.00	10	3.677
Standard flow of traffic in the neighbourhood/area	5.70	.251	7.00	10	4.087
Standard cleanliness of the ambient/neighbourhood	7.08	.225	9.00	10	3.665
Preservation of the habitat/parks	6.95	.234	9.00	10	3.818

Finding a convenient car parking space in the neighbourhood/area	4.53	.270	4.00	0	4.403
Serviceability standards of playfields/hiking trails/ parks	4.92	.261	5.00	0	4.252
Standard peace and quietude of the neighbourhood	7.71	.207	10.00	10	3.373

The basic aim of this section of the questionnaire is to obtain a clue for the existence of the social costs in that region. It is obtained from tables 7.2, 7.3, and 7.4 that, the respondents' complains about the nuisance criteria for house, household and neighbourhood at a ratio equal to, for house 7.13/10, for households 4.2/10 and for neighbourhood 6.63/10. This proves that the respondents have strong considerations of the existence of the building construction caused social costs in those north Cyprus cities.

7.5 ENUMERATION OF THE CONSTRUCTION ACTIVITIES BASED ADVERSE IMPACTS UPON THIRD PARTIES (PART C)

With the intention of performing the enumeration of the construction activities causative adverse impacts upon third parties, Part C is included into the questionnaire. Part C is composed of 5 questions. In the first question criterions determined about house have been concerned.

House

In this question, the respondents were asked whether there have been any alterations in their daily routine in terms of the six criterions concerning their house. They have answered "yes", if there have been any alterations in their daily routine depending on the experience they have obtained so far, and they have replied to the asked criterions as "no" if there have been no alterations. 7 indicates the percentage of the respondents on the basis of the "yes" and "no" answers given for each nuisance criterion.

As depicted by Figure 7.7, most of the respondents have considered that the on-going construction in their neighbourhood has increased the frequency of cleaning they perform within the house compared to the frequency of cleaning they used to perform before the start of the construction.

Particularly, most of the respondents think that the general cleanliness of their house (78.3%) and general cleanliness of the windows of the house (74.4%) are adversely affected due to the on-going construction in their neighbourhood. In addition to these, the respondents were asked to provide the number of days they perform each cleaning task before and during the construction.

For instance, before the construction a person has been cleaning the windows 4 times in a month, but during the construction same person started to clean it 7 times in a month in order to maintain his/her standard cleanliness of the windows. The mean values of the days which the respondents spend to perform the standard cleanliness of each item is tabulated by Table 7.5. It is indicated in this table that, there have been an increase in terms of the days residents spent to maintain the standard cleanliness within the house.

In addition, participants have been asked to state what the required time is to reinstate their standard cleanliness for each criterion. The mean values of the required time to maintain the standard cleanliness for each criterion are also illustrated by Table 7.5. With the intention of examining the differences in daily routine of the residents in terms of the days (per month) they have been performing cleaning before and during the construction significantly, ANOVA is conducted. F-values and significance level of these nuisance criteria are given by Table 7.6. Since, the significance level of each criterion is less than 0.001; this has significantly certified that there were distinct alterations in daily routine of the residents in terms of the number of cleanings they perform before and during the construction.

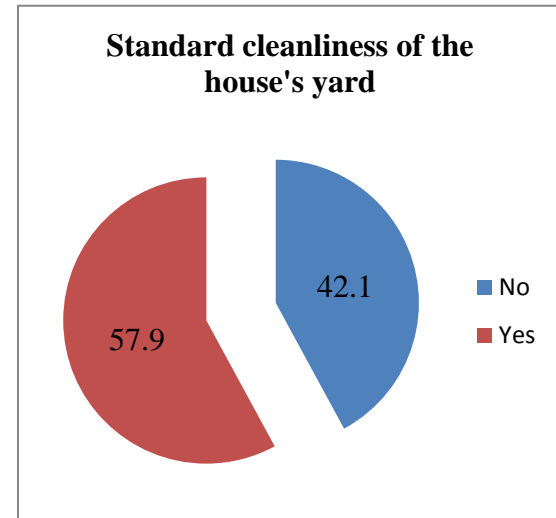
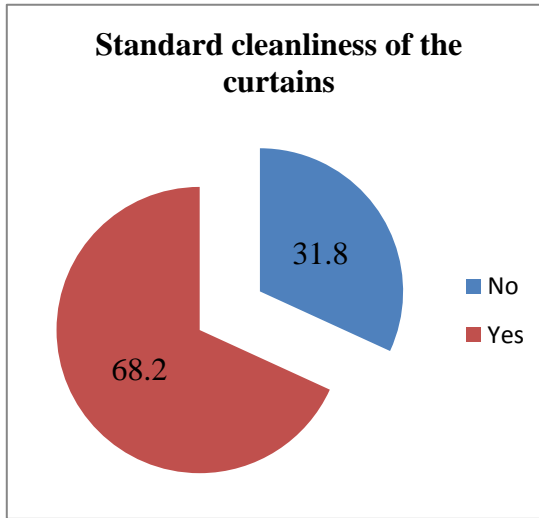
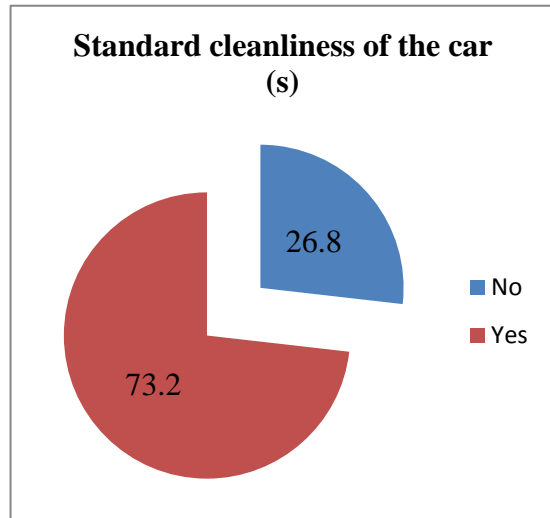
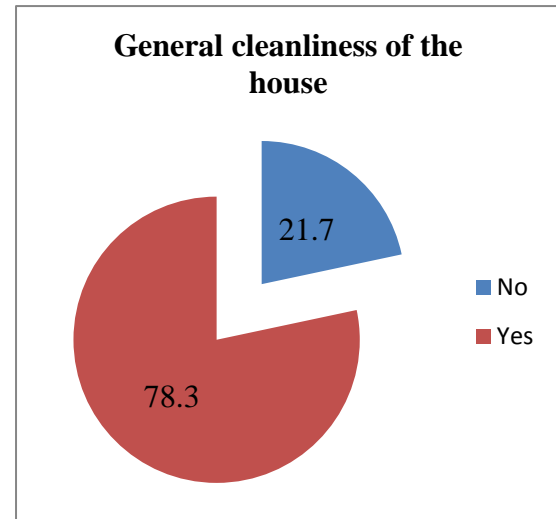
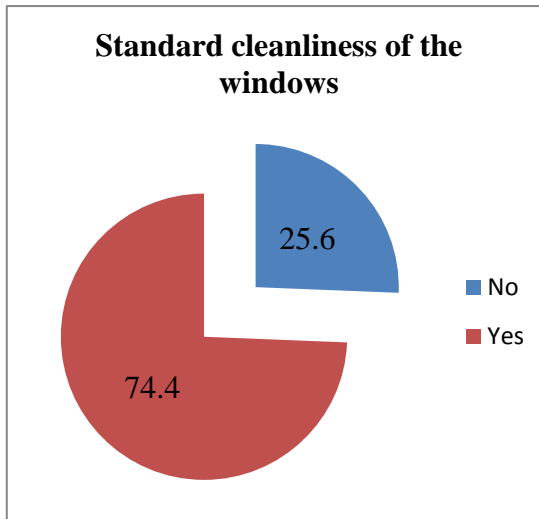
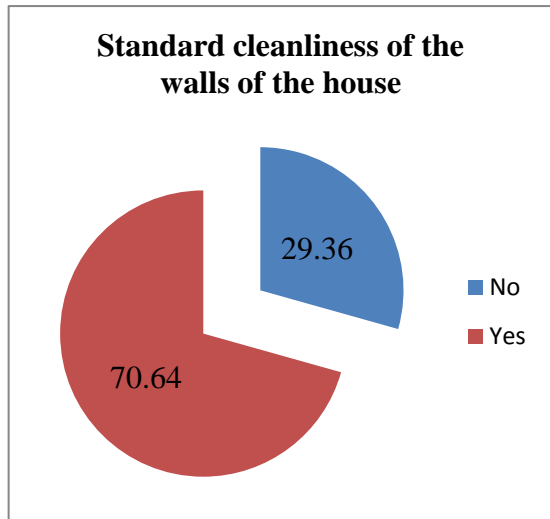


Figure 7-7: Residents who have altered their daily routine due to perceived nuisances for their house

Table 7-5 : The mean values of hours spending for each criterion

Nuisance Criterion (House)	Before the construction	Throughout the construction	Time required to undertake each criterion (minutes)
Standard cleanliness of the walls of the house	9.37	12.76	67.2
General cleanliness of the house	8.95	14.55	60
Standard cleanliness of the curtains	2.75	5.42	156
Standard cleanliness of the windows	5.56	9.21	80
Standard cleanliness of the car (s)	3.75	5.46	*
Standard cleanliness of the house's yard	17.33	22.11	22

* There is a specific cost per car wash. For that reason, required time to perform the car wash has not been asked to the participants.

Table 7-6 : ANOVA between Values of Parameters before and throughout Construction

Nuisance Criterion (House)	F Value	Significance Level
Standard cleanliness of the walls of the house	79.766	0
General cleanliness of the house	15.562	0
Standard cleanliness of the curtains	508.113	0
Standard cleanliness of the windows	1532.788	0
Standard cleanliness of the car (s)	189.539	0
Standard cleanliness of the house's yard	1433.667	0

Households

Since different parameters have been used in order to enumerate the criteria of the households, each nuisance criterion of this category has been examined under different questions. For that reason, three different questions were added into the questionnaire to investigate each nuisance criterion individually. The second question consists of three parts,

and these parts are used to enumerate the adverse impacts of the on-going construction on the households in meeting their daily necessities. In this question, firstly the respondents are asked whether they have altered their daily routine in terms of meeting their daily necessities.

The percentages of the responses are illustrated in Figure 7.8. As it is depicted by this figure, more than half of the respondents (56.7%) have altered their daily routines in terms of meeting their daily necessities.

Moreover, the respondents who have stated that there have been alterations in their daily routines due to the on-going construction in the neighbourhood are asked to indicate the additional distance which they have been travelling to reinstate their daily routines. They have written this additional distance travelled by them in terms of meters per day on average.

The mean value of the additional distance travelled by the respondents is determined as 500 m. For this case, with the intention of finding the middle number of a set of collected data hence, minimising the effect of the outliers, median values are used. For instance, a person may be living 200 meter away from a market where another person might be living 3,000 meters away. In calculating the additional distance travelled by the residents in order to meet their daily necessities, adopting mean values might have decreased the consistency of the quantification process.

In addition, the respondents who have answered the second question are also asked to state in what frequency they have performed this alteration. The mean frequency of the additional distance travelled per day is calculated as 2.66 (number of times the task is repeated in a day).

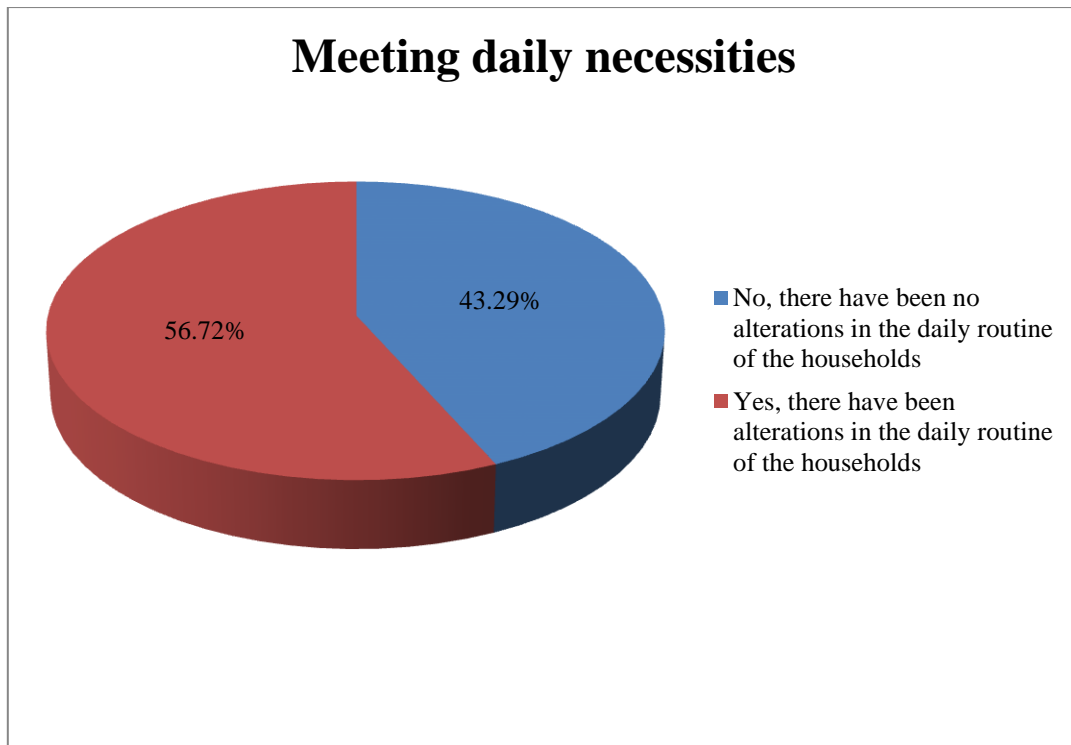


Figure 7-8: Residents that have altered their daily routine in meeting their daily necessities

The third question is about the enumeration of the adverse impacts of on-going construction on the households in terms of maintaining their standard health/ well-being/personal care. This question is composed of two parts.

In the first part respondents have been questioned if there have been any alterations in their daily routine in terms of visiting the doctor or specialist more often than they used visit due to the exposed construction causative nuisances. If they had no alteration they were asked to proceed to the next question. If there were any alterations, respondents were asked to remark how many times more they have visited the doctor/specialist since the construction started in their neighbourhood.

Overall, it is illustrated in Figure 7.9 that, most of the respondents (60.00%) have not confronted any alteration in their daily routine in terms of maintaining their health/well-being/personal care. It can be deduced from this question that, building construction sites have less effect on the residents near to them based on their health/well-being/personal care. . On the other hand, 40% of the respondents have detected a negative effect probably they are very near to the sites or the sites is lasting long.

The participants who had alterations in their routine in terms of visiting the doctor or specialist more have taken action in doing it for 2.1 times more in terms of mean value.

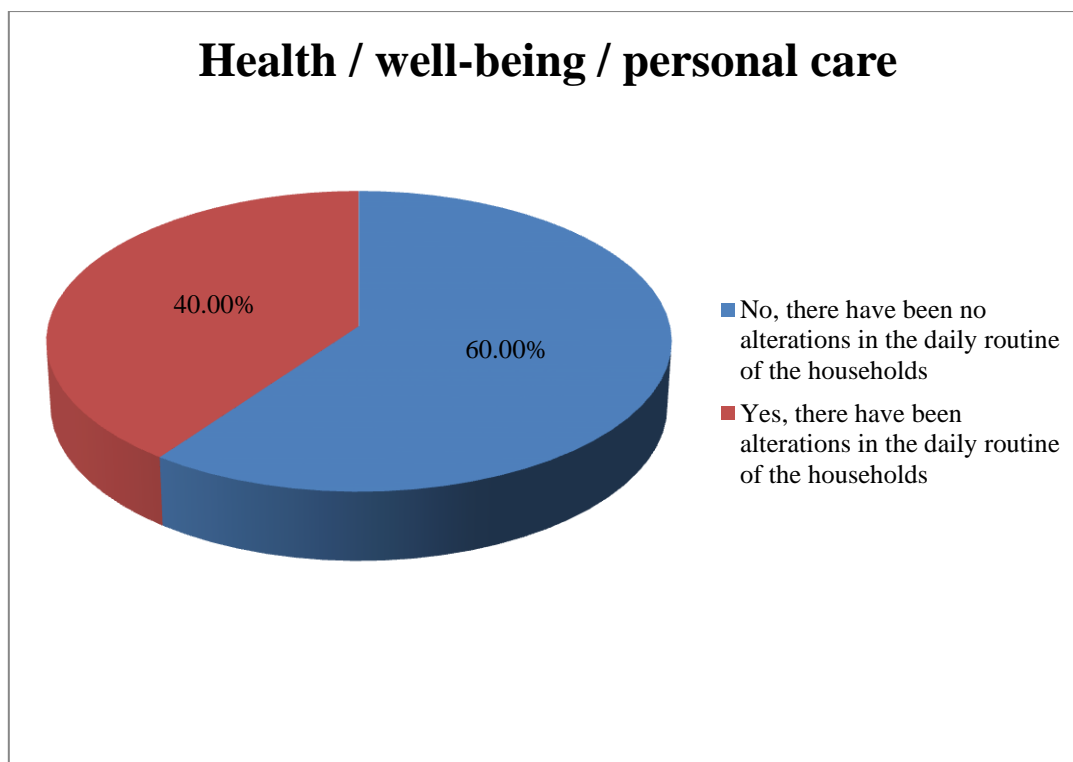


Figure 7-9: Residents who have altered their daily routine to maintain their health/ well-being/ personal care

The last nuisance criterion concerning the households is considered in the fourth question of part C. This question has also composed of two parts. In line with the participants’ responses in the first part of question four, respondents were asked either to proceed to the next question or the second part of question 4.

In the first part, they have been questioned on the whether they have altered their daily routine in terms of the time they the outdoor areas of their houses for maintaining their comfort in the sense of freshening up/air temperature, or not.

In figure 7.10, percentage of respondents who have considered that there have been alterations in the daily routine in terms of the time spending at the outdoor areas of the house and those who do not observe any alterations is depicted. For the ones who have proceeded to the second part of question four, the respondents were asked how many hours of extra air conditioning they have used to maintain their comfort in terms of freshening up/ air temperature.

In this question, one additional sub category exists, since some of the respondents may have no air conditioning in their house. This percentage of the respondents who do not have air conditioning is also shown in Figure 7.10; therefore the most of the respondents considered

that they have alterations in their daily routine in terms of the time they spend at the outdoor areas of their houses. The mean value of the hours of daily extra air conditioning usage by the residents due to the on-going construction is calculated as 3.1 hours.

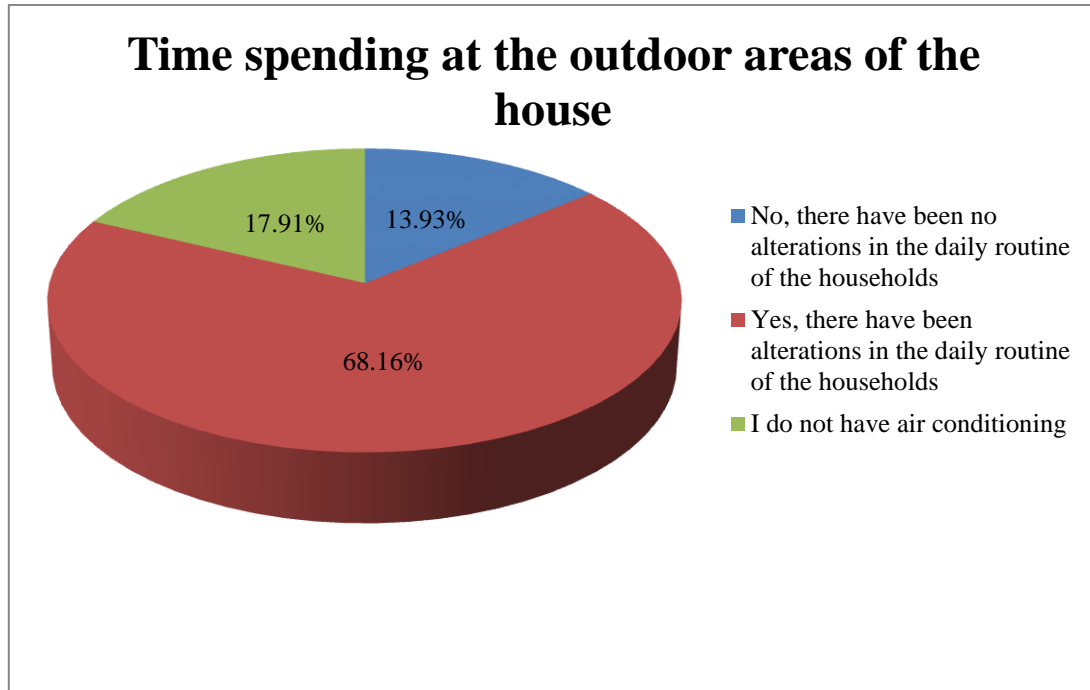


Figure 7-10: Residents that have altered the time they spent at the outdoor areas of their houses

Neighbourhood

Question 5 of part C is about the enumeration of the adverse impacts occurring due to on-going construction in the neighbourhood. As aforementioned, eight criterions are determined as the potential sources of the social costs related to the neighbourhood. In this question, the respondents are asked whether there have been any alterations in their daily routine on the basis of these eight criterions. Figure 7.11 depicts the percentage of the responses obtained from the participants for each criterion. In this figure, the “red” indicates that “there have been alternations in the daily routine of the residents”, and blue indicates that “there have been no alternations in the daily routine of the residents”.

As depicted by Figure 7.11, except from finding a convenient parking space in the neighbourhood/ area, most of the respondents confront these difficulties to reinstate their

standards related to neighbourhood. Especially, most of the respondents have said that they had to go to alternative places due to the lessened peace and quietude of their neighbourhood. This was also an expected result, as mentioned before; construction is one of the most common sources of noise in living areas. In the second stage of question five, the respondents are asked to remark the additional distance in meters/ day they have travelled in order to avoid the perceived nuisances created by the on-going construction.

The median values of the responses representing the additional distances travelled by the residents in order to reinstate their daily routines which have been altered due to occurred nuisances in the neighbourhood are given by Table 7.7. Due to the abovementioned facts, median values are considered.

To conclude, they have stated the frequency of each criterion fulfilled per day is and it is also illustrated by Table 7.7.

Table 7-7 : Additional distance travelled by the people due to on-going construction

Nuisance Criterion	Additional distance travelled (meters/day)	Frequency of each criterion fulfilled per day
Detouring/deviating due to flow of traffic in the neighbourhood/area	300	7
Detouring/deviating due to lessened road cleanliness in the neighbourhood/area	250	6
Detouring/deviating due to lessened road safety in the neighbourhood/area	200	6
Going to alternative areas due to lessened peace and quietude of the neighbourhood	650	4
Going to alternative areas due to lessened serviceability standards of playfields/ hiking trails/ parks in the area	400	5
Not finding a convenient parking space in the neighbourhood/area	100	14
Going to alternative areas due to lack of serviceability of the habitat/parks in the area	2000	1
Going to alternative areas due to lessened standard of the ambient/neighbourhood	450	4

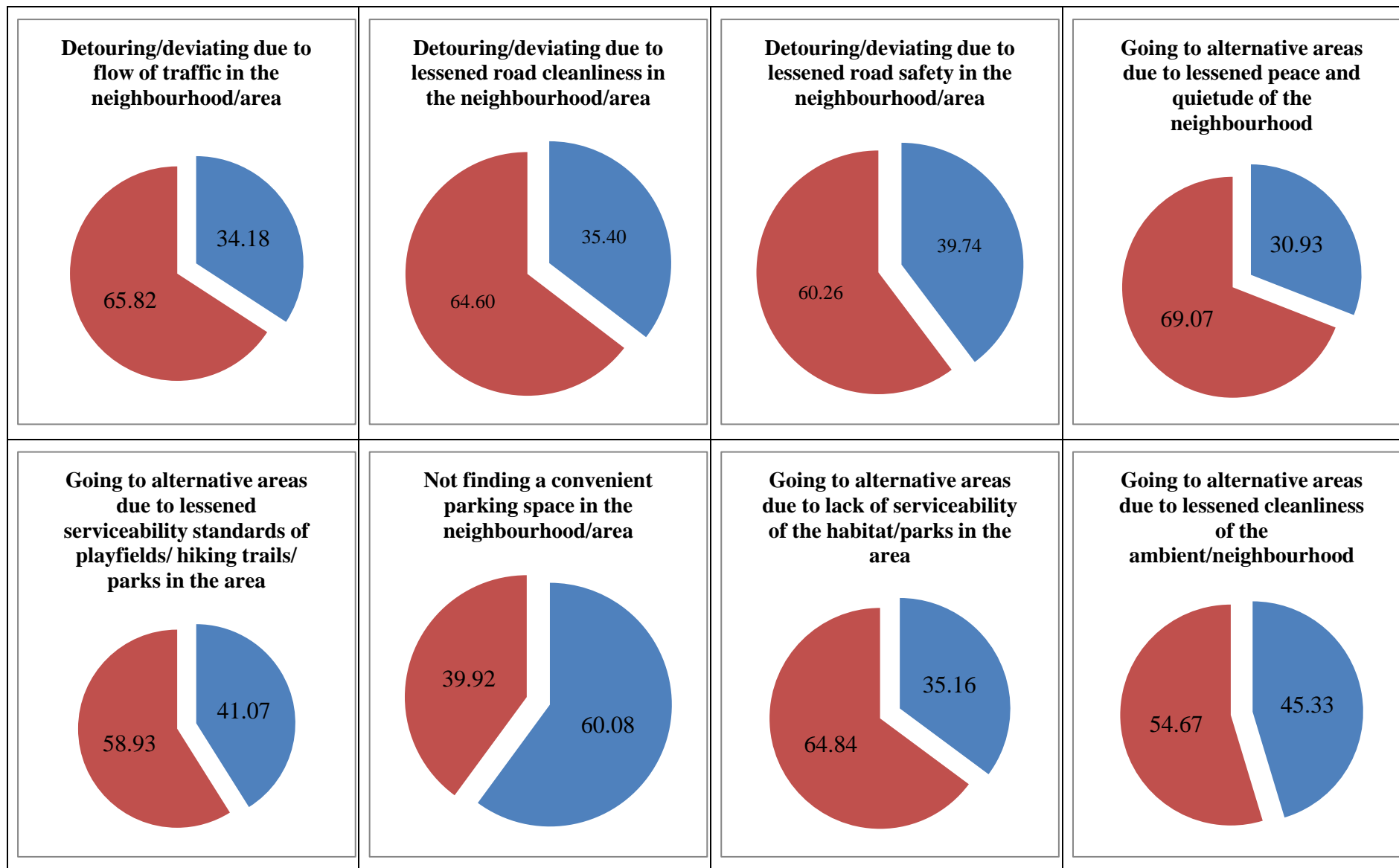


Figure 7-11: Respondents that have altered their daily routine due to perceived nuisances related to their neighbourhood

CHAPTER 8: MONETISATION OF THE SOCIAL COSTS AND APPLICATION OF THE DEVELOPED SOCIAL COST ESTIMATING FRAMEWORK

8.1 INTRODUCTION

In this research a generic framework to estimate the social costs of a building construction in a residential area was developed. For this framework, as it was explained in chapter 5, it is necessary to collect geographical data. The proposed method to collect the data is conducting a questionnaire which was explained in chapter 6 and its analysis was given in chapter 7.

With the intention of gathering the necessary data for the proposed social cost estimating framework, the performed questionnaire was a part of this principal study. Under favour of this field work, a platform that enables the application of the proposed social cost estimating framework, is established hence, monetisation of the social costs in light of the collected data through the questionnaire, is discussed.

8.2 MONETISATION OF THE SOCIAL COSTS

With the help of the conducted questionnaire, enumerated data which were necessary for the monetisation process of the social costs which are incurred to people living in the residential areas have been obtained. Referring to figure 5.5, enumeration processes fell into phase 6 of the followed concept.

After that, as it is depicted by the same figure, in order to meet the requirements of phase 6, in other words, in order to obtain the incurred social costs per house in accordance with the generated construction causative nuisances, set of equations have been developed in this study.

As it was discussed previously in chapter 5, drivers of the social costs in the sense of nuisance criteria have been examined via performed segmentation (discussed in chapter 5) for the units that are considered as being exposed to the generated adverse impacts of the construction, namely; neighbourhood, households, house. Each segmented unit is comprised of various nuisance criteria as shown in phase 3 of table 5.1.

In this study, the social costs occurring due to behavioural alterations in the daily routine of the residents because of the on-going construction projects in their neighbourhoods are calculated via different equations that have been developed as a part of this research.

Due to the nature of collected data, as variables are comprised of different measurement units, it was not possible to perform the monetisation over a single standard formula. For instance, additional fuel cost formation due to difficulty in finding a convenient car parking space in the neighbourhood is calculated on the basis of the additional petrol consumption price, where, increase in the number of doctor/specialist visits of the residents' due to adversely affected health/well-being/personal care conditions is calculated on the basis of the doctor/specialist visit tariff.

It is also worth highlighting at this stage that, all the cost data used in this study have been exchanged from Turkish Lira (TL) to Sterling (GBP) in accordance with the currency exchange rate obtained in August 2013 from the Turkish National Bank. The currency rate was approximately 3TL equivalent to 1 GBP.

In order to monetise all the perceived nuisances by the participants, this study necessitated development of six equations.

HOUSE (SC_H)

This set accommodated 6 different nuisance criteria as shown by phase 3 in Table 5.1.

In order to calculate the costs of the behavioural changes in the daily routine of the residents', equation 6 and equation 7 have been developed.

Equation 6; Developed to assist the monetisation of SC_H

$$\text{Cost}_{\text{msc}} = W_c \times T_c \times N_{ac} \times \frac{1}{60} \times \frac{1}{30} \times A\%$$

- Cost_{msc(n)}; Daily cost of maintaining the standard cleanliness, (n) is used to give a number for the output of each different criterion
- W_c; Wage of cleaner (£/hour)
- T_c ; Time required to perform the cleaning (in minutes)
- N_{ac} ; Number of additional cleaning performed in a month

- A%; Percentage of the residents who have altered their daily routine due to exposed nuisance (*applied to all the equations 2, 3, 4 and 5*)
- $\frac{1}{60}$; Participants responded the time required for performing each criterion in terms of minutes, and this number is used to express the duration in terms of hours.
- $\frac{1}{30}$; Participants responded the number of additional cleaning performed on monthly basis, and this number is used to express the cost on daily basis.

While performing the evaluations of the criteria by using equation 6, N_{ac} values are obtained from the table 8.7, by subtracting the values under “before the construction” from the variables under “throughout the construction”.

Equation 7; Developed to assist the monetisation of SC_H

$$\text{Cost}_{cw} = P_{cw} \times N_{acw} \times N_{oc} \times \frac{1}{30} \times A\%$$

- Cost_{cw} ; Daily cost of additional car wash
- P_{cw} ; Price of a car wash
- N_{oc} ; Number of cars held per each house
- N_{acw} ; Number of additional car washes in a month
- $\frac{1}{30}$; This number is used in order to express the occurred costs on daily basis

HOUSEHOLDS (SC_{HH})

This set accommodated 3 different nuisance criteria as depicted by phase 3 in Table 5.1. In order to monetise the perceived nuisances which have led to behavioural changes in the daily routine of the residents, three different equations given below; equation 8, equation 9 and equation 10 have been developed for the monetisation process.

Equation 8; Developed to assist the monetisation of SC_{HH} and SC_N (see section 8.2.3)

$$\text{Cost}_{f(n)} = D_{at} \times C_{ap} \times P_{of} \times N_{at} \times \frac{1}{1000} \times A\%$$

- $Cost_{f(n)}$ = Daily fuel cost of additional distance travelled,(n) is used to give a number for the output of each different criterion where necessary
- D_{at} = Additional distance travelled in a day (in meters)
- C_{ap} = Average petrol consumption of the car per km
- P_{of} = Average price of fuel (£/litres)
- N_{at} = Number of times additional distance travelled in a day
- $\frac{1}{1000}$ = This number is used in order to equate the units in kilometres

Equation 9; Developed to assist the monetisation of SC_{HH}

$$Cost_{ds} = P_{vds} \times N_{ov} \times \frac{1}{30} \times A\%$$

- $Cost_{ds}$ = Daily cost of additional visit to a doctor/specialist
- P_{vds} = Price of visiting a doctor/specialist
- N_{ov} = Additional number of visits to a doctor/specialist
- $\frac{1}{30}$; This number is used in order to express the occurred costs on daily basis

Equation 10; Developed to assist the monetisation of SC_{HH}

$$Cost_{ac} = C_{ae} \times P_e \times U_{aa} \times A\%$$

- $Cost_{ac}$ = Daily cost of additional air- conditioning usage
- C_{ae} = Average electricity consumption of air conditioners per hour
- P_e = Unit rate price for electricity
- U_{aa} = Additional air-conditioning usage hours/day

8.2.1 Monetisation of the Nuisance Criteria in the House Set

By using the above given two equations, adverse impacts of the on-going construction on the house, which led to incurrence of the social costs for the residents are monetised.

1. Standard cleanliness of the walls of the house;

Equation 6 is used in order to calculate the cost of this criterion. In north Cyprus, cleaner wages are 4.15 £/hour. In line with the obtained results from the questionnaire, average daily

money spent by the residents of each house to maintain the standard cleanliness of the wall of their house during construction is worked out as follows;

$$W_c = \text{£}4.15/\text{hour}$$

$$T_c = 67.2 \text{ minutes}$$

$$N_{ac} = 3.39$$

$$A_{\%} = 0.71$$

$$\text{Cost}_{\text{msc}(1)} = 4.15 \times 67.2 \times 3.39 \times \frac{1}{60} \times \frac{1}{30} \times 0.71$$

$$\text{Cost}_{\text{msc}(1)} = \text{£}0.38/\text{day}$$

2. General cleanliness of the house;

By adopting the equation 6, average daily money spent by the residents of each house to maintain the standard of general cleanliness of their house during the construction is calculated as follows;

$$W_c = \text{£}4.15/\text{hour}$$

$$T_c = 60 \text{ minutes}$$

$$N_{ac} = 5.6$$

$$A_{\%} = 0.78$$

$$\text{Cost}_{\text{msc}(2)} = 4.15 \times 60 \times 5.6 \times \frac{1}{60} \times \frac{1}{30} \times 0.78$$

$$\text{Cost}_{\text{msc}(2)} = \text{£}0.60/\text{day}$$

3. Standard cleanliness of the curtains;

By adopting the equation 6, average daily money spent by the residents of each house to maintain the standard cleanliness of their curtains within the house during the construction is worked out as follows;

$$W_c = \text{£}4.15/\text{hour}$$

$$T_c = 156 \text{ minutes}$$

$$N_{ac} = 2.67$$

$$A_{\%} = 0.68$$

$$\text{Cost}_{\text{msc}(3)} = 4.15 \times 156 \times 2.67 \times \frac{1}{60} \times \frac{1}{30} \times 0.68$$

$$\text{Cost}_{\text{msc}(3)} = \text{£}0.65/\text{day}$$

4. Standard cleanliness of the windows;

By adopting the equation 6, average daily money spent by the residents of each house to maintain the standard of cleanliness of the windows of their house during the construction is calculated as follows;

$$W_c = \text{£}4.15/\text{hour}$$

$$T_c = 80 \text{ minutes}$$

$$N_{ac} = 3.65$$

$$A\% = 0.75$$

$$\text{Cost}_{\text{msc}(4)} = 4.15 \times 80 \times 3.65 \times \frac{1}{60} \times \frac{1}{30} \times 0.75$$

$$\text{Cost}_{\text{msc}(4)} = \text{£}0.50/\text{day}$$

5. Standard cleanliness of the house's yard;

By adopting the equation 6, average daily money spent by the residents of each house to maintain the standard of cleanliness of the yard of their house during the construction is;

$$W_c = \text{£}4.15/\text{hour}$$

$$T_c = 22 \text{ minutes}$$

$$N_{ac} = 11.78$$

$$A\% = 0.58$$

$$\text{Cost}_{\text{msc}(5)} = 4.15 \times 22 \times 11.78 \times \frac{1}{60} \times \frac{1}{30} \times 0.58$$

$$\text{Cost}_{\text{msc}(5)} = \text{£}0.35/\text{day}$$

6. Standard cleanliness of the car(s);

It is worth mentioning at this stage that, according to the “Economic and Social Indicators” research of north Cyprus State and Planning Organisation (2013), in north Cyprus, there is an average of 1.38 car per each house. This number has been taken into consideration as the variable for the number of cars held by each house. By adopting the equation 7, average daily money spent by the residents of each house to maintain the standard of cleanliness of their cars during the construction is calculated as follows;

$$P_{cw} = \text{£}10$$

$$N_{acw} = 1.71$$

$$N_{oc} = 1.38$$

$$A\% = 0.73$$

$$\text{Cost}_{\text{cw}} = 10 \times 1.71 \times 1.38 \times \frac{1}{30} \times 0.73$$

$$\text{Cost}_{\text{cw (6)}} = \mathbf{\pounds 0.58/\text{day}}$$

In accordance with the above performed calculations, total cost incurred on the people because their houses have been exposed to adverse impacts of the on-going construction is calculated next. Within this context, for each house that is located within the 150 m of a construction site, average daily cost that people paid with the intention of reinstating their adequate level of standard is calculated as follows;

- SC_{H} = Social cost for house/car(s) (Daily incurred social cost by exposed adverse impacts on each house including cleanliness of the walls of the house, cleanliness of house, cleanliness of windows, cleanliness of curtains, cleanliness of house yard and cleanliness of the car(s))

$$\text{SC}_{\text{H}} = \text{Cost}_{\text{msc (1)}} + \text{Cost}_{\text{msc (2)}} + \text{Cost}_{\text{msc (3)}} + \text{Cost}_{\text{msc(4)}} + \text{Cost}_{\text{msc (5)}} + \text{Cost}_{\text{cw}}$$

$$\text{Cost}_{\text{H}} = \pounds 0.38 + \pounds 0.60 + \pounds 0.65 + \pounds 0.50 + \pounds 0.35 + \pounds 0.58$$

$$\text{SC}_{\text{H}} = \mathbf{\pounds 3.06/\text{day}}$$

8.2.2 Monetisation of the Nuisance Criteria in the Household Set

By using the above given equations 8, 9 and 10, adverse impacts of the on-going construction on the households, which led to incurrance of the social costs for the residents are monetised.

1. Meeting daily necessities;

First of all, during monetisation of this criterion, average litre of petrol that a car consumes per kilometres, through observations and personal experience is assumed to be 0.125litres/km. Further assumption has taken place that, the car owned by the residents is a medium size car. This assumption is also applied for the rest of the nuisance criterion's monetisation processes, where average petrol consumption of a car per kilometre is required for the evaluation. In addition average price per litre of fuel in north Cyprus is £1.15 considering the prices obtained in August 2013. By adopting equation 8, average daily money spent by the residents in terms of the additionally consumed fuel for each house, so that they maintain the standard in meeting their daily necessities is calculated as follows;

$$D_{\text{at}} = 500 \text{ meters}$$

$$C_{\text{ap}} = 0.125 \text{ litres/km}$$

$$P_{\text{of}} = \pounds 1.15/\text{litre}$$

$$N_{at} = 2.66/\text{day}$$

$$A_{\%} = 0.57$$

$$\text{Cost}_f = 500 \times 0.125 \times 1.15 \times 2.66 \times \frac{1}{1000} \times 0.57$$

$$\text{Cost}_f = \mathbf{\pounds 0.11/\text{day}}$$

2. Maintaining standard health/well-being/personal care;

By adopting equation 9, evaluation of the costs incurred on the people due to additional visit to a doctor/specialist is performed in this section. In north Cyprus, each visit to a doctor or a specialist can be approximately accepted as £30. This is a fixed tariff applied by doctors and personal care assistants for the patients/customers.

In line with this, performed calculations of the construction causative adverse impact related incurred costs on people in order to maintain their standard health/well-being/personal care is conducted as follows;

$$P_{vds} = \pounds 30$$

$$N_{ov} = 2.1$$

$$A_{\%} = 0.40$$

$$\text{Cost}_{ds} = 30 \times 2.1 \times \frac{1}{30} \times 0.40$$

$$\text{Cost}_{ds} = \mathbf{\pounds 0.84/\text{day}}$$

3. The time residents use the outdoor areas of their house;

Due to adverse impacts of the on-going construction, the time that residents use the outdoor areas of their houses in order to maintain their comfort in the sense of freshening/air temperature is lessened, hence, usage of air-conditioning is enhanced leading to incurrence of additional costs on the residents.

It is noteworthy to mention at this stage that 17.91% of the participants did not have air-conditioners at their houses, however if they had, they would have utilised it. For that reason when evaluating the “A_%” value, the participants who did not have the air-conditioners are also incorporated. With the help of equation 10, evaluation of how much additional cost has formed is performed.

Through observations, it is assumed that the average air conditioners fitted in the houses in north Cyprus is rated about 12,000 Btu. According to numerous air-conditioner suppliers, their conditioners that have a cooling capacity of 12,000 Btu, uses 1500 watts (1.5 kilowatts) per hour. On the other hand, according to north Cyprus Electricity Administration’s figures

which are obtained in August 2013, unit rate price for electricity in north Cyprus is averagely £0.22/kilowatts. In accordance with these figures, the evaluation for the cost of additional air-conditioning usage by the participants is calculated as follows;

$$\begin{aligned}
 C_{ac} &= 1.5 \text{ kilowatts/hour} \\
 P_e &= \text{£}0.22/\text{kilowatts} \\
 U_{aa} &= 3.1 \text{ hours/day} \\
 A_{\%} &= 0.86 \\
 \text{Cost}_{ac} &= 1.5 \times 0.22 \times 3.1 \times 0.86 \\
 \mathbf{\text{Cost}_{ac} &= \text{£}0.88/\text{day}}
 \end{aligned}$$

In accordance with the above performed calculations, total cost incurred on the households because they have been exposed to adverse impacts of the on-going construction is computed. Within this context, for the members of each house that is located within the 150 m of a construction site, average daily cost paid by people with the intention of reinstating their adequate level of standard is calculated as follows;

- SC_{HH} =Social cost for households (Daily incurred social cost by exposed adverse impacts on the households)

$$SC_{HH} = \text{Cost}_f + \text{Cost}_{ds} + \text{Cost}_{ac}$$

$$SC_{HH} = \text{£}0.11 + \text{£}0.84 + \text{£}0.88$$

$$\mathbf{SC_{HH} = \text{£}1.83/\text{day}}$$

8.2.3 Monetisation of the Nuisance Criteria in the Neighbourhood Set

By using the above given equation 8, adverse impacts of the on-going construction on the neighbourhood, which led to incurrence of the social costs for the residents are monetised for the each criterion that is categorised under the neighbourhood set as shown by phase 3 of table 5.1.

1. Detouring/deviating due to lessened road safety in the neighbourhood/area;

Average daily money spent by the residents of each house in terms of additional fuel consumption occurring due to detouring/deviating because of lessened road safety in the neighbourhood is calculated as follows;

$$D_{at} = 200 \text{ meters}$$

$$C_{ap} = 0.125 \text{ litres/km}$$

$$P_{of} = \text{£}1.15/\text{litre}$$

$$N_{at} = 6/\text{day}$$

$$A_{\%} = 0.60$$

$$\text{Cost}_{f(1)} = 200 \times 0.125 \times 1.15 \times 6 \times \frac{1}{1000} \times 0.60$$

$$\text{Cost}_{f(1)} = \text{£}0.10/\text{day}$$

2. Detouring/deviating due to lessened road cleanliness in the neighbourhood/area;

Average daily money spent by the residents of each house in terms of additional fuel consumption occurring due to detouring/deviating because of lessened road cleanliness in the neighbourhood is calculated as follows;

$$D_{at} = 250 \text{ meters}$$

$$C_{ap} = 0.125 \text{ litres/km}$$

$$P_{of} = \text{£}1.15/\text{litre}$$

$$N_{at} = 6/\text{day}$$

$$A_{\%} = 0.65$$

$$\text{Cost}_{f(2)} = 250 \times 0.125 \times 1.15 \times 6 \times \frac{1}{1000} \times 0.65$$

$$\text{Cost}_{f(2)} = \text{£}0.14/\text{day}$$

3. Detouring/deviating due to flow of traffic in the neighbourhood/area;

Average daily money spent by the residents of each house in terms of additional fuel consumption occurring due to detouring/deviating because of the traffic flow in the neighbourhood is calculated as follows;

$$D_{at} = 300 \text{ meters}$$

$$C_{ap} = 0.125 \text{ litres/km}$$

$$P_{of} = \text{£}1.15/\text{litre}$$

$$N_{at} = 7/\text{day}$$

$$A_{\%} = 0.66$$

$$\text{Cost}_{f(3)} = 300 \times 0.125 \times 1.15 \times 7 \times \frac{1}{1000} \times 0.66$$

$$\text{Cost}_{f(3)} = \mathbf{\pounds 0.20 /day}$$

4. Going to alternative areas due to lessened standard cleanliness of the ambient/neighbourhood;

Average daily money spent by the residents of each house in terms of additional fuel consumption occurring due to going to alternative areas because of the lessened standard of the ambient/neighbourhood conditions is calculated as follows;

$$D_{at} = 450 \text{ meters}$$

$$C_{ap} = 0.125 \text{ litres/km}$$

$$P_{of} = \pounds 1.15/\text{litre}$$

$$N_{at} = 4/\text{day}$$

$$A_{\%} = 0.55$$

$$\text{Cost}_{f(4)} = 450 \times 0.125 \times 1.15 \times 4 \times \frac{1}{1000} \times 0.55$$

$$\text{Cost}_{f(4)} = \mathbf{\pounds 0.14 /day}$$

5. Going to alternative areas due to lack of serviceability of the habitat/parks in the area;

Average daily money spent by the residents of each house in terms of additional fuel consumption occurring due to going to alternative areas because of lack of serviceability of the habitat/parks in the area is calculated as follows;

$$D_{at} = 2000 \text{ meters}$$

$$C_{ap} = 0.125 \text{ litres/km}$$

$$P_{of} = \pounds 1.15/\text{litre}$$

$$N_{at} = 1/\text{day}$$

$$A_{\%} = 0.65$$

$$\text{Cost}_{f(5)} = 2000 \times 0.125 \times 1.15 \times 1 \times \frac{1}{1000} \times 0.65$$

$$\text{Cost}_{f(5)} = \mathbf{\pounds 0.19 /day}$$

6. Not finding a convenient parking space in the neighbourhood/area;

Average daily money spent by the residents of each house in terms of additional fuel consumption occurring due to difficulty in finding a convenient car parking space in the neighbourhood/area is calculated as follows;

$$D_{at} = 100 \text{ meters}$$

$$C_{ap} = 0.125 \text{ litres/km}$$

$$P_{of} = \text{£}1.15/\text{litre}$$

$$N_{at} = 14/\text{day}$$

$$A_{\%} = 0.40$$

$$\text{Cost}_{f(6)} = 100 \times 0.125 \times 1.15 \times 14 \times \frac{1}{1000} \times 0.4$$

$$\text{Cost}_{f(6)} = \text{£}0.08 \text{ /day}$$

7. Going to alternative areas due to lessened serviceability standards of playfields/hiking trails/parks in the area;

Average daily money spent by the residents of each house in terms of additional fuel consumption occurring due to going to alternative areas because of the lessened serviceability standards of the playfields/hiking trails/parks in the area is calculated as follows;

$$D_{at} = 400 \text{ meters}$$

$$C_{ap} = 0.125 \text{ litres/km}$$

$$P_{of} = \text{£}1.15/\text{litre}$$

$$N_{at} = 5/\text{day}$$

$$A_{\%} = 0.59$$

$$\text{Cost}_{f(7)} = 400 \times 0.125 \times 1.15 \times 5 \times \frac{1}{1000} \times 0.59$$

$$\text{Cost}_{f(7)} = \text{£}0.17 \text{ /day}$$

8. Going to alternative areas due to lessened peace and quietude of the neighbourhood;

Average daily money spent by the residents of each house in terms of additional fuel consumption occurring due to going to alternative areas because of the lessened peace and quietude of the neighbourhood is calculated as follows;

$$D_{at} = 650 \text{ meters}$$

$$C_{ap} = 0.125 \text{ litres/km}$$

$$P_{of} = \text{£}1.15/\text{litre}$$

$$N_{at} = 4/\text{day}$$

$$A_{\%} = 0.69$$

$$\text{Cost}_{f(8)} = 650 \times 0.125 \times 1.15 \times 4 \times \frac{1}{1000} \times 0.69$$

$$\text{Cost}_{f(8)} = \text{£}0.26 / \text{day}$$

In accordance with the above performed calculations, total cost incurred on the people because their neighbourhood have been exposed to adverse impacts of the on-going construction is computed.

Within this context, for the neighbourhood, average daily cost paid by the people with the intention of reinstating their adequate level of standard is calculated as follows;

$SC_N = \text{Social cost for neighbourhood}$ (Daily incurred social cost by exposed adverse impacts on the neighbourhood)

$$SC_N = \text{Cost}_{f(1)} + \text{Cost}_{f(2)} + \text{Cost}_{f(3)} + \text{Cost}_{f(4)} + \text{Cost}_{f(5)} + \text{Cost}_{f(6)} + \text{Cost}_{f(7)} + \text{Cost}_{f(8)}$$

$$SC_N = \text{£}0.10 + \text{£}0.14 + \text{£}0.20 + \text{£}0.14 + \text{£}0.19 + \text{£}0.08 + \text{£}0.17 + \text{£}0.26$$

$$SC_N = \text{£}1.28/\text{day}$$

8.3 CALCULATION OF THE TOTAL SOCIAL COST INCURRED ON THE THIRD PARTIES

As abovementioned, in this study, adverse impacts of the on-going construction projects on people residing within 150 m distance of a construction site is measured. Within this context, for this specific case, an equation 11 is developed in order to generate the total social cost/day incurred on the third parties (local residents) living in a residential area due to the on-going construction projects.

According to Equation 1;

$$SC_{LR} (\text{Social cost per local resident}) = SC_N + SC_{HH} + SC_H$$

$$SC_{LR} = [3.06 + 1.83 + 1.28] = \text{£}6.17/\text{day}/ \text{house}$$

Equation 11; Developed to assist monetisation of Total Social cost incurred to local residents on the basis of per each house located within the vicinity of construction area

$$TSC_{LR} = SC_{LR} \times N_h = [Cost_H + Cost_{HH} + Cost_N] \times N_h$$

- N_h = Number of houses within 150 m distance of a construction site
- TSC_{LR} = Total Social Cost

According to the collected data from the questionnaire, in this study, there was an average of 22 houses located within 150 m distance of each construction site. Therefore, the total social cost for a construction site is calculated as below;

$$N_h = 22$$

$$TSC_{LR} = [\text{£}6.17/\text{day}/ \text{house}] \times 22 \text{ house}$$

$$TSC_{LR} = \text{£}135.74/\text{day}$$

CHAPTER 9: EVALUATION OF THE PROPOSED SOCIAL COST ESTIMATION SYSTEM

9.1 INTRODUCTION

In this thesis a new social cost estimation system is proposed. This system includes three parts namely, (i) the generic framework for the estimation of the social costs of building constructions in the residential areas which is explained in section 5.3, (ii) the compensation method of the social costs which is explained in section 5.4, and (iii) estimation of the social costs based on the duration of the construction, in other words, time based social cost estimation as it was explained in section 2.10.

Due to the varied characteristics of those parts, their evaluation will be done separately. The generic framework for the estimation of the social costs of building constructions in the residential areas is evaluated by three experts' opinions. Two of those experts are from north Cyprus, out of them one is an academic in construction field and the other one is a contractor. The other one is employed in a Turkish company based in Istanbul.

The newly proposed compensation method of the social costs can be divided into two as the determination of a cost category for the social cost and compensation method of the affected people of the social costs. For the evaluation of the first part a series of interviews was conducted with 9 contractors based in New York, USA. The second part of compensation is evaluated by the senior authorities of the two largest municipalities in TRNC.

In this study, the social cost is estimated based on time. The importance of construction duration in terms of the social cost is especially underlined by performing a case study comparing the two different construction methods namely, lightweight steel construction and reinforced concrete construction. In this way it was tried to underline that, in selecting a construction method, it is important to consider the social costs as well.

9.2 EVALUATION OF GENERIC SOCIAL COST ESTIMATION FRAMEWORK VIA EXPERTS' OPINION

Eliciting experts' opinion by means of an evaluation is moderately an informal method that can be accommodated in studies with the intention of gathering their opinions and judgements where relevant (Yousuf, 2007). In general, experts' opinions in the sense of an evaluation method can be used at any stage of a design. On the other hand, it is significant to make sure that experts who have been participated in the evaluation process have not been involved or interested with the presented topic as this may lead to difficulty in obtaining impartial results (Nielsen and Molich, 1990).

Once the relevant calculations by means of the proposed social cost estimation framework are performed, obtained results have been reviewed by three experts for their assessment who have not been involved or interested with the quantification of the social costs previously. The first expert was a director of a building construction company based in Nicosia, north Cyprus. The second expert was a professor in the Civil Engineering Department of Eastern Mediterranean University, north Cyprus. The third expert was an employer of a construction company based in Istanbul, Turkey. Evaluations took place by sharing the information provided in the chapters 5, 6, 7, and 8 of this thesis.

9.2.1 Views of the Experts

The views of the three experts are given below.

Considering his experience, vision, and knowledge in the sector for more than 20 years, the first expert has mentioned his views about the application of the proposed construction cost composition as follows;

“By going through the report prepared by Tolga Çelik that concerns, the monetisation of the building construction caused social costs, and the proposed social cost composition model, I think that the undertaken study is quite satisfactory and illustrative for a contractor.

Currently we find the building construction costs by calculating the direct costs using the tender file and add up our project and head office overheads. I first time came across of the importance of social costs and the estimation methods of it. Sometimes we face with some of these types of costs but because we normally do not include it in our cost calculations, we either pay the incurred cost from our profit or try to solve

the problem by legal attempts. In the proposed compensating method it was stated that the social cost will be excluded from the bid value and will be paid by the owner directly. This is acceptable for a contractor. Obviously, there is a risk for the contractor that the total social costs paid by the owner to municipality will be under his responsibility. Providing “social cost bond” and this risk will also cause to be included by the contractor in the bidding. I think calculating the social costs in per day is relatively easy and practical. The calculated social cost of £6.17/day for a house near to a construction site is reasonable. However, it will change from region to region depending on the houses near to the site.

Consequently, I found this study interesting, illustrative, and useful for contractors in north Cyprus. I evaluate this study as well researched and well presented.

The second expert declared his feedback about the proposed social cost system via a letter and mentioned the following:

“I have read the chapters 5, 6, 7, and 8 of Tolga Çelik’s PhD thesis. I found the work thorough and comprehensive. It is to a high technical standard and is looked as well researched.

Up until recently, the total cost of a construction project to a contractor was the summation of the direct costs and a mark-up. It is believed that, as a new approach of estimating the social cost and including it in the project total cost of construction project will be considered by construction experts and it will be discussed more; as who will pay this cost, to whom, when and how? However, the proposed compensation method probably is needed to be discussed by municipalities.

Social costs for the construction projects have been stated to be researched recently. In the literature there are several attempts to quantify the social costs. However, it is not an easy task. Especially the calculation of social costs in a residential area where a great number of people with varying characteristics are affected, the task even becomes more arduous.

The approach of calculating the social costs in per day is quite practical and reasonable. The selected parameters to calculate the social costs are acceptable. However, it should be remembered that, these parameters have varying intensity, therefore varying effects on social costs throughout the duration of a construction. It is expected that, the daily social costs will not be uniform in different stages of a

construction. It is obvious that, calculation of the social costs based on the construction activities requires a laborious work, but may generate precise and timely results.

It is understood that, a social cost of £6.17/day for a house near to a construction site is obtained by a questionnaire and at the end of a tiresome study. This value may change from region to region of the world; however, it is reasonable for north Cyprus or Turkey.

As a result, in my opinion this study is interesting, capable of creating some question marks in the head of staff of construction industry, quite well searched and presented. The proposed cost composition model including the social costs is reasonable and the developed social costs formula will attract the attention of many researchers and construction experts.”

The third expert is employed in a Turkish construction company executing construction jobs both in Turkey and other countries. His views are given in below letter.

“Social Cost Analysis is an important tool for analysing a project to reflect its positive and negative impact on the society. Today, it has expanded to evaluation of private projects as they are much more responsible for good and bad effects on the society. Hence, the social cost analysis became a must for each company to be considered as part of project total cost.

The calculation of social cost requires many data as it is affected by different factors. In addition, the factors affecting the social cost calculation will vary as per the project which makes a precise estimation of the social cost more difficult.

The developed framework has been found a comparative tool which definitely will help the contractor in calculating the social cost to be considered as part of the project total cost.

Principally, excluding the social cost from the bidding process sounds reasonable and good for both the contractors and owners. It avoids mistakes in selecting the best contractor through the bidding. The proposed social cost compensation method through the municipalities is needed to be discussed and worked out with the municipality authorities. Beside it requires some legal issues. However, it looks it is practical.

The framework that has been evaluated by experts within the company where all has recommended it mentioning that they found it well equipped, useful and reflecting the need of a contractor with its highly useful information”.

9.2.2 Discussions of Experts' Evaluations

From the feedbacks of the contractor, who has been in the market for more than 20 years, it is interpreted that he has agreed with the presence of the construction causative social costs. He has mentioned the fact that, in some cases they take the responsibility in compensating the construction causative nuisances to people.

On the other hand, in some condition the company takes a legal attempt. This indicates that fact that, no specific standard in quantifying and monetising the building construction causative social costs exists hence, they may disagree in the amount of the compensation that should be paid to third parties or they may have difficulties in identifying who have been actually exposed to the nuisances. It has been accepted that consideration of the social costs during construction cost estimation is overlooked.

The developed quantification and monetisation method for the social costs is found to be simple and practical. Correspondingly, it can be said that the segmentation process performed in this study that concerns various units which are being exposed to adverse impacts of the on-going construction was a good idea. For instance, if the residents are getting majorly affected by the construction causative nuisances being exposed to their neighbourhood, working together with the council, contractor may compensate the incurred cost on residents through the owner due to the lessened standards of the neighbourhood.

If the residents are getting affected least by the construction causative nuisances being exposed to them physically, they may skip compensating the incurred cost on the residents if they have already compensated the unit residents get affected most. Obtained social cost per day per house is found reasonable.

From the feedbacks of the academic staff, it is understood that from who to whom the social costs will be compensated needs a further research. He has believed in the novelty of the research, as in this research, the effects of building construction causative social costs on third parties living in residential areas are examined. On the other hand, he has the same opinion with the director of the contractor company that the quantification and monetisation of the social costs through the developed and followed method in this study is rather simple and practical. Daily obtained social costs, £6.17, which is estimated to be incurred per house

located within 150 m distance of a construction site, is also found reasonable by the academic.

However, he has made an interpretation that throughout the various stages of a construction project, intensity of the perceived nuisance by the third parties should vary. In addition to these, he has made an additional comment that quantification and monetisation of the social costs for each different construction activity is expected to provide more precise and timely results. In line with the obtained reviews from him it is noteworthy to mention that, in order to measure the nuisance occurred on activity based is rather difficult and with the current technology of the industry it is not performable.

For instance, if dust formation in the sense of a nuisance criterion is considered, in order to measure the intensity of the dust perceived nuisance by the residents, there is a need for very sensitive equipment that detects the formed dust by the works undertaken during the construction of foundation. This can also be measured in the laboratory medium engaging numerous specialists for the test however, within the time constraints of this research this was not possible. Overall, according to him the proposed cost composition model was satisfactory and the novelty of the research was successful.

According to the feedback of the third expert employed in a Turkish construction company every construction project has some positive and negative impacts on the society. Therefore, the social cost also is to be estimated and added to the total project cost. However, measuring and estimating the social costs, as it was stated in the thesis, varies from project to project and is difficult to estimate. Therefore, the developed social cost estimating framework was found to be helpful for cost estimators.

The third expert found the proposed social cost category applicable since it leaves the social cost out of the bidding value. The proposed social cost compensation method is found to be practical, however, it is recommended to be discussed by the municipalities since it requires legal acts. The third expert stated that those opinions were established having discussed and evaluated the subject with some other experts within the company.

9.3 EVALUATION OF THE PROPOSED SOCIAL COST COMPENSATION METHOD

The proposed social cost compensation method includes two parts. In the first part there is an attempt to establish a cost category for the social costs. In the second part social cost compensating method of the affected people is put forward. The evaluation of those methods is explained separately in below.

9.3.1 Evaluation of Cost Category Method

As it was discussed in detail in chapter 5, there are some arguments about the cost category of the social cost. In order to propose a cost category for the social costs, the author of this thesis conducted a series of interviews with 9 building contractors located in New York, USA in March 2014. Three questions were asked to a senior manager in their estimating and tendering department.

- First question was “Could you please briefly describe your company?”
- Second Question was “Are you familiar with the construction causative social costs?”
- The third question was “Do you prefer to include the estimated construction causative social cost into the bid value in the direct cost or mark-up?”

From the answer of the first question it was learned that all of those 9 contractors were doing building construction works at national level and they have permanent personnel number less than 100. As answer to the second question, they all stated that they are familiar with social costs. They came across with social cost problems in some of their projects and they try to solve it in peace by trying to soften the objecting individuals in some method of compensation.

In the answer of third question, they all objected to include the social cost into the direct cost or into the mark-up. They didn't want the social cost to be included into the bid value stating the problem with the estimation of it. They stated that there is no widely accepted standard method to estimate the social cost and therefore the competition among the contractor will not be fair. They all mentioned that, the owner also will suffer with such an application.

Having considered the literature as explained in chapter 2, and the results of this interview, it was deduced that, the social costs should not be included into the contractual costs of a building construction project. Therefore, the social cost is decided to be placed into the non-contractual part of the total project cost as shown in figure 5.6.

9.3.2 Evaluation of Method of Compensation for the Affected People

Social cost compensation method for affected people is explained in detail in section 5.4.2. Just for a recall, the municipality will estimate the social costs as identified and described in chapter 5 and the owner will pay the estimated social cost to the municipality while he is getting the final approval. The municipality will compensate the affected residents in its own method.

The owner to enforce the contractor to pay attention to minimise or to eliminate the social cost, he will ask a social cost bond from the contractor during signing the construction contract. The contractor will know that, the social cost estimated by the municipality will at last be paid through his bond and will try to minimise it.

This method was first discussed and then evaluated by the senior directors of the two largest municipalities in TRNC, namely, Famagusta Municipality and Nicosia Turkish Municipality. The authorities of both municipalities found the proposed method acceptable.

They mentioned that, every month around 10 persons residing near a building construction site come to them to complain about the building construction causative nuisances. They accept their responsibility; however they stated that there is no a legal and applicable instrument in their hand and they send them to the Ministry of Labour. They found the proposed compensation method acceptable and useful. The owner will be responsible to pay to the municipality any realised social cost directly and the contractor ultimately is responsible to reimburse the owner.

They mentioned that, having the municipality got the money equal to the estimated social cost from the owner at the end of the building construction; the municipality can compensate the affected people in one of the ways of reducing their municipality taxes or their other bills. They asked to meet further with the author of this thesis to provide contribution to them in establishing a legally supported system to apply the proposed social cost compensation method with the proposed social cost estimation framework.

9.4. A CASE STUDY: ESTIMATION OF THE SOCIAL COSTS BASED ON THE DURATION OF THE CONSTRUCTION COMPARING IN-SITU REINFORCED CONCRETE AND LIGHTWEIGHT STEEL BUILDINGS

Lightweight steel construction and in-situ reinforced concrete construction are the two construction methods that in between both, variations exist in terms of their properties such as; material, physical, dead weight, assembling techniques, quality, sustainability. In general, accumulation of these properties of the two alternative construction methods turn out to have an impact on overall construction duration and cost of construction project.

In this study an attempt has been undertaken with the intention of quantifying social costs occurring due to execution of construction activities on the daily basis. For that reason, two construction methods which have significant variation in terms of construction duration has

chosen to be included into this comparative case study hence, impacts of social costs could be associated with the construction duration and construction method.

In order to conduct this case study, author has attended group of sessions in Istanbul, Turkey in the beginning of August 2012. It is noteworthy to mention at this stage that, during the comparison of two alternative construction methods, only; structural frame, walls and foundation of the buildings have been taken into consideration.

9.4.1 Purpose of the Case Study

According to Yin (2003), the case study can be exploratory to create new knowledge, constructive to solve some problems, or confirmatory to test a hypothesis with empirical evidence. Moreover, in the case studies either primary data (the researcher collects the data) or secondary data (the researcher uses someone else's data) can be used.

Through this conducted case study a platform will be formed that helps to monitor whether there are any differences between what literature has discussed and application of it in real life practice in Turkey and north Cyprus.

In this way, with the help of collected empirical data, a foundation for the platform was established to indicate the impact of construction duration on total social cost hence, project total cost. Conducted case study aimed to act as an empirical evidence for the decision makers so that they can consider the best fit alternative to lower the social cost hence, project total cost.

9.4.2 Specification and Justification of the Case Study

In-situ reinforced concrete is being ubiquitously used in Turkey and north Cyprus where both construction industries shows similar patterns (Yardimci, 2005). However with the recent advances of construction sector in Turkey and north Cyprus, alternative construction methods are emerging due to the special requirements of the countries such as;

- a- both countries are of high risk in terms of earthquake
- b- according to urban planning & building regulations of north Cyprus it is advantageous and recommendable to construct residential building up to 4 stories

The author of this research has extracted from comprehensive literature review, site visits and discussions with the experts that, lightweight steel construction has benefits over other

construction methods in the way of being extremely light in weight which makes it more durable against earthquakes.

In addition, lightweight steel construction is at an optimum efficiency in terms of economics and applicability when constructed up to 4 stories (Çelik , 2010). Additionally, lightweight steel construction method is more beneficial compared to in-situ reinforced concrete construction method in terms of construction duration. The value of being “more beneficial” in terms of construction duration will be corroborated by including the effect of social costs in overall construction cost of the project.

In this research, building construction related social costs have been quantified on daily basis. Within this context, the interrelationship between construction duration and social costs therefore, impact of construction duration on construction cost was examined.

Considering all the above specified circumstances and both countries’ construction sector being receptive for new construction methods, it has been decided to conduct a case study that covers a comparative study of the lightweight steel construction and in situ-reinforced concrete construction. The main aim of this case study was to form the platform to compare two different construction methods in terms of quantitative parameters such as construction duration and initial cost.

Considering the fact that, in eastern Mediterranean region, generally 2-3 storey detached villas are the most common type of low rise dwellings, a specific structure (two storey detached villa) has been designed by lightweight steel construction. Afterwards, the villa which was designed by lightweight steel construction has been re-designed with exactly the same indoor dimensions by in-situ reinforced concrete construction method so that an accurate comparison could have been undertaken.

9.4.3 Collaborated Contractor

The contractor that the author has collaborated in Turkey is offers a new building alternative for Turkey with steel (light-weight) structure systems. Collaborated company which manufactures steel structure systems is established in Istanbul in 2001. It is considered to be Turkey’s biggest manufacturer and one of the three largest manufacturers of Europe with its 35 thousand tons of structural steel manufacturing capacity annually.

9.4.4 Shared Duties of the Collaboration

The author of this research had a function to guide the collaborated company within the below specified points;

- Describing design aspects (2 storey detached villa, same indoor dimensions)
- Specifying the quantitative parameters as mentioned above, which were the key drivers of the comparative study
- Obtaining and evaluating the real life practice data in terms time, and cost.
- Comparing the real life practice data with the written literature in terms of time, and cost.
- Driving out the results of the comparison.
- Interrelating the results with the social costs hence, project total cost.

The collaborated contractor had the duty to provide the author with the requested designs considering the pre-defined specifications and provide demanded quantitative and qualitative data so that comparison of two alternative construction methods can take place in line with the literature. This collaboration is for the mutual benefits of the both parties.

9.4.5 Mutual Benefits for Parties

Benefits for the author of this research can be classified as;

- Accessing the data that requires to be formed by an experienced design team.
- To be able to compare the literature about the two different construction methods with real world practice, especially for the construction sector of Turkey and north Cyprus.
- Having the platform to indicate the importance of construction duration on the social cost hence, project total cost.
- Increasing the awareness of construction industry professionals by providing empirical evidence so that they can consider which type of construction method is more advantageous including the social costs.

On the other hand, with the help of this comparative case study, collaborated contractor had the opportunity for their current process to be audited by an external academic researcher. This comparative case study helped them to realise their strengths especially by reducing the

construction duration by using the method of lightweight steel construction. However, in this case study only the cost and the construction duration comparison were performed.

9.4.6 Comparison of Alternatives

i. Financial (initial cost) comparison of lightweight steel and reinforced concrete construction methods;

In this section, initial cost evaluations of the two alternative construction methods have concerned only the structural frame, walls and foundations of the buildings. Additionally, initial cost in this case is composed by summation of direct and indirect costs and was evaluated at the procurement phase via unit price estimation method depending on the historical data of the collaborated company.

Additionally, overhead expenses given in Table 9.1 and Table 9.2 are composed through accumulation of project and company overheads. Furthermore, drivers of direct cost such as; structural frame, brickworks and internal plastering works, and roof construction plus external plastering works that were provided in below given tables accommodate the equipment, labour, material, and sub-contractor prices hence, each cost item is categorised as an element of direct cost.

In view of the fact that social costs have not been incorporated in estimation phases of construction projects yet, cost items that were given in Table 9.1 and Table 9.2 did not include the social costs. However, the social costs that were monetised through the developed equations (see chapter 8) with respect to the enumerated nuisances (see chapter 5) those residents were being exposed to have been added to the cost items given in Table 9.1 and Table 9.2. Since the cost data and work quantity were obtained from the collaborated contractor who is already practicing in the market, the cost comparison is highly precise and reliable.

The work breakdown structure of the cost items given in Table 9.1 and Table 9.2 are included in the Appendix D. It is also worth highlighting at this stage that, all the cost data given in this study have been exchanged from Turkish Lira (TL) to Sterling (GBP) in accordance with the currency exchange rate obtained in August 2012 from Turkish National Bank. The currency rate was approximately 3TL equivalent to 1 GBP.

At the end of these calculations, it has been obtained that, for this specific case, two storey detached villa designed by reinforced concrete construction was 22% more expensive (in

terms of gross floor area) compared to the villa designed by lightweight steel construction. The details of financial calculations are provided in Table 9.1 and Table 9.2. Similar outputs were also obtained from the literature such as; in the UK reinforced concrete construction is 19% more expensive than lightweight steel construction when it is compared with regards to gross floor area (Corus, 2007).

Table 9-1 : Total cost of a two storey detached villa constructed by reinforced concrete.

Cost Items	Total (£)
Overhead expenses	1465.2
Structural frame	8295.41
Brickworks and internal plastering works	3227.42
Roof construction and external plastering works	3825.32
	Total Cost: £16,813.35

Table 9-2 : Total cost of a two storey detached villa constructed by lightweight steel.

Cost Items	Total (£)
Overhead expenses	782.09
Structural frame	8135.5
Walls and ceilings panels construction	1293.99
Heat, sound and water isolation systems	3614.21
	Total Cost: 13,825.8

ii. Comparison of lightweight steel and reinforced concrete construction in terms of construction duration;

Finishing a construction project in the shortest possible time provides various benefits such as; cost savings on site management and on-site activities, reduction in cost of finance as shorter construction duration decreases the time for the duration of which interest has to be paid and providing earlier return on investment (Corus, 2004).

During the conducted comparison of two alternative construction methods in terms of duration, only; structural frame, walls and foundation of the building have been considered as the drivers of time.

In this specific case study, considering the organisational process assets of the collaborated company, the construction activity schedules for two building construction methods were prepared separately as shown in Figure 9.1 and Figure 9.2. In these scheduling, the accepted working hours were 8 hours per day and working days were 5 days per week (Mon-Fri). For that reason in this study, nuisances occurring due to working days of the project have been taken into consideration during quantification of project's total social costs.

It is illustrated in Figure 9.1 that, for a two storey detached villa designed by reinforced concrete construction method, for the construction activities of structural frame, walls and foundation construction site was estimated to be open for 79 days. However, considering the fact that, the adverse impacts of building construction activities on third parties being effective only on working days, total of 58 working days was justified as the duration of this type of project.

On the other hand, in order to construct structural frame, walls and foundation of the two storey detached villa designed by lightweight steel construction method, construction site was estimated to be open for 23 days, where the actual construction is needed 17 working days to be completed as illustrated by Figure 9.2.

9.4.7 Key Findings of the Case Study

The key findings from the aforementioned case study are listed as follows;

- Accumulation of direct and indirect costs for constructing the structural frame, walls and the foundation of the two storey detached villa designed by reinforced concrete construction was roughly £16,800. On the other hand, accumulation of the direct and indirect costs for constructing the same elements of the two storey detached villa designed by lightweight steel construction was roughly £13,800.
- By adopting lightweight steel construction it is possible to construct the structural frame, walls, and foundations of the two storey detached villa in 17 working days. Alternatively, by reinforced concrete construction these can be achieved in 58 working days.
- Within this context, comparison of a traditionally obtained construction cost with the construction cost obtained including the estimated social costs is depicted in figure 9.3. In light of this comparison, it can be said that when the construction cost of two alternative construction methods are compared via the traditional method, villa designed by lightweight steel construction is **£2,987.56** cheaper, in other words, **%17.77** cheaper, concerning the construction of walls, foundations, and the structural frame when compared to the villa designed by reinforced concrete construction.

However, when the social cost is also added as in the recommended cost category as explained in section 5.4.1 the construction cost of the structural frames, walls and the foundations, villa designed by lightweight steel construction turns out to be **£8,552.9** cheaper.

In other words, lightweight steel construction will be **%34.65** cheaper, when compared to the villa designed by reinforced concrete construction. Therefore, the proposed construction project total cost model that includes the social costs will obviously motivate the decision makers to make a more careful and comprehensive consideration in selecting the type of construction method for their projects.

Last but not least, figure 9.4 illustrates the comparison of two alternative construction methods on the basis of the cost elements accommodated in the proposed construction project total cost system which includes the social costs as well.

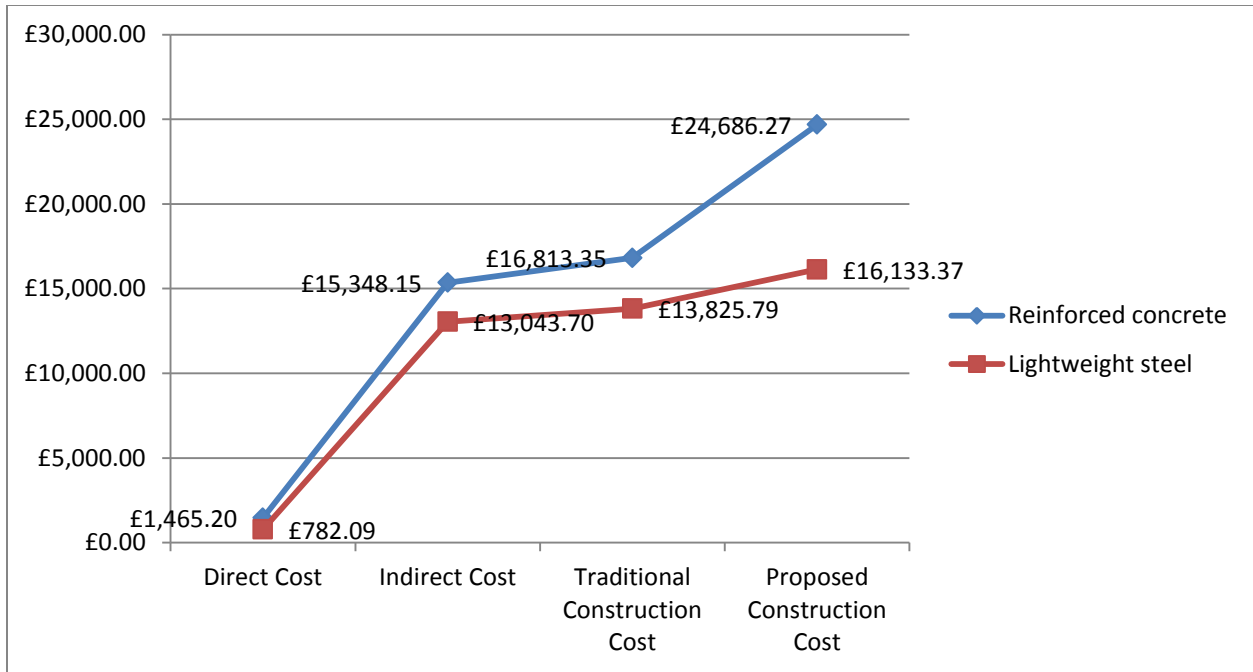


Figure 9-3: Comparison of costs of alternative construction methods on the basis of traditional and proposed construction project total cost system which includes the social costs

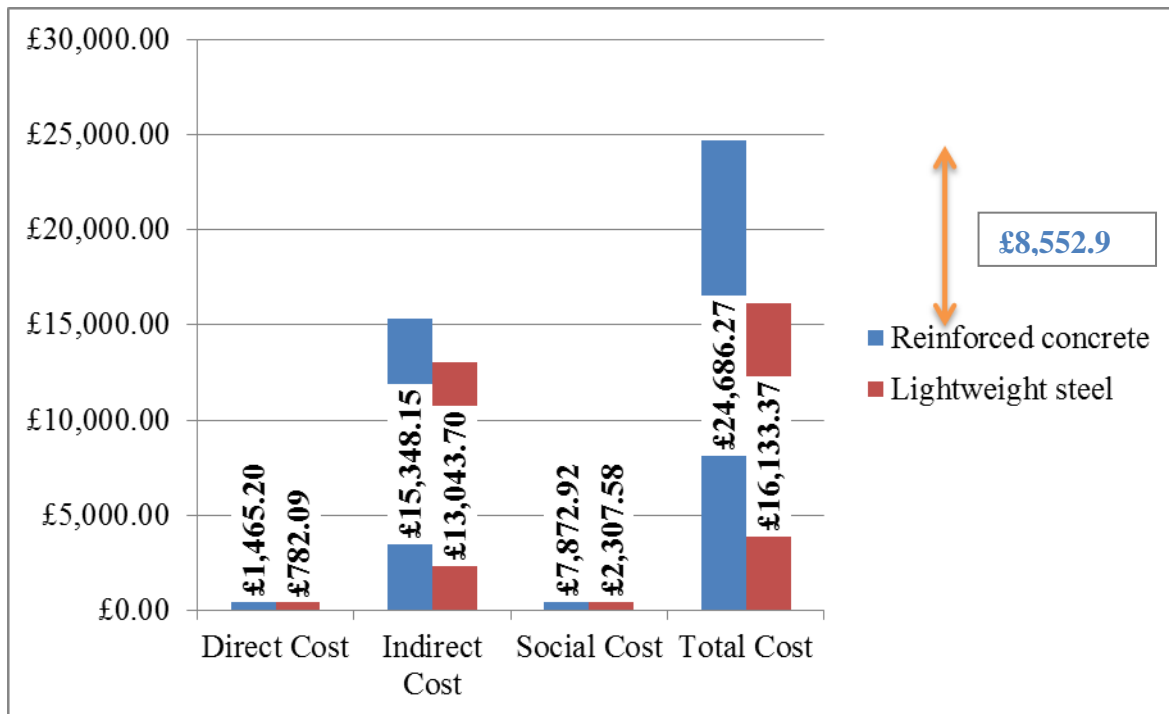


Figure 9-4: Comparison of cost of alternative construction methods on the basis of cost elements accommodated in the proposed construction project total cost system including the social costs.

CHAPTER 10 : CONCLUSION AND RECOMMENDATIONS

10.1 CONCLUSIONS

In the literature there are some studies to attract the attention of the construction industry on the social costs. Some researchers have attempts to monetize the social costs in some infrastructure project mostly away from the residential areas (Boyce and Bried, 1998; EOU, 2012; Gilchrist and Allouche, 2005). This study aimed to describe the social costs of a building construction site in residential areas and to develop a generic framework to monetize it. Later a social cost compensation method proposed that includes a cost category for the social costs and a compensation method for the affected residents in the vicinity of building construction sites.

Having undertaken a comprehensive literature review, the author of this thesis made an attempt to describe the social costs of a building construction site and to monetize them in a residential area. For that purpose a questionnaire was conducted in north Cyprus by 266 respondents in July 2012. The respondents were selected among those who are residing within 150 m of a construction site scattered to the three major cities of north Cyprus, Nicosia, Famagusta, and Kyrenia. The questionnaire results were analysed by using SPSS Statistics 20.

Part B of the questionnaire was aim to obtain a clue for the existence of the social costs in that region. In the research undertaken here, it is obtained that, the respondents' complains about the nuisance criteria for house, household and neighbourhood at a ratio equal to, for house 7.13/10, for households 4.2/10 and for neighbourhood 6.63/10. These results showed that the respondents of the questionnaire have strong considerations of the existence of the building construction caused social costs in those north Cyprus cities.

According to the results of the questionnaire, the social costs of building construction site in a residential region are divided into three as it is depicted in Figure 5.3. These are Neighbourhood, Households, and House.

The nuisance criterions that caused social costs in these divisions are as follow.

Neighbourhood:

- Road safety standards of the neighbourhood
- Road cleanliness of the neighbourhood
- Standard flow of traffic in the neighbourhood
- Standard cleanliness of the ambient/neighbourhood
- Preservation of the habitat/parks
- Finding a convenient car parking space in the area
- Serviceability standards of the playfields/parks/hiking trails
- Standard peace and quietude of the neighbourhood

Households:

- Meeting daily necessities
- Maintaining their standard health/wellbeing/personal care
- Time they use outdoor areas of their house

House:

- Cleanliness of the walls of the house
- General cleanliness of the house
- Cleanliness of the curtains
- Cleanliness of the windows
- Cleanliness of the car(s)
- Cleanliness of the house's yard.

In calculation the total social costs, the contribution of neighbourhood, households, and house are quite similar as 35.4%, 31.81%, and 32.79% respectively. Therefore, it can be said that, the weighted effect of neighbourhood criterions, households criterions and house criterions are more or less analogous.

In the questionnaire there were questions to monetize a social cost for each criterion given in above. At the end of an elaborate analysis and calculations the obtained social costs per day for neighbourhood, household, and house are as follow.

SC_N = Daily incurred social cost by exposed adverse impacts on the neighbourhood
= £3.06/day

SC_{HH} = Daily incurred social cost by exposed adverse impacts on the households
= £1.83/day

SC_H = Daily incurred social cost by exposed adverse impacts on each house
= £1.28/day

The total social costs obtained for one house in this questionnaire is $T_{SC/house} = £6.17/day$.

In order to calculate the daily total social cost for a specific construction site (T_{SC}), it is necessary to multiply this cost by the number of the houses within 150 m of the site.

$$TSC_{LR} = [Cost_H + Cost_{HH} + Cost_N] \times N_h$$

In this case the average number houses (N_h) within 150 m were 22. Therefore, the calculated total social cost per day is:

$$TSC_{LR} = [3.06 + 1.83 + 1.28] \times 22 = £135.74/day.$$

In those countries where the building permission regulations and building construction code of practices are loose, as in most of the developing countries like north Cyprus and Turkey, the third parties are incurred the social costs and these costs are to be compensated.

The locally changing social costs that can be estimated at the end of the construction by the professional staff of municipality can be compensated through the municipality. Owner will pay the estimated social costs to the municipality during getting the final approval certificate of the building.

On the other hand, the owner will ask a social cost bond (about 10% of the bid value) from the contractor during signing the contract to force him to minimise if not totally eliminate the social costs. The municipality will compensate the affected people from the building construction site in their own way, for example via making reduction in their municipality taxes or in other bills.

In order to evaluate the proposed social cost estimation system three methods were applied. First, the social cost calculations were presented to three experts, one academic; the other one director of a construction company in north Cyprus and the third one was a senior staff of a Turkish

construction company based in Istanbul. Afterwards, their expert opinions were asked. All three of them found the proposed cost model reasonable and satisfactory.

Second, a case study was undertaken to test the effects of the social costs on the total cost of a villa house designed in Turkey. The same house was designed in two methods, reinforced concrete, and lightweight steel. Since the construction duration for lightweight steel structure was less than the reinforced concrete structure, the daily social cost should have an important role in the favour of lightweight steel construction.

The analysis showed that, in case of excluding the social cost, the lightweight steel structure had only 17.77% cost advantage over reinforced concrete structure. However, after including the social cost, the lightweight steel structure had 34.65% cost advantage over the reinforced concrete structure. This shows that, the social cost is to be considered in selecting the construction method as well. The construction methods that have less construction durations will certainly be more advantageous in case of considering the social costs as well.

For the evaluation of the proposed social cost category a series of interview was performed with 9 contractors based in Ney York, USA. They all evaluated that; the social cost should be left out of the bidding value. Therefore, the social cost category as denoted in figure 5.6 is not included into the contractual bidding value. The proposed compensation method for the affected people of the social costs was discussed and agreed by the senior directors of the two largest municipalities of north Cyprus. The senior directors of the two largest municipalities of north Cyprus stated that, the proposed compensation method of the social cost affected people is reasonable and applicable and they are willing to use this method after completing its legal issues.

10.2 RECOMMENDATIONS FOR FURTHER WORKS

In this research there was an attempt to describe and monetize the social costs of a building construction in residential areas. However, this requires laborious and long lasting study, so there were some limitations in this study. Further works are recommended for the future studies.

- i. In this study the social costs were obtained in terms of per day. If the social costs can be obtained in terms of per activity, these costs can be included into the activity costs separately and the timely cash flow of the construction can be prepared more precisely.

- ii. In the questionnaire conducted in this study the segmentation of social costs were as house, household, and neighbourhood. The segmentation of social costs can be more elaborate to obtain more precise values.
- iii. This study was aimed to obtain the social cost for building construction sites in only a residential area and only houses are visited for questionnaire. Further studies can be done in commercial areas including the commercial premises as well.
- iv. Similar studies can be done for infrastructure construction sites in residential areas.

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APPENDICES

APPENDIX A – Sample of Conducted Questionnaire Survey

A. GENERAL PERCEPTIONS OF RESIDENTS (WHO RESIDE NEAR A CONSTRUCTION SITE) ABOUT THE ONGOING CONSTRUCTION

A1. On a scale of 0-10 [(0) Very unfavourable (5) neither unfavourable nor favourable (10) Very favourable], please rate the following criteria considering how the ongoing construction affected your neighbourhood in terms of;

	Very unfavourable		Neither unfavourable nor favourable		Very favourable
A Economic activities in the area	0	1 2 3 4	5	6 7 8 9	10
B Landscaping standards	0	1 2 3 4	5	6 7 8 9	10
C Safety hazards in the area during construction	0	1 2 3 4	5	6 7 8 9	10
D Ambient conditions' standard in the area	0	1 2 3 4	5	6 7 8 9	10
E Neighbourliness/human relations standards of the area	0	1 2 3 4	5	6 7 8 9	10
F Standard quality of life in the area	0	1 2 3 4	5	6 7 8 9	10

A2. The majority of the buildings are traditionally constructed by reinforced concrete in North Cyprus. However, have you ever had the experience of living near to a steel/lightweight steel building construction site?

Yes, I did experience that	1	Please proceed to question A3.
No, I did not experience that	2	Please proceed to question B1

A3. On a scale of 1-5, please rate depending on your experience in living near to a steel/lightweight steel building construction site, how you think the use of this construction method instead of using traditional reinforced concrete building construction method will affect residents in terms of;

	Very unfavourable	Unfavourable	Neither unfavourable nor favourable	Favourable	Very favourable
A Safety hazards in the area during construction	1	2	3	4	5
B Standard cleanliness of the area/neighbourhood	1	2	3	4	5
C Area/neighbourhood traffic flow	1	2	3	4	5
D Standard cleanliness of the house	1	2	3	4	5
E Meeting their daily necessities	1	2	3	4	5

B. IDENTIFYING THE ADVERSE IMPACTS OF ONGOING CONSTRUCTION ON HOUSE, HOUSEHOLDS & NEIGHBOURHOOD

B1. On a scale of 0-10 [(0) Very unfavourable (5) neither unfavourable nor favourable (10) Very favourable], please rate the following criteria considering to what extent the ongoing construction affected your house in terms of standard;

GROUP A (House)	Very unfavourable	Neither unfavourable nor favourable				Very favourable					
A Cleanliness of the walls of the house	0	1	2	3	4	5	6	7	8	9	10
B General cleanliness within the house	0	1	2	3	4	5	6	7	8	9	10
C Cleanliness of the curtains and blinds	0	1	2	3	4	5	6	7	8	9	10
D Cleanliness of the windows	0	1	2	3	4	5	6	7	8	9	10
E Cleanliness of the car(s)	0	1	2	3	4	5	6	7	8	9	10
F Cleanliness of the house's yard	0	1	2	3	4	5	6	7	8	9	10

B2. On a scale of 0-10 [(0) *Very unfavourable* (5) *neither unfavourable nor favourable* (10) *Very favourable*], please rate the following criteria considering to what extent the ongoing construction affected the households in terms of;

GROUP B (Households)	Very unfavourable					Neither unfavourable nor favourable					Very favourable
A Meeting your daily necessities	0	1	2	3	4	5	6	7	8	9	10
B Maintaining your standard health/well-being/personal care	0	1	2	3	4	5	6	7	8	9	10
C The time you use the outdoor areas of your house	0	1	2	3	4	5	6	7	8	9	10

B3. On a scale of 0-10 [(0) *Very unfavourable* (5) *neither unfavourable nor favourable* (10) *Very favourable*], please rate the following criteria considering to what extent the ongoing construction affected your neighbourhood in terms of;

GROUP C (Neighbourhood)	Very unfavourable					Neither unfavourable nor favourable					Very favourable
A Road safety standards in the neighbourhood/area	0	1	2	3	4	5	6	7	8	9	10
B Road cleanliness standards in the neighbourhood/area	0	1	2	3	4	5	6	7	8	9	10
C Standard flow of traffic in the neighbourhood/area	0	1	2	3	4	5	6	7	8	9	10
D Standard cleanliness of the ambient/neighbourhood	0	1	2	3	4	5	6	7	8	9	10
E Preservation of the habitat/parks	0	1	2	3	4	5	6	7	8	9	10
F Finding a convenient car parking space in the neighbourhood/area	0	1	2	3	4	5	6	7	8	9	10
G Serviceability standards of playfields/hiking trails/parks	0	1	2	3	4	5	6	7	8	9	10
H Standard peace and quietude of the neighbourhood	0	1	2	3	4	5	6	7	8	9	10

C. ENUMERATION OF THE CONSTRUCTION ACTIVITIES BASED ADVERSE IMPACTS UPON THE THIRD PARTIES

C1. Considering the nuisances occurring due to execution of the construction in your neighbourhood, have you altered your daily routine in order to maintain;

GRUP A (House)	There have been no alteration in daily routine of the households (routine frequency of days/ cleaning /month)	There have been alterations in the daily routine of the households (existing frequency of days/cleaning / month)	Number of hours required to undertake each criterion
A Standard cleanliness of the walls of the house	1	2	3
B General cleanliness of the house	1	2	3
C Standard cleanliness of the curtains	1	2	3
D Standard cleanliness of the windows	1	2	3
E Standard cleanliness of the car(s)	1	2	*
F Standard cleanliness of house's yard	1	2	3

* Please ignore the required time for performing the car wash

C2. Considering the nuisances occurring due to execution of the construction in your neighbourhood, have you altered your daily routine in terms of *meeting your daily necessities*;

No, there have been no alterations in the daily routine of the households	1	Please proceed to question C3
Yes, there have been alterations in the daily routine of the households	2	Please proceed to question C2.1

C2.1 Considering the fact that ongoing construction in your neighbourhood has led to alterations in the daily routines of the households, what was the additional distance travelled by the households in order to meet their daily necessities? Please write in terms of meters per day.

C2.2 In order to meet your daily necessities, in what frequency the above given distance travelled each day by the households?

C3 Considering the nuisances occurring due to execution of the construction in your neighbourhood, have you altered your daily routine in terms of; going to a doctor/specialist more often than you used to go in order to maintain the standard of ***your health/well-being/personal care***;

No, there have been no alterations in the daily routine of the households	1	Please proceed to question C4
Yes, there have been alterations in the daily routine of the households	2	Please proceed to question C3.1

C3.1 Considering the fact that the ongoing construction in your neighbourhood has altered daily routine of the households, how many times more you have visited the doctor/specialist since the construction started in order to maintain the standard of your health/wellbeing/personal care?

C4. Considering the nuisances occurring due to execution of the construction in your neighbourhood, have you altered your daily routine in terms of the ***time you use the outdoor areas of your house*** for maintaining your comfort in the sense of freshening/air temperature;

No, there have been no alterations in the daily routine of the households	1	Please proceed to question C5
Yes, there have been alterations in the daily routine of the households	2	Please proceed to question C4.1

C4.1 Considering the fact that ongoing construction in your neighbourhood has altered the daily routine of the households in terms of the time you use the outdoor areas of your house, in a day, how many hours of extra air conditioning have you used to maintain your comfort in terms of freshening up/air temperature?

Please tick the box if you do not have any air conditioning in your house

C5. Considering the nuisances occurring due to execution of the construction in your neighbourhood, have you altered your daily routine in terms of;

GROUP C (Neighbourhood)	There have been no alterations in the daily routine of the households	There have been alterations in the daily routine of the households (additional distance travelled in meters/day)	Frequency of the criterion fulfilled per day
A Detouring/deviating due to lessened road safety in the neighbourhood/area	1	2	
B Detouring/deviating due to lessened road cleanliness in the neighbourhood/area	1	2	
C Detouring/deviating due to flow of traffic in the neighbourhood/area	1	2	
D Going to alternative areas due to lessened cleanliness of the ambient/neighbourhood	1	2	
E Going to alternative areas due to lack of serviceability of the habitat/parks in the area	1	2	
F Not finding a convenient parking space in the neighbourhood/area	1	2	
G Going to alternative areas due to lessened serviceability standards of playfields/hiking trails/parks in the area	1	2	
H Going to alternative areas due to lessened peace and quietude of the neighbourhood	1	2	

C6. Are there any other adverse impacts besides of the ones mentioned in this questionnaire that occur due to execution of the construction activities hence, affect the households, houses and neighbourhood negatively?

D. DEMOGRAPHIC CHARACTERISTICS OF THE PARTICIPANTS

D1. What is your gender? Please tick as appropriate.

Woman Man

D2. What is your age group? Please tick as appropriate.

18-24
25-33
34-44
45-54
54-65
66 and over

D3. What is the highest level of education you have completed? Please tick as appropriate.

I am literate
Primary School
Secondary School
High School
2 Year College Degree
4 Year College Degree
Master's Degree
Doctoral Degree and above

Participant Invitation Letter for Questionnaire

Questionnaire to identify the adverse impacts of the construction site (construction activities) in your neighbourhood with the intention of evaluating how much your nuisances cost

This questionnaire is a part of data collection process of a PhD study conducted by XXX, who is a 2ⁿ year PhD Student at the School of the Built Environment, University of Salford, in U.K. Overall title of the research is “Effects of Social Costs on Building Construction”. In this research it is targeted to identify the nuisances that third parties, for instance you as a member of the society, are exposed to due to execution of a construction activity. If you are exposed to any nuisance, how much it costs to your house (members of the family) is aimed to be identified so that in the future these expenditures of your house can be taken into consideration with the intention of compensating it.

All the contents of the questionnaire are prepared and target population of the participants is selected by XXXX. It is a must for the participant to be at least 18 years of age, to be one of the households and to be fully aware of the other (if any) households’ daily routine behaviours. KADEM polling company is only responsible for diverting the questions to participants and noting down their answers.

In order to save time and considering the possibility of vulnerable participants workers of KADEM polling will be reading out the questions to you and noting down your answers. This questionnaire will take approximately 20 minutes to complete.

It is noteworthy to mention at this stage that, participation to this questionnaire is **voluntarily**. **Also please feel free not to answer any question if for any reason you do not want to.** On the other hand, after the questionnaire begins, if for any reason you no longer want to carry on, please feel free to inform the person diverting you the questions that you want to stop, and terminate the participation process.

Please read carefully the confidentiality statement and the research brief provided on the next page before commencing on the questionnaire. Should you need any further information, please do not hesitate to contact XXX. Your participation and contribution is highly appreciated. Thank you for your support.

p.s: Please read the consent form which explains into more detail and sign the form if you accept to participate in this study. If you have any difficulties in doing it or understanding it, please feel free to ask the poll-talker any time.

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Participant Consent Form (Questionnaire)

Research Brief:

Near or in every construction site, no matter if the construction method in preference is steel, reinforced concrete, timber or masonry, contractors place signs which states “We apologise for the inconvenience we cause to environment”. It is monitored by the researcher that the term “social cost” is emerged as a matter of quantifying “apology” to environment and third parties in terms of cost. Up until today, identification and quantification of social costs focused on infrastructure based civil engineering construction activities (i.e. road construction). Moreover, some researchers are satisfied by just suggesting a way to quantify the social costs, some are pleased by quantifying social costs and some of them claim that social costs should be included during the cost estimation and bidding process.

In line with this, the aim of this research is to define and justify the social cost types arising due to building construction activities as majority of building constructions are taking place in congested cities while thousands of people are residing around construction sites. It is certain that if there is a building construction in one's neighbourhood, facing the “social costs” is inevitable. So, “how much social cost people are inevitably exposed to?” is the question that this research seeks to find an answer.

Purpose of the Questionnaire:

First of all, in order to examine the social cost types, in other words, types of nuisances that people residing near a construction site are being inevitably exposed to this questionnaire needs to be undertaken. Additionally, an attempt will be made in accordance with the obtained responses to quantify how much these nuisances cost for the people residing next to a construction site. It worth to mention at this stage that the participants of the questionnaire needs to people who reside within the 150 meters distance (in any direction) of the construction site (distance obtained from literature) . This study is part of a PhD thesis in School of the Built Environment, under the supervision of Dr. XXXX.

Procedure:

If you agree to be in this study, you will be asked to do the following:

1. Listen carefully the questions that will be read out to you by the poll-talker
2. Answer the questions considering your experience in residing next to a construction site hence, the poll talker notes it down for you.

The total time required to complete the questionnaire should be approximately 20 minutes.

Benefits to Participant:

Participants will learn about the typical social costs types and will help the contribution of the body of knowledge in construction management.

Voluntary Nature of the Study/Confidentiality:

Your participation in this questionnaire is entirely voluntary and you may refuse to complete the study at any point during the questionnaire, or refuse to answer any questions with which you are uncomfortable. In case you refuse to carry on the questionnaire answers you have given until that stage will be disposed and you will not be considered as a respondent. You may also stop at any time and ask the poll-talker any questions you may have. Your name will never be connected to your results or to your responses on the questionnaires; instead, a number will be used for identification purposes. Information that would make it possible to identify you or any other participant will never be included in any sort of report. The data will be accessible only to those working on the project (researcher and supervisor) and it will not be shared with any other organization or individual.

Contacts and Questions:

At this time you may ask any questions you may have regarding this study. If you have questions later, you may contact XXXX at 0044 792 XXX2 or XXXX@edu.salford.ac.uk. If you have any concerns or complains about the conducted questionnaire you may contact his faculty supervisor, Dr. XXX at 0044 161 XXXX or XXXX@salford.ac.uk. Any concerns or complains about the poll-talker, you may contact the company they he/she works for at XXX or xxxxx@xxxx.com

Statement of Consent:

I have read the above information. I have asked any questions I had regarding the questionnaire and poll-talker has been answered to my satisfaction. I consent to participate in this study.

Name of Participant: _____

Date: _____
(please print)

Signature of Participant _____

Age: _____

(Note: You must be 18 years of age or older to participate in this study. Let the poll-talker aware if you are under 18 years of age.)

Thanks for your participation!

APPENDIX D – Breakdown of the cost items for reinforced concrete and lightweight steel building construction methods

Appendix D.1 – Cost of structural frame for a two storey detached villa designed by reinforced concrete construction

Description	Unit	Quantity	Unit Cost (£)	Total Cost (£)
<i>Formworks</i>				
Foundation	m ²	56.25	8.43	474.19
Slab	m ²	105.17	8.43	886.58
Columns and beams	m ²	142.83	8.43	1204.06
<i>Steel Fixing Works</i>				
Foundation	kg	3,450.00	0.35	1207.5
Slab	kg	3,306.30	0.35	1157.21
Columns and beams	kg	4,030.30	0.35	1410.61
<i>Concreting Works</i>				
Foundation	m ³	38.00	27	1026
Slab	m ³	14.94	27	403.38
Columns and beams	m ³	19.44	27	524.88
				Total: 8,295.41

Appendix D.2 – Cost of brickworks and internal plastering works for a two storey detached villa designed by reinforced concrete construction

Description	Unit	Quantity	Unit Cost (£)	Total Cost (£)
<i>Brickworks</i>				
Wall Thickness: 13.5 cm	m ²	185.97	4.9	910.63
Wall Thickness: 8.5 cm	m ²	119.82	4.38	524.41
Ytong Blocks	m ²	67.30	6.81	458.54
<i>Plastering Works</i>				
Internal walls plastering	m ²	421.33	3.17	1,334.21
				Total: 3,227.42

Appendix D.3 – Cost of roof construction and external plastering works for a two storey detached villa designed by reinforced concrete construction

Description	Unit	Quantity	Unit Cost (£)	Total Cost (£)
<i>EPS Heat Insulation</i>				
External walls jacketing works	m ²	251.62	10.33	2,599.23
<i>Roof Construction Works</i>				
Timber roof installation	m ²	82.88	14.78	1,225.97
				Total: 3,825.32

Appendix D.4 – Cost of structural frame for a two storey detached villa designed by lightweight steel construction

Description	Unit	Quantity	Unit Cost (£)	Total Cost (£)
<i>Formworks</i>				
Foundation	m ²	50.00	8.43	421.5
<i>Steel Fixing Works</i>				
Foundation	kg	2,066.00	0.38	785.08
<i>Concreting Works</i>				
Foundation	m ³	30.00	26.17	785.1
<i>Lightweight Steel Construction Works</i>				
Application of AKKON lightweight steel systems	m ²	151.17	31.84	4,813.25
<i>Oriented Strand Board (OSB) Works</i>				
Covering of external walls: 11mm OSB	m ²	286.80	2.81	807.91
Covering of roof: 11mm OSB	m ²	107.90	2.81	307.2
<i>Metal Sheet Works</i>				
Floor metal sheet application	m ²	73.80	2.9	214.02
				Total: 8,135.5

Appendix D.5 – Cost of walls and ceiling panels construction for a two storey detached villa designed by lightweight steel construction

Description	Unit	Quantity	Unit Cost (£)	Total Cost (£)
<i>Ceiling Works</i>				
FX Gypsum boards for ceilings	m ²	103.02	1.35	139.32
Water resistant (WR) gypsum boards for ceilings	m ²	13.50	1.80	24.30
<i>Wall Covering Works</i>				
FX Gypsum boards for walls	m ²	702.00	1.27	891.54
WR gypsum boards for walls	m ²	140.70	1.72	242.00
				Total: 1,293.99

Appendix D.6 – Cost of heat, sound, and water isolation systems for a two storey detached villa designed by lightweight steel construction

Description	Unit	Quantity	Unit Cost (£)	Total Cost (£)
<i>Heat insulation by using glass fibre</i>				
Internal wall insulation by 80 mm un-foiled glass fibre	m ²	116.00	1.12	129.92
External wall insulation by 100mm foiled glass fibre	m ²	244.50	1.48	361.86
Floor insulation by 80mm un-foiled glass fibre	m ²	73.80	0.96	70.85
Roof insulation by 100mm foiled glass fibre	m ²	73.80	1.32	97.41
<i>EPS Heat Insulation Works</i>				
External walls jacketing	m ²	241.80	10.33	2,498.80
<i>Shingle Roof Covering Works</i>				
Shingle roof covering	m ²	85.25	5.34	455.24
				Total: 3,614.21