

Northumbria Research Link

Citation: Çelik, Tolga, Kamali, Saeed and Arayici, Yusuf (2017) Social cost in construction projects. Environmental Impact Assessment Review, 64. pp. 77-86. ISSN 0195-9255

Published by: Elsevier

URL: <https://doi.org/10.1016/j.eiar.2017.03.001> <<https://doi.org/10.1016/j.eiar.2017.03.001>>

This version was downloaded from Northumbria Research Link:
<http://nrl.northumbria.ac.uk/id/eprint/43442/>

Northumbria University has developed Northumbria Research Link (NRL) to enable users to access the University's research output. Copyright © and moral rights for items on NRL are retained by the individual author(s) and/or other copyright owners. Single copies of full items can be reproduced, displayed or performed, and given to third parties in any format or medium for personal research or study, educational, or not-for-profit purposes without prior permission or charge, provided the authors, title and full bibliographic details are given, as well as a hyperlink and/or URL to the original metadata page. The content must not be changed in any way. Full items must not be sold commercially in any format or medium without formal permission of the copyright holder. The full policy is available online: <http://nrl.northumbria.ac.uk/policies.html>

This document may differ from the final, published version of the research and has been made available online in accordance with publisher policies. To read and/or cite from the published version of the research, please visit the publisher's website (a subscription may be required.)



Northumbria
University
NEWCASTLE



UniversityLibrary

1 **1. Introduction**

2 Construction is a large, multifaceted, and dynamic industry that accommodates processes for building
3 new structures and engineering projects. Construction works also concern processes for renovation
4 encompassing additions, alterations, or maintenance and repair of existing structures and engineering
5 projects (Behm, 2008). Construction plays an important role for the growth of local and national
6 economies (Chen, 1996; Lewis, 2004; Rameezdeen and Rameezdeen, 2006; Behm, 2008; Osei, 2013).
7 The built environment which comprises all structures and living spaces constructed or modified by
8 human beings offers social and welfare benefits (Ofori, 2004; Sarkis, Meade and Presley, 2009). For
9 instance, housing accomplishes to meet the second necessity of mankind by offering shelter from the
10 elements (George, 2002; Ijigah *et al.*, 2013). Concordantly, construction Industry underpins to foster
11 a good quality of life as it creates the built environment and provides the tangible facilities and
12 infrastructures in accordance with the needs, wants and values of the people (Bartuska, 2007; Myers,
13 2013; Osei, 2013). Therefore, happiness, life and need satisfactions of the society are interrelated
14 with the quality of the built environment thus it is one of the standard indicators of the quality of life
15 (Pearce, 2003; Mohit, 2013).

16 Despite the fact that completion of construction projects and their entry into service have a direct
17 influence on people's wellbeing, development phases of construction projects generate countless
18 unintentional adverse impacts on their surrounding environments (Butterworth, 2000; Gilchrist and
19 Allouche, 2005; Centre for Good Governance, 2006; Sev, 2009; Zainul Abidin Nazirah, 2010;
20 Balaban, 2012). Especially in urban areas, due to high density of population implementation of
21 construction projects turn out to be the sources of serious nuisances to, including but not limited,
22 adjacent residents and businesses (Pucker, Allouche and Sterling, 2006; Gangolells *et al.*, 2009;
23 Ferguson, 2012). Apeldoorn (2008) put forward that level of construction causative nuisances
24 incurred to the surrounding society is highly dependent on the location of a project. He performed

25 several case studies and determined that in densely populated areas the negative effects of
26 construction activities are greater compared to the areas with lower population.

27 Near or in every construction zone, no matter if the executed project accommodates processes for
28 building new or renovating existing structures, contractors place signs which state “We apologise for
29 the inconvenience we cause to environment”. Many researchers (Allouche, Ariaratnam and Abourizk,
30 2000; Gilchrist and Allouche, 2005; Najafi and Gokhale, 2005; Rahman, Vanier and Newton, 2005;
31 Yu and Lo, 2005; Matthews, Allouche and Sterling, 2015), by referring the term “environment” as
32 the society who surround the construction sites that are adversely impacted by the operation of these
33 sites in terms of pollution, traffic problems, economic activities and damage to natural/built
34 environment, embark to estimate the cost of contractors’ “apology” on behalf of the society
35 (Apeldoorn, 2008; Xueqing *et al.*, 2008). These researchers have commonly entitled this attempt as
36 the quantification of the construction causative “social costs”.

37 An overview on social costs in construction projects will be presented in this review. This study has
38 intended to review previous studies about definition, identification, classification and quantification
39 of social costs in construction industry. Finally, with regard to the social cost definitions in the
40 previous researches, a comprehensive and exhaustive definition for social cost in construction
41 industry is presented.

42 **2. Social costs definition**

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

46 Ormsby (2009) emphasises that social costs which are new to civil engineering / construction
47 management, are well studied subjects in economics with research dating back over a century and a

48 half. On the other hand, Button (1993) states that the term social cost is originated by the economists
49 for use in public policy analysis.

50 Economists generally have consensus to define the social costs as follows (Field, 1997; Baker *et al.*,
51 2013): “Social costs are the overall impact of an economic activity on the welfare of society. Social
52 costs are the sum of private costs arising from the activity and any externalities”.

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

59 At the end of a comprehensive literature review, it is revealed that many definitions of the social costs
60 particularly associated with civil engineering projects have been proposed over the last two decades
61 (Boyce and Bried, 1998; McKim, 1998; Rahman, Vanier and Newton, 2005; Yu and Lo, 2005;
62 Pucker, Allouche and Sterling, 2006; Matthews, Allouche and Sterling, 2015). For instance,
63 Allouche, Ariaratnam, and Abourizk (2000) defines the social costs as costs generated due to
64 execution of a construction project incurred by the parties involved in the contractual agreement. For
65 measuring purposes, they encompassed social costs by the costs incurred on the third parties as a
66 result of being exposed to air pollution, noise, vibration, disruption to traffic and increased level of
67 traffic accidents. In their work, they identified costs subject to contract as direct, indirect, and social
68 costs. Meanwhile, Tanwani (2011) offered the following definition: construction causative adverse
69 impacts that neighbouring communities are inevitably being exposed to due to implementation of
70 construction projects and for which in traditional practices parties involved in the project such as;
71 owner, designer, contractor, and users are not held accountable is named as “social costs”. Gilchrist
72 and Allouche (2005) just as Allouche, Ariaratnam and Abourizk (2000) proposed that project

73 contractual costs should be comprised of direct, indirect and social costs but for measuring purposes
74 distinctively grouped the social costs based on the area of impact namely: traffic, pollution, economic
75 activities, and ecological/social/health.

76 On the other hand, other researchers (McKim and Kathula, 1999; Rahman, Vanier and Newton, 2005)
77 recognize the economic definition of Field (1997) and Baker *et al.* (2013) and appraise the entire
78 project costs to be encompassed in the social costs and identified it as the overall impact of a
79 construction activity on the welfare of society. They categorised the encompassing social costs as
80 direct, indirect and intangible costs.

81 Apeldoorn (2008) offers the following definition: Implementation of construction projects generates
82 disruptions to common life patterns of the society around the construction zones. Equivalent monetary
83 values of these disruptions are called social costs. Contrary to previous researches, they offered two
84 categories for costs associated with a construction project namely, costs incurred to the owner of the
85 project: direct and indirect costs; and costs incurred to the society: quantifiable and non-quantifiable
86 social costs.

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

94 **3. Social costs consideration**

95 Civil engineering projects’ development phases associated social costs while widely acknowledged,
96 are predominantly not considered during estimation process of the project initial cost hence, they are

97 rarely considered in the design, planning or bid evaluation phases of construction projects (Gilchrist
98 and Allouche, 2005). In traditional bid estimation practices, bid price prepared by the contractors for
99 the tendered project does not incorporate the social costs (Apeldoorn, 2008). According to Yu and Lo
100 (2005), because the social costs are being undertaken by the public rather than the project participants,
101 these costs are not included in the contractual bid value. Pucker, Allouche and Sterling (2006)
102 explained why project participants do not take responsibility for considering the infrastructure related
103 social costs as follows: “For the most part, social costs are not considered during a construction
104 project’s planning, design and bid evaluation stages because they cannot be calculated using standard
105 estimating methods. In recent years, efforts have been made to introduce approaches for predicting
106 social costs associated with utility construction projects. Nevertheless, unit cost data needed for the
107 verification of such prediction methods is lacking.”

108 In conventional practices parties involved in construction projects are not held accountable for the
109 social costs as these costs are incurred to the public instead of parties involved in the project such as;
110 owner, designer, contractor, and users (Kapp, 1970; Yu and Lo, 2005). This is why in practice the
111 contractors’ estimators did not involve in estimating the social costs for bidding purposes so far.
112 Having not performing an effort to estimate the social cost does not mean that, the social costs are
113 not existent. The study found that social costs can account for up to 400% of construction costs on
114 certain projects (Rahman, Vanier and Newton, 2005).

115 However, during design build and construction phases of a project, only considering needs, wants,
116 and expectations of parties involved in the project and responding to these accordingly without being
117 concerned about the expectations of other interest groups leads to lack of responsibility and improper
118 management of the social costs which can in return result with public objection hence delay the
119 completion date of the project (Yu and Lo, 2005). To clarify the interest groups of construction
120 projects, Guoqing and Shaojun (2004) referred interest groups to those who have either direct or
121 indirect relation with the development during the project preparation and construction period. In light

122 of this information, it is deduced that society surrounding the construction sites should also be
123 considered as project stakeholders and broader accountability should be taken by the parties involved
124 in the project. This outcome is reinforced by the definition made by Ducoff (2013) about
125 accountability. He has defined accountability as taking ownership for the behaviour of others as a
126 result of implementing projects even if others are not directly involved because it occurred on your
127 watch. In the past, many researchers have come to a consensus about the difficulty in predicting the
128 social costs due to lack of a standard estimating method and in return they attempted to establish one
129 (Boyce and Bried, 1998; McKim, 1998; Gilchrist and Allouche, 2005; Rahman, Vanier and Newton,
130 2005; Yu and Lo, 2005; Pucker, Allouche and Sterling, 2006; Matthews and Allouche, 2010).
131 Additionally, each proposed method suggests a cost category for the consideration of the social costs
132 but the way to compensate these costs for the society is yet to be determined. Xueqing *et al.* (2008)
133 stated that in majority of the conducted researches the social costs incorporated into bid evaluation
134 processes are predicted based on formerly collected data. In his research, he highlights the complexity
135 in accurately predicting the future social costs during bidding period.

136 **4. Social costs classification**

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

142 Matthews, Allouche and Sterling (2015) assess the social cost impact on pipeline infrastructure
143 projects. They categorized social cost in eight most important divisions for these types of projects
144 which also can be considered for many utility construction projects, namely travel delay, vehicle
145 operating costs, decreased road surface value, lost business revenue, loss of parking revenue, cost of
146 dust control, noise pollution cost and safety.

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

154 Wang (2011) analyses the urban underground expressway constructions based on social costs and
155 determine specific social costs for these types of constructions. The social costs determined by Wang
156 (2011) are pollution, traffic delays, access restrictions, other costs, safety and pavement damage.

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

162 For that reason, it can be said that social cost parameters more or less will be the same in any type of
163 construction project, but the intenseness of it will vary. This is why some of the scholars classify
164 social costs in general instead of focusing on specific project types. For instance, Yu and Lo (2005)
165 mentioned that there are three types of social costs occurred in all construction projects, namely traffic
166 impacts, environmental impacts, and business impacts. They consider traffic impacts as the vehicles
167 and the road user costs emerged due to construction works. Environmental impacts are the daily
168 environmental costs to the public due to the execution of construction works, such as daily noise
169 pollution cost, daily air pollution cost. Business impacts are the daily loss of local business due to the
170 construction operations, such as productivity loss and loss of income. Ferguson (2012) also classified
171 the construction social costs in similar way.

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

175 Gilchrist and Allouche (2005) mentioned that there are four types of construction social costs, namely
176 traffic, economic activities, pollution and ecological/social/health, and they elaborate this
177 classification by inserting sub categories, namely adverse impact and social cost indicators. The
178 proposed classification is shown in Figure 1. It depicts the breakdown structure of construction social
179 costs. The construction social costs are classified under four categories: traffic, economic activities,
180 pollution and ecological/social/health. These categories consist of sub-categories. These sub-
181 categories are being considered under two main headings, namely adverse impacts and social cost
182 indicators.

183 **4.1. Traffic**

184 The negative effects of construction projects on the traffic was stated widely in the literature (Jiang,
185 1999; Lee, Ibbs and Thomas, 2005). Especially, the highway renovation projects directly affect the
186 traffic, and cause social costs to the road users due to the reduced speed, lane closures and alteration
187 of traffic circulation patterns. However, the construction projects in urban areas can also affect the
188 traffic; therefore, the construction social costs related to traffic should be considered not only in
189 highway renovation projects but also in the construction projects in urban areas. Gilchrist and
190 Allouche (2005) mentioned about three adverse impacts, namely prolonged closure of road space,
191 detours and utility cut.

192 Although most of the construction activities are performed within the border of the construction site,
193 some of the activities can require space outside the construction site, such as movement of
194 machineries while performing the construction activities and entry/exit corridors. Especially, in urban
195 areas, the entry/exist corridors can affect the traffic flow intensely, since the manoeuvre capacity of

196 the construction vehicles are so limited when compared with the vehicles used in daily life. Therefore,
197 traffic congestion, loss of parking spaces and changes in traffic patterns can be observed in the roads
198 close to the construction sites. These could lead to time delay costs, extra oil combustion, increase in
199 number of traffic accidents, vehicle loss cost and environmental pollutions (Mao, Zhu and Duan,
200 2012).

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

207 **4.2. Economic activities**

208 Throughout a project, the businesses placed in the neighbourhood of the construction sites can be
209 affected negatively, since, the customers can be confronted with difficulties to reach these businesses
210 due the closure of the roads and detours. In addition, the customers do not prefer spending their spare
211 time in an environment where dust and noise exist, in other words they will prefer other markets to
212 shop. Consequently, these companies can lose their income. In addition, the householders close to the
213 construction site can lose their income. Firstly, the value of their properties decreases significantly
214 due to high noise and dust levels, and lack of aesthetics. Secondly, the householders can lose the rent
215 revenue. Even, in some situations, the governments have to mitigate the loss of the householders, for
216 instance, Manchester airport provides financial assistance to the householders for installation of sound
217 proof glazing and home relocation (Manchester Airport, 2013). Finally, the properties adjacent to
218 construction projects can be damaged hence, additional necessity in terms of cost occurs, in order to
219 repair and maintain the damaged properties.

220 The construction can also affect the employees' productivity rate adversely due to dust and noise, and
221 construction related nuisances. In addition, the efficiency level of the equipment that are sensitive to
222 the high level of noise and vibration can be reduced which can cause fatal consequences. Finally,
223 traffic congestion can affect the mood of the employees which affect their productivity indirectly.
224 The loss of income of businesses is also likely to affect the economy of governments indirectly due
225 to the reduction in tax revenue. Consequently, the impact of the construction on business and public
226 agencies should be considered as one of the construction social costs.

227 **4.3. Pollution**

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

234 *4.3.1. Noise*

235 Noise is defined as any sound that has potential to cause psychological or physiological symptoms
236 such as high blood pressure, cardiovascular disease, anxiety, restlessness, irritability, sleep
237 disturbances and difficulty in concentrating (Gilchrist and Allouche, 2005; Akan *et al.*, 2012). Bein
238 (1997) stated that noise can affect social behavioural, mental and physical health of people. In other
239 words, high decibel noises should be considered seriously by the government, especially in urban
240 environment.

241 Unfortunately, construction is one of the main sources of noise. Noise will be generated by site
242 operations including heavy earth moving and paving equipment, operator pumps, generators, and

243 demolition activities. The effects of noise are not limited only with psychological and physiological
244 symptoms, but also the economic effects of noise are also observed

245 *4.3.2. Dust*

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

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

254 *4.3.3. Vibration*

255 Around the construction site, a damaging vibration can always be felt throughout digging, pile
256 driving, compacting, blasting and operation of heavy construction equipment. The vibration can
257 create social costs, since these vibrations can damage structures adjacent to the construction site. In
258 addition, it can affect the sensitive equipment that is used in the businesses and hospitals. This
259 situation can lead to fatal and unexpected results. Finally, high frequency vibration can create
260 psychological trauma due to lack of safety psychology, even low frequency vibration can have a
261 psychological impact on people (Read and Vickridge, 2004).

262 *4.3.4. Air pollution*

263 The machines used in the construction have high power engines which produce harmful air emissions
264 causing serious damages to human beings and other living organizations. These harmful emissions

265 not only affect the lower layer of atmosphere, but also affect ozone layer which absorbs the sun's
266 harmful ultraviolet radiation.

267 **4.4. Ecological / Social / Health**

268 The construction projects can affect the ecological systems, especially the groundwater table, surface
269 water areas and the recreational areas are vulnerable against the construction activities. In addition,
270 the quality of life of the residents close to the construction site is significantly decreased due to the
271 environmental pollution and traffic. The environmental pollution can lead to fatal diseases, such as
272 respiratory illness, cardiovascular diseases, allergies, anxiety and annoyance. (Gilchrist and Allouche,
273 2005) mentioned two adverse impacts associated with damage to ecological systems, namely;
274 surface/subsurface disruption and damage to recreational areas.

275 The negative impact of construction on the ground is obvious, however the construction does not only
276 damage the ground but also it affects the natural water that exist around the construction site and
277 groundwater. The construction activities can affect the natural structure of the water which lead to
278 bank erosion, flooding, alterations of the normal course of rivers and streams and damage to the
279 aquaculture (Gilchrist and Allouche, 2005). In addition, in order to facilitate construction, the ground
280 water level placed under the construction area is lowered by using different methods, such as deep
281 wells, well-points and horizontal drainage. However, this operation can lead to serious consequences,
282 such as deterioration of green life, and reduction of water required for agriculture

283 **5. Social costs quantification**

284 The quantification of social costs is set of procedures followed to evaluate the cost of construction
285 originated adverse impacts. Various scholars have proposed numerous approaches where each
286 approach accommodates similar procedures to evaluate the social costs. It is construed that majority
287 of the performed studies focused on evaluation of the infrastructure projects related adverse impacts.
288 Most of the studies for quantifying the social cost are conducted in highway construction projects.

289 For instance, Jiang (1999) developed a model for estimating excess user costs at highway work zones.
290 He determined that the highway work zones can cause additional travel time, consumption of extra
291 fuel and oil, and wear and tear of vehicle parts due to the traffic bottlenecks where accumulation of
292 these lead to traffic delays and congestions.

293 Matthews, Allouche and Sterling (2015) propose a mathematical method to quantify eight different
294 types of social costs relating to water infrastructure construction projects. They analyse two pipeline
295 infrastructure projects, each presenting an open-cut and trenchless scenario to determine trends for
296 the different social cost divisions. The analysis of these two projects reveal that the inclusion of social
297 cost on the project cost estimation could make open-cut method less advantageous in comparison to
298 trenchless technology, especially in high density urban areas. Moreover, it is stated that the relative
299 percentage of social costs is greater for the projects with low direct costs due to the limited impact of
300 project technical complexity on its social costs.

301 the social costs are mostly independent of many of technical parameters which affecting direct costs
302 such as groundwater elevation, pipe diameter and soil conditions.

303 Lee, Ibbs and Thomas (2005) developed an innovative approach to development of construction and
304 traffic management plans for I-15 Devore project constructed in Southern California. They used
305 CA4PRS (Construction Analysis for Pavement Rehabilitation Strategies) software for scheduling
306 analysis. They mentioned about the negative effects of construction activities on the traffic flow of
307 the roadways above or near flow capacity. They compared the different scenarios in determination of
308 optimum solution for this project and obtained an optimum solution by considering construction cost,
309 road user cost, and agency cost. In addition to these, there are studies that have developed innovative
310 contracting methods which consider social costs in the literature.

311 Herbsman (1995) evaluated A+B bidding method which consists of two parts. First part, namely A,
312 is the construction costs which can be considered as the traditional bidding method. The second part

313 composes of project duration time and this part was calculated by considering the road user cost which
314 is basically social cost.

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

319 Çelişkin(2014) describes the social costs of a building construction site in the residential areas and
320 develop a generic social cost estimation system to monetize it. Moreover, a social cost compensation
321 method is also presented that consists of a cost category for the social costs and a compensation
322 method for the affected residents in the vicinity of construction sites. It is found that execute of
323 building construction projects in residential areas incur £6.25 per day per house located within 150m
324 distance of a construction site.

325 Yu and Lo (2005) develop a time-dependent construction social costs (COSCO) model to quantify
326 the comprehensive construction social cost. In their model, they tried to integrate three social costs.

327 Gilchrist and Allouche (2005) proposed a model based on abovementioned four types of social costs
328 they categorized with the intention of quantifying the social costs associated with the construction
329 projects. They considered seven methods for valuation of social costs, namely; loss of productivity,
330 human capital, replacement cost, lane closure cost, hedonic pricing, user delay costs, and contingent
331 valuation technique. They identified that different methods are suitable for valuation of different
332 social costs. For instance, they concluded that the loss of productivity method should be used for
333 valuation of loss of income, productivity reduction, reduction in taxes revenues and health costs. In
334 addition, different methods can be used for valuation of one social cost. For instance, travel time
335 social cost can be quantified by using lane closure cost and user delay costs valuation techniques.

336 **Conclusion**

337 It can be concluded that, in the literature the majority of the attempts to define and quantify the social
338 costs, have been focused on the construction projects incorporating infrastructure works. It is obvious
339 that, the majority of the infrastructure projects, such as highways, railways, airports, etc. are being
340 accomplished mostly out of the congested residential areas. Therefore, inherently the social costs of
341 those projects are less involved with the residents. However, attempts to investigate the social costs
342 of building constructions in urban residential areas are still insufficient due to probable difficulties
343 and complexities of including the third parties.

344 With regard to the previous social costs definition, the following statement can be considered as an
345 appropriate definition for construction social costs. “The people themselves and the environment they
346 live in; their homes and neighbourhoods if located around the building construction zones are exposed
347 to adverse impacts of the construction activities. In return, people react via altering their daily routine
348 to resolve or alleviate the exposed disruptions to their common life patterns. Cost of this reaction is
349 defined as the social costs associated with building construction projects”.

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

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

359 members of the society into social cost calculations, some researches that are conducted in this
360 manner can be used as a road map during further investigations.

361 Additionally, the social cost quantification techniques suggested by researchers are superficial and
362 need to be elaborated more. The methods and techniques developed so far have not managed to go
363 beyond a conjecture. Still more investigations and researches are required to corroborate the effects
364 of social costs especially building construction social costs in the residential areas. Up until now, the
365 developed formulas and models for social cost calculation are scholarly hypothesis based on their
366 investigations.

367 As aforementioned, up until recently different methods are suggested by scholars concerning the
368 quantification methods of the social costs and many scholars have discussed the
369 difficulties/complexities in doing it. In majority of these studies, there are attempts with the intention
370 of expressing the social costs in terms of monetary units. The only common part among the numerous
371 methods suggested by scholars for quantifying the social costs is the aspect that drivers of these costs
372 are evaluated on daily basis for the duration of the construction project. This indicates that even
373 though elements of the social costs may act upon the third parties at different intensity level on each
374 day, an average daily cost of the nuisances occurring due to existence of construction site in the
375 neighbourhood can be taken into consideration during quantification of the social costs.

376 Finally, it is acknowledged that quantifying the social costs on construction activity basis is not
377 practicable. For instance, the third parties who are being exposed to nuisance are normally not aware
378 of which specific construction activity is the driver for the exposed nuisance. This is the reason why
379 the social costs have been preferred to be quantified on daily basis by scholars as well.

380 **References**

381 Akan, Z., Yilmaz, A., Özdemir, O., Selvi, Y. and Korpınar, M. A. (2012) 'P-436 - Noise pollution,
382 psychiatric symptoms and quality of life: noise problem in the east region of Turkey', *European*

383 *Psychiatry*. Elsevier Masson, 27, p. 1. doi: 10.1016/S0924-9338(12)74603-5.

384 Allouche, E. N., Ariaratnam, S. T. and Abourizk, S. M. (2000) ‘Multi-dimensional utility model for
385 selection of a trenchless construction method’, in *Construction Congress VI: Building Together for a
386 Better Tomorrow in an Increasingly Complex World*. Reston, VA: American Society of Civil
387 Engineers, pp. 543–553. doi: 10.1061/40475(278)59.

388 Apeldoorn, S. (2008) ‘Comparing the Costs – Trenchless Versus Traditional Methods’, *MIESA*,
389 38(4), pp. 55–57.

390 Baker, E., Fowlie, M., Lemoine, D. and Reynolds, S. S. (2013) ‘The Economics of Solar Electricity’,
391 *Annual Review of Resource Economics*. Annual Reviews, 5(1), pp. 387–426. doi: 10.1146/annurev-
392 resource-091912-151843.

393 Balaban, O. (2012) ‘The negative effects of construction boom on urban planning and environment
394 in Turkey: Unraveling the role of the public sector’, *Habitat International*, 36(1), pp. 26–35. doi:
395 10.1016/j.habitatint.2011.05.003.

396 Bartuska, T. (2007) ‘The Built Environment: Definition and Scope’, in Bartuska, T. and Young, G.
397 (eds) *The Built Environment: A Creative Inquiry into Design and Planning*. Crisp Publications.

398 Behm, M. (2008) ‘Construction Sector’, *Journal of Safety Research*, 39(2), pp. 175–178. doi:
399 10.1016/j.jsr.2008.02.007.

400 Bein, P. (1997) *Monetization of Environmental Impacts of Roads*. Victoria: HighwMinistry of
401 Transportation and Highways.

402 Boyce, G. and Bried, E. (1998) ‘Social Cost Accounting for Trenchless Projects’, in *NORTH
403 AMERICAN NO DIG*. Albuquerque, pp. 2–12. Available at:
404 [https://www.tib.eu/en/search/id/BLCP%3ACN029319728/Social-Cost-Accounting-for-Trenchless-
405 Projects/](https://www.tib.eu/en/search/id/BLCP%3ACN029319728/Social-Cost-Accounting-for-Trenchless-Projects/).

406 Butterworth, I. (2000) 'The Relationship Between the Built Environment and Wellbeing : a Literature
407 Review', *Prepared for the Victorian Health Promotion Foundation*, (February).

408 Button, K. (1993) *Transport, the environment, and economic policy*. Aldershot: Edward Elgar.

409 Çelik, T. (2014) *Developing a Building Construction Associated Social Cost Estimation System for*
410 *Turkish Construction Industry*. University of Salford.

411 Centre for Good Governance (2006) *A Comprehensive Guide for Social Impact Assessment*.

412 Chen, J. J. (1996) 'The impact of public construction investment upon special economic zones - The
413 Chinese experience', *Construction Management and Economics*. Taylor & Francis Group, 14(2), pp.
414 175–182. doi: 10.1080/014461996373610.

415 Chung, S.-S. and Poon, C.-S. (1997) 'Quantifying externalities in solid waste management in Hong
416 Kong', *Journal of Environmental Engineering*. American Society of Civil Engineers, 123(3), p. 282.
417 doi: 10.1061/(ASCE)0733-9372(1997)123:3(282).

418 Ducoff, N. (2013) *Six strategies to create a culture of accountability - Strategies*. Available at:
419 <http://www.strategies.com/blog/six-strategies-to-create-a-culture-of-accountability/> (Accessed: 4
420 April 2014).

421 Ferguson, A. (2012) *Qualitative Evaluation Of Transportation Construction Related Social Costs*
422 *And Their Impacts On The Local Community*. The University of Texas at Arlington. Available at:
423 <http://hdl.handle.net/10106/11165>.

424 Field, B. C. (1997) *Environmental Economics: An Introduction*. 2nd edn. Irwin/McGraw-Hill.

425 Gangolells, M., Casals, M., Gassó, S., Forcada, N., Roca, X. and Fuertes, A. (2009) 'A methodology
426 for predicting the severity of environmental impacts related to the construction process of residential
427 buildings', *Building and Environment*, 44(3), pp. 558–571. doi: 10.1016/j.buildenv.2008.05.001.

428 George, C. K. (Catherine K. (2002) *Basic principles and methods of urban and regional planning*. 2.
429 Aufl. Lagos: Libro-Gem Books.

430 Gilchrist, A. and Allouche, E. N. (2005) 'Quantification of social costs associated with construction
431 projects: State-of-the-art review', *Tunnelling and Underground Space Technology*, 20(1), pp. 89–
432 104. doi: 10.1016/j.tust.2004.04.003.

433 Guoqing, S. and Shaojun, C. (2004) 'ANALYSIS ON SOCIAL IMPACT IN WATER
434 CONSERVANCY AND HYDROPOWER DEVELOPMENT', in *UNHYDRO*. Beijing, pp. 1–8.

435 Herbsman, Z. J. (1995) 'A+B Bidding Method—Hidden Success Story for Highway Construction',
436 *Journal of Construction Engineering and Management*. American Society of Civil Engineers, 121(4),
437 pp. 430–437. doi: 10.1061/(ASCE)0733-9364(1995)121:4(430).

438 Herbsman, Z. J. and Glagola, C. R. (1998) 'Lane Rental - Innovative way to reduce road construction
439 time', *Journal of Construction Engineering and Management*. American Society of Civil Engineers,
440 124(5r), pp. 411–417. doi: 10.1061/(ASCE)0733-9364(1998)124:5(411).

441 Ijigah, E. A., Jimoh, R. A., Aruleba, B. O. and Ade, A. B. (2013) 'An Assessment of Environmental
442 Impacts of Building Construction Projects', *Civil and Environmental Research*, 3(1), pp. 93–105.

443 Jiang, Y. (1999) 'A Model for Estimating Excess User Costs at Highway Work Zones',
444 *Transportation Research Record*. Transportation Research Board of the National Academies,
445 1657(1), pp. 31–41. doi: 10.3141/1657-05.

446 Kapp, K. W. (1970) 'ENVIRONMENTAL DISRUPTION AND SOCIAL COSTS: A CHALLENGE
447 TO ECONOMICS', *Kyklos*. Blackwell Publishing Ltd, 23(4), pp. 833–848. doi: 10.1111/j.1467-
448 6435.1970.tb01047.x.

449 Lee, E.-B., Ibbs, C. W. and Thomas, D. (2005) 'Minimizing Total Cost for Urban Freeway
450 Reconstruction with Integrated Construction/Traffic Analysis', *Journal of Infrastructure Systems*.

451 American Society of Civil Engineers, 11(4), pp. 250–257. doi: 10.1061/(ASCE)1076-
452 0342(2005)11:4(250).

453 Lewis, T. M. (2004) ‘The construction industry in the economy of Trinidad & Tobago’, *Construction*
454 *Management and Economics*. Taylor & Francis Group, 22(5), pp. 541–549. doi:
455 10.1080/0144619042000190234.

456 Manchester Airport (2013) *Mitigation Schemes*. Available at:
457 <http://www.manchesterairport.co.uk/community/living-near-the-airport/mitigation-schemes/>
458 (Accessed: 21 May 2013).

459 Mao, L.-Z., Zhu, H.-G. and Duan, L.-R. (2012) ‘The Social Cost of Traffic Congestion and
460 Countermeasures in Beijing’, in *Sustainable Transportation Systems*. Reston, VA: American Society
461 of Civil Engineers, pp. 68–76. doi: 10.1061/9780784412299.0010.

462 Matthews, J. C. and Allouche, E. N. (2010) ‘A social cost calculator for utility construction projects’,
463 in *North American Society for Trenchless Technology No-Dig Show 2010*.

464 Matthews, J. C., Allouche, E. N. and Sterling, R. L. (2015) ‘Social cost impact assessment of pipeline
465 infrastructure projects’, *Environmental Impact Assessment Review*, 50, pp. 196–202. doi:
466 10.1016/j.eiar.2014.10.001.

467 McKim, R. A. (1998) ‘Bidding Strategies for Conventional and Trenchless Technologies Considering
468 Social Costs’, *Canadian Journal of Civil Engineering*, 24(40), pp. 819–827. doi: 10.1139/197-036.

469 McKim, R. A. and Kathula, V. S. (1999) ‘Social Costs and Infrastructure Management’, in *INFRA*
470 *99 International*. Montreal: CERIU, p. 10.

471 Mohit, M. A. (2013) ‘Quality of Life in Natural and Built Environment – An Introductory Analysis’,
472 *Procedia -Social and Behavioral Sciences*. Elsevier, 101, pp. 33–43. doi:
473 10.1016/j.sbspro.2013.07.176.

474 Myers, D. (2013) *Construction Economics: A New Approach*. 3rd edn. Routledge.

475 Najafi, M. and Gokhale, S. (2005) 'SOCIAL COSTS OF UTILITY CONSTRUCTION: A LIFE
476 CYCLE COST APPROACH - Access Engineering from McGraw-Hill', in Najafi, M. (ed.)
477 *Trenchless Technology: Pipeline and Utility Design, Construction, and Renewal*. McGraw-Hill
478 Education. Available at: [https://accessengineeringlibrary.com/browse/trenchless-technology-](https://accessengineeringlibrary.com/browse/trenchless-technology-pipeline-and-utility-design-construction-and-renewal/c9780071422666ch02)
479 [pipeline-and-utility-design-construction-and-renewal/c9780071422666ch02](https://accessengineeringlibrary.com/browse/trenchless-technology-pipeline-and-utility-design-construction-and-renewal/c9780071422666ch02).

480 Ofori, G. (2004) 'Construction Industry Development for disaster prevention and response', *2nd*
481 *International Conference on Post-Disaster Reconstruction: Planning for Reconstruction*, (65), pp. 1–
482 21.

483 Ormsby, C. (2009) *A framework for estimating the total cost of buried municipal infrastructure*
484 *renewal projects: A Case Study in Montreal, [Master's Thesis]*. McGill University. Available at:
485 digitool.library.mcgill.ca/thesisfile66768.pdf.

486 Osei, V. (2013) 'the Construction Industry and Its Linkages To the Ghanaian Economy-Policies To
487 Improve the Sector'S Performance', *International Journal of Development and Economic*
488 *Sustainability*, 1(1), pp. 56–72. Available at: [https://www.mendeley.com/research/construction-](https://www.mendeley.com/research/construction-industry-linkages-ghanaian-economypolicies-improve-sectors-performance/?utm_source=desktop&utm_medium=1.15.2&utm_campaign=open_catalog&userDocumentId={734c8d10-4792-4dc7-8b7f-04949f16bf28})
489 [industry-linkages-ghanaian-economypolicies-improve-sectors-](https://www.mendeley.com/research/construction-industry-linkages-ghanaian-economypolicies-improve-sectors-performance/?utm_source=desktop&utm_medium=1.15.2&utm_campaign=open_catalog&userDocumentId={734c8d10-4792-4dc7-8b7f-04949f16bf28})
490 [performance/?utm_source=desktop&utm_medium=1.15.2&utm_campaign=open_catalog&userDoc](https://www.mendeley.com/research/construction-industry-linkages-ghanaian-economypolicies-improve-sectors-performance/?utm_source=desktop&utm_medium=1.15.2&utm_campaign=open_catalog&userDocumentId={734c8d10-4792-4dc7-8b7f-04949f16bf28})
491 [umentId={734c8d10-4792-4dc7-8b7f-04949f16bf28}](https://www.mendeley.com/research/construction-industry-linkages-ghanaian-economypolicies-improve-sectors-performance/?utm_source=desktop&utm_medium=1.15.2&utm_campaign=open_catalog&userDocumentId={734c8d10-4792-4dc7-8b7f-04949f16bf28}).

492 Pearce, D. (2003) *The Social and Economic Value of Construction*, nCRISP. doi:
493 [http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:The+Social+And+Economic+Val](http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:The+Social+And+Economic+Value+of+Construction#1)
494 [ue+of+Construction#1](http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:The+Social+And+Economic+Value+of+Construction#1).

495 Pucker, J., Allouche, E. N. and Sterling, R. L. (2006) *Social Costs Associated with Trenchless*
496 *Projects: Case Histories in North America and Europe*.

497 Rahman, S., Vanier, D. J. and Newton, L. A. (2005) *MIIP Report: Social Cost Considerations for*
498 *Municipal Infrastructure Management*, NRC Publications Archive. Ottawa. doi: 10.4224/20377011.

499 Rameezdeen, T. and Rameezdeen, R. (2006) ‘Study of Linkages Between Construction Sector and
500 Other Sectors of The Sri Lankan Economy’, *Built Environment*, 6(2), pp. 1–15. Available at:
501 <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.163.1561>.

502 Read, G. F. and Vickridge, I. (2004) ‘Social or Indirect Costs of Public Utility Works’, in *Sewers:*
503 *Replacement and New Construction*. Elsevier.

504 Sarkis, J., Meade, L. and Presley, a (2009) ‘Sustainability in the Built Environment: Factors and a
505 Decision Framework’, *Handbook of Corporate Sustainability: Frameworks, Strategies and Tools*,
506 (October 2015), p. 113.

507 Sev, A. (2009) ‘How can the construction industry contribute to sustainable development? A
508 conceptual framework’, *Sustainable Development*. John Wiley & Sons, Ltd., 17(3), pp. 161–173. doi:
509 10.1002/sd.373.

510 Tanwani, R. (2011) *Social Costs of Traditional Construction Methods | Gunda Corporation, Gunda*
511 *Corporation*. Available at: [http://gundacorp.com/2012/04/19/social-costs-of-traditional-](http://gundacorp.com/2012/04/19/social-costs-of-traditional-construction-methods/)
512 [construction-methods/](http://gundacorp.com/2012/04/19/social-costs-of-traditional-construction-methods/).

513 Teo, M. M. M. and Loosemore, M. (2001) ‘A theory of waste behaviour in the construction industry’,
514 *Construction Management and Economics*. Taylor & Francis Group, 19(7), pp. 741–751. doi:
515 10.1080/01446190110067037.

516 Wang, R. (2011) ‘Autos, transit and bicycles: Comparing the costs in large Chinese cities’, *Transport*
517 *Policy*, 18(1), pp. 139–146. doi: 10.1016/j.tranpol.2010.07.003.

518 Wong, E. O. W. and Yip, R. C. P. (2004) ‘Promoting sustainable construction waste management in
519 Hong Kong’, *Construction Management and Economics*. Taylor & Francis Group, 22(6), pp. 563–

520 566. doi: 10.1080/0144619042000226270.

521 Woskie, S. R., Kalil, A., Bello, D. and Virji, M. A. (2002) 'Exposures to quartz, diesel, dust, and
522 welding fumes during heavy and highway construction.', *AIHA journal : a journal for the science of*
523 *occupational and environmental health and safety*, 63(4), pp. 447–457. doi:
524 10.1080/15428110208984733.

525 Xueqing, W. X. W., Bingsheng, L. B. L., Allouche, E. N. and Xiaoyan, L. X. L. (2008) 'Practical bid
526 evaluation method considering social costs in urban infrastructure projects', *2008 4th IEEE*
527 *International Conference on Management of Innovation and Technology*, (2000), pp. 617–622. doi:
528 10.1109/ICMIT.2008.4654436.

529 Yu, W.-D. and Lo, S.-S. (2005) 'Time-dependent construction social costs model', *Construction*
530 *Management and Economics*. Taylor & Francis Group, 23(3), pp. 327–337. doi:
531 10.1080/01446190500040281.

532 Yuan, Q.-M., Cui, D.-J. and Jiang, W. (2013) 'Study on evaluation methods of the social cost of green
533 building projects', in Jun, W., Yanbin, L., Jinfeng, W., and Fouad, R. H. (eds) *Advances in Industrial*
534 *Engineering, Information and Water Resources*. Southampton: WIT press.

535 Zainul Abidin Nazirah, N. (2010) 'Investigating the awareness and application of sustainable
536 construction concept by Malaysian developers', *Habitat International*, 34(4), pp. 421–426. doi:
537 10.1016/j.habitatint.2009.11.011.

538

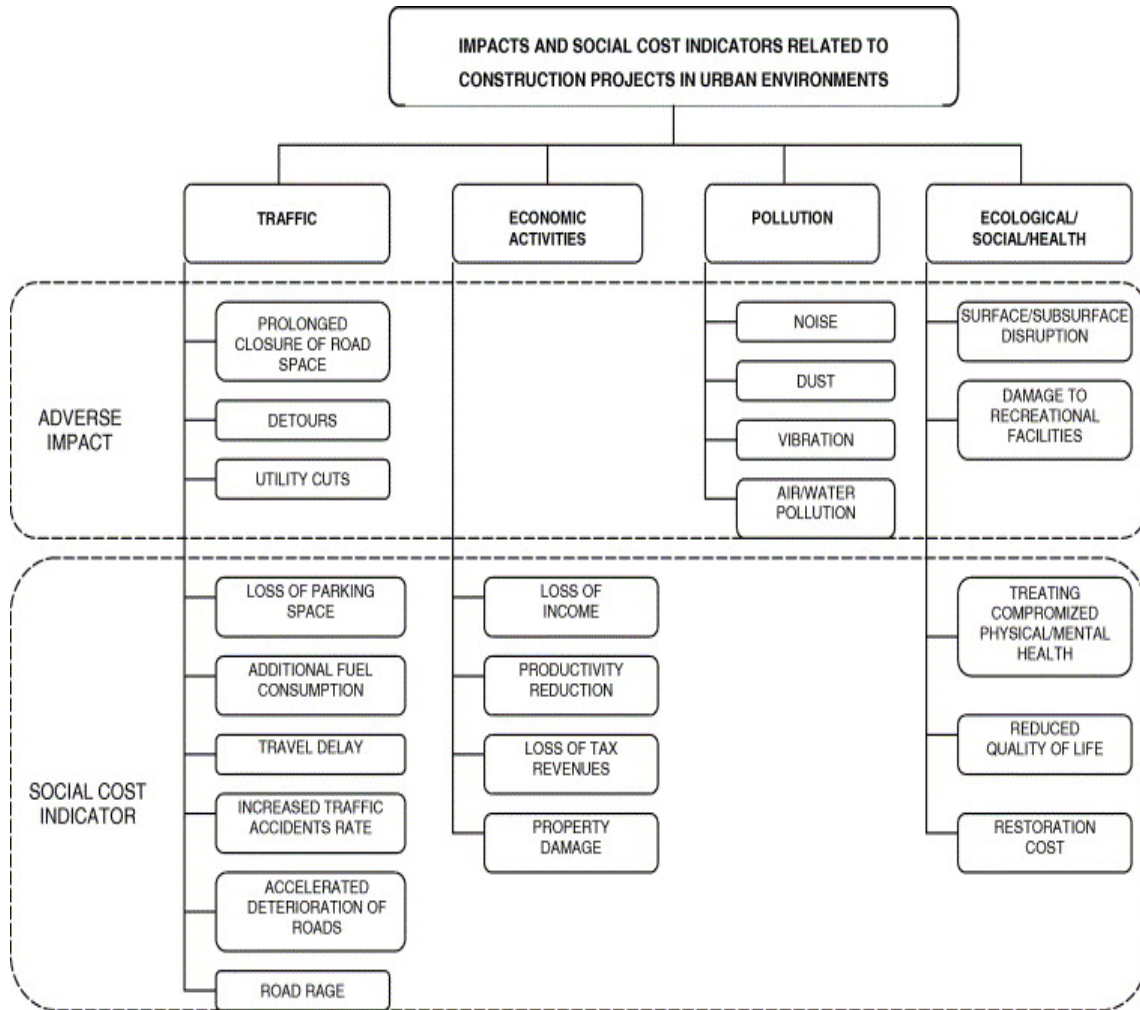


Figure 1. Breakdown of potential impacts and social cost indicators associated with construction activities (Gilchrist and Allouche, 2005)

Social Cost in Construction Projects: A Review

Tolga ÇELİK¹, Saeed KAMALI², Yusuf ARAYICI³

^{1,3} School of Built Environment, University of Salford, Manchester, United Kingdom

² Civil Engineering Department, Middle East Technical University, Ankara, Turkey

¹ tolga.celik@emu.edu.tr, ² saeedkamali2002@gmail.com, ³ y.arayici@salford.ac.uk

Abstract. Despite the fact that completion of construction projects has a direct positive impact on the growth of national and local economics as well as humans' wellbeing, construction projects, especially in the urban areas, generate serious environmental nuisances for the adjacent residents and have unintentional adverse impacts on their surrounding environment. Construction causative adverse impacts on the neighbouring communities are known as the social costs. This study aims to present a state-of-the-art overview of social costs in construction industry in terms of definition, consideration, classification and quantification. Furthermore, a definition for social costs in construction projects will be presented as well as a summarization of more recent researches.

Keywords: social cost; construction costs; construction management; construction adverse impact; social cost definition; social cost quantification.