Corrigendum to: forensic delay analysis as evidence of transaction costs in construction projects.

ATANASOV, V.A., GREENWOOD, D.J., ROSS, H. and SANCHEZ, D.E.

2022

Corrigendum: Forensic Delay Analysis as Evidence of Transaction Costs in Construction Projects (*IOP Conf. Ser.: Earth Environ. Sci.* 1101 *052009*)

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Description of corrigendum:

Page 1: the following text appears:

Construction projects are invariably and manifestly beset by delay [1]. A major consequence of this is costly and time-intensive disputes [5]. This article (or paper) examines disputes arising out of delay in construction projects, with a particular emphasis on viewing such disputes as a significant transaction cost.

In 1937 Coase introduced his theory of Transaction Cost Economics (TCE)[6], which was subsequently taken up and further developed by Williamson [7]. A number of observers have found this theory to be effective in accounting for inefficiencies in the construction sector. However, the practicalapplication of some key aspects of TCE theory has proved contentious.

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Construction projects are invariably and manifestly beset by delay [1]. A major consequence of this is costly and time-intensive disputes [2, 3, 4]. This article (or paper) examines disputes arising out of delay in construction projects, with a particular emphasis on viewing such disputes as a significant transaction cost.

In 1937 Coase introduced his theory of Transaction Cost Economics (TCE) [5], which was subsequently taken up and further developed by Williamson [6]. A number of observers have found this theory to be effective in accounting for inefficiencies in the construction sector. However, the practical application of some key aspects of TCE theory has proved contentious.

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The empirical findings reported in this article originate from twelve project case studies which address hypothesis (1) (above) by seeking to define and quantify the

expenditure of effort which the management of transactional disputes ordinarily necessitates. First, a few background assumptions are outlined, drawing on relevant literature and comprising: (i) a review of distinctive characteristics of construction delay disputes and their typical management, and (ii) a brief summation of key elements of TCE theory. The adopted methodology outlines a case study approach to collection of data. Findings based on an analysis of the collected data include quantifying transaction costs across a range of typical contributors. Finally, having regard to the more encompassing body of work to which this paper contributes, consideration is given to how information technology within the construction sector might be more constructively deployed towards reducing or eradicating some of the transaction costs identified in the study, ultimately with a view to disposing of construction disputes more effectively or efficiently, or eliminating them altogether.

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A report published in 2021, focusing on construction disputes in the global arena [5], estimates the cost of the average dispute as US$54million, typically playing out over 13 months. The report does not separately itemise cost and duration attributable to delay-based claims, but the National Construction Contracts and Law Report [8], which examines the position in the UK, maintains that disputes centring on project delays were the most prevalent among UK-based construction industry players who had been involved in disputes.

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…However, delay-related disputes are inherently complex, and this can often be compounded by an absence of supporting information [12] and a tendency for differences

between parties to escalate [13]. This may precipitate disputes that require to be resolved by formal or informal processes [14].

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It is instructive at this point to draw attention to Williamson's dichotomy used in reference to TCE approaches, namely: 'a governance branch and a measurement branch'[34]. Authors, including Reve and Levitt [35]; Winch [36] [37]; Walker and Wing [38]; Lai, [39]; Bridge and Tisdell [40]; and Bygballe, *et al*., [41] have focused attention on the governance branch, following Eccles' initiative to apply TCE theory towards explaining 'boundaries' of construction companies and the organisation of their businesses and projects. Other writers have focused on applying the measurement branch of TCE theory to explain project performance and other phenomena, such as the behaviour of key stakeholders. For instance, Yates and Hardcastle [42] have focused on how bounded rationality and opportunistic behaviour might impact conflict and disputes in construction projects. Greenwood and Yates have adopted the same approach using evidence provided by a partnering case study [43]. Empirical studies by Li *et al*. [44] and You *et al.* [48] identified pre- and post-contract transaction costs, suggesting how these impacted the choice of project delivery systems and type of contract.

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Page 4: the following text appears:

This study is concerned with (i) identifying the processes and resources currently required for analysing delay disputes; (ii) categorising them using TCE 'language' and aligning them with components of transaction costs (as discussed above); and (iii) operationalising and measuring these costs by examining data collected from twelve project case studies. For ethical reasons cases have been anonymised and described by their function (i.e., Infrastructure Design; Panel Manufacturing Plant; Bridge Construction, etc.). The methodological approach is primarily archival and based upon analysis of the records of twelve case studies chosen from an initial sample of sixty projects. In common with many types of consultants, FDA activity records are kept for payroll, project accounting and client-billing purposes. These provided a rich source of data for identifying, categorising and quantifying the FDA processes and the resources required to sustain them. The selection of cases was based on four criteria. The first was that each involved a delay or delays upon which the parties were unable to reach agreement under the terms of the contract (hence escalated to a dispute). The second criterion was recency: the case studies were selected from the period between January 2015 and January 2021. Projects that started before this timeframe or were incomplete by the end of it were eliminated. The third criterion was representativeness: the case studies must, as far as possible, be reasonably representative of the range of projects dealt with. Finally, the fourth criterion, in order to secure the accessibility and consistency of collected data, was that the entire delay analysis process had been undertaken 'in-house' by a single FDA consultant. This is a significant filter, as projects are often completed by a network of analysts in different international locations. Based on the above criteria twelve projects were identified for further analysis. Daily record-keeping is a fundamental requirement for the FDA, as it is for most consultant organisations. The records from the twelve casestudy projects were reviewed to identify: (a) the type of task conducted by each consultant for each working day; (b) the reasons for conducting the tasks; (c) the product that was produced as a consequence of each task; and (d) the time spent on a particular task.

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Table 1 is incorrect and should be:

Table 1. Case studies (CS).

CS	Project Type	Service	Location	Client	Contract	Forum
1	Mixed use development	Independent delay report	Asia	Contr.	FIDIC	Arb.
2	Shopping centre	Independent delay report	UK	Eng.	JCT	Adj.
3	Infrastructure (tunnelling)	Independent delay report	UK	Contr.	NEC	Adj.
4	Railway services	Independent delay report	UK	Eng.	NEC	CAP
5	Bridge construction	Independent delay report	Africa	Con.	FIDIC	DAB
6	Panel manufacturing plant	Delay analysis report	UK	Suppl.	NEC	Neg.
7	Infrastructure design	Delay analysis report	UK	Design.	NEC	Neg.
8	Infrastructure construction	Independent delay report	UK	Contr.	Bespoke	Adj.
9	Infrastructure design	Delay analysis report	UK	Design.	NEC	Neg.
10	Data centre	Independent delay report	UK	Contr.	JCT	Adj.
11	Food packaging plant	Independent delay report	UK	Contr.	JCT	Adj.
12	Office building	Independent delay report	UK	Contr.	JCT	Adj.

Page 5: the following text appears:

…Undifferentiated activities (or 'Others') where in a record it was difficult to allocate time to a single category, e.g., where records related to time spent overall on all of them, it was assumed that the relative proportion of time could be allocated to Categories 1-3 pro-rata to

the predominant patterns from data that could be differentiated. Analysis of the records from each of the twelve case studies produced the following results.

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Table 2 is incorrect and should be:

Table 2. Summary of production hours.

Categories	Preliminary Tasks	Delay	Causation	Others	Total	Total less Others
Production hours Case 1	84	725	561	418	1788	1370
Production hours Case 2	24	231	39	252	546	294
Production hours Case 3	44	179	238	20	481	461
Production hours Case 4	101	1975	37	571	2684	2113
Production hours Case 5	58	374	175	381	988	607
Production hours Case 6	52	374	35	17	378	461
Production hours Case 7	27	1518	823	1588	3956	2368
Production hours Case 8	211	144	6	623	984	361
Production hours Case 9	74	641	730	624	2069	1445
Production hours Case 10	58	594	47	70	769	699
Production hours Case 11	15	773	44	1101	1933	832
Production hours Case 12	16	413	30	319	778	459
Production hours (all cases)	764	7941	2765	5984	17354	11470

Page 7: the following text appears:

…Although the study was limited in terms of sample size, it is based on the kind of evidence that has hitherto been rare or non-existent. Not only does this provide empirical evidence to support the estimates but provides a relatively detailed indication of the categories of activities performed by FD analysts and quantifies the time spent on those tasks which can be used as an indicator of the cost of the service. Perhaps most importantly, the evidence indicates that there is a duplication of costs where the delay analysis is conducted originally by the commercial teams of the parties and again by independent consultants. It could be argued that the efforts of both teams are examples of construction project transaction costs and that these costs increase when the commercial team is unable to complete the task effectively and external FD analysts are contracted to complete the claims.

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…Although the study was limited in terms of sample size, it is based on the kind of evidence that has hitherto been rare or non-existent. The identified published work does not present such evidence. Not only does this study provides empirical evidence to support the estimates but it also offers a relatively detailed indication of the categories of activities performed by FD

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The authors would like to acknowledge the assistance of the Major Projects Association, UK for its continuing support throughout the study.

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The authors would like to acknowledge the assistance of the Major Projects Association, UK for its continuing support throughout the study. The findings presented in this paper are one aspect of a wider research investigating the potential of advances in information technology and the incorporation of contractual solutions to achieve more efficient and effective resolutions of fact-related construction delay disputes.