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THE PREVAILING PROCUREMENT SYSTEM AS A SOURCE OF WASTE IN CONSTRUCTION: A CASE STUDY

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ABSTRACT

Prevailing project procurement processes and strategies are thought to be the root cause for many of the reported criticisms of the construction industry, such as lack of trust and collaboration and short term adversarial and transactional relationships. However, very few studies have sought to examine the relationship between the organisational, commercial and institutional environments influencing construction procurement and the generation of process waste in construction projects. This study addresses this gap in knowledge by providing findings from a case study of a major UK infrastructure project.

The study identifies a number of prevailing, yet counterproductive, procurement and contractual governance practices that lead to a 'network of causal wastes'. The study provides a conceptual model which exposes the complex, dynamic, interconnectedness and reciprocal nature of waste at the procurement and supply-chain level. The authors believe that this is the first study to expose the nature of waste at this level of analysis. It uses an integrated grounded theory case-study methodology that is demonstrably effective and can be useful for supporting studies seeking to investigate the concept of waste within the construction procurement context. The study concludes by suggesting that future studies focus on pre-procurement processes.

KEYWORDS

Procurement; Waste; Institutions; Contractual Governance; Grounded Theory

INTRODUCTION

The construction industry is often criticised for being confrontational, lacking trust and capacity for learning and improvement, and for being wasteful compared to other industries (see for example, Koskela, 2000; Sarhan *et al*., 2018). Numerous industry reports have

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been commissioned by the United Kingdom (UK) Government and industry organisations, over the past eighty years, with the aim of highlighting concerns and calling for industry reform (for example see Bossom, 1934; Simon, 1944; Banwell, 1964; Latham, 1994; Egan, 1998; Wolstenholme et al., 2009; Farmer 2016; Construction Leadership Council, 2018). In 2013, the UK Government challenged construction to achieve 50% faster delivery and a 33% reduction of clients' capital costs by 2025 (HM Government, 2013). Similarly, in 2016, the Government Construction Strategy 2016-20 was produced with an ambition of achieving efficiency savings of £1.7 billion over the course of the current Parliament (Infrastructure and Projects Authority, 2016). All these reports call for productivity improvements and a shift away from traditional short-term, adversarial, and transactional procurement and business models.

In October 2016, Farmer's report highlighted various inefficiencies within the UK construction sector, including its lack of innovation and collaboration. The report urged the need for the introduction of new business models that align with innovative production delivery approaches (e.g. offsite construction). Of interest, the report collected evidences that many innovative approaches to construction design and construction processes stall or get immediately refused, due to negative and deeply-rooted perceptions of risk in the industry. According to the report, these perceptions often stem from the commissioning clients and their advisers, architects, building control inspectors, the wider supply chain, and ultimately, insurers and funders (p. 35). This assertion aligns with a previous warning provided by Paul Morrell, the former Chief Construction Officer, who argued that the standing and perceived value of the various professions involved in the construction industry is challenged, "with detractors seeing in their conduct and practice a tendency towards protectionism, resistance to change, the reinforcement of silos and the preservation of hierarchies" (Morrell, 2015, p. 5). It is also consistent with work of Sarhan et al. (2017) who explained how and why inefficient construction-procurement safeguarding arrangements prevail in the industry, due to institutional pressure exerted on clients from third parties (e.g. consultants, quantity surveyors, lawyers, insurance companies and banks). These professionals do not "*take a central stake in the project outcome, only a stake in the process by which the project is delivered*" (p. 570).

The prevailing project procurement processes are thought to be a root cause for many, if not all, of these aforementioned issues and problems (Latham, 1994; Osipova and Eriksson, 2011; Sarhan *et al*., 2018). A small but growing number of studies have attempted to investigate the influence of procurement processes on the generation of waste in construction projects (for example see Jaques, 2000; Gamage et al., 2009). However, most of these studies, if not all, have limited their attention to physical (material) waste; other important considerations such as process waste and value-creation or loss in relation to project procurement have been hardly explored. Work by Sarhan *et al.* (2018) introduced the concept of 'institutional waste' within the construction procurement context, stressing the importance of investigating the institutional factors influencing procurement, and how these contribute to the generation and persistence of process waste in construction projects.

The authors are unaware of any empirical studies that examine the relationship between institutions, project procurement and process waste in construction. The purpose of this study is to explore this apparent gap in knowledge through an integration of both

interpretative case-study and grounded-theory methodologies. In general, both terms `procurement system' and 'contractual arrangement' are closely related and are often used synonymously (Love *et al.*, 1998). For convenience, this study focusses on 'construction project procurement and governance arrangements', as defined and conceptualised in work by Sarhan *et al.* (2018, pp. 7-11). In the next section, the research methodology adopted for the study will be explained. Following this an analysis and discussion of emerging findings will be presented, and finally the conclusion and recommendations for clients and decision-makers will be provided.

RESEARCH METHODOLOGY

The main aim of this study is to contribute to the concept of waste as understood in construction by exploring the prevailing construction procurement and commercial contexts that surround the design and delivery of construction projects. The methodology for such a study should enable to a holistic explanation of the underlying motives and behaviours associated with the use of wasteful construction procurement and commercial arrangements.

'Accurate shared-learning' is rarely obtainable in relation to commercial issues. People will generally share good news but not necessarily the bad, and the links between cause-and-effect in the case of both are rarely accurately assigned. Thus, it was decided that an interpretative research approach is necessary for the study. These considerations along-side both the exploratory and explanatory natures of the study pointed the authors towards qualitative methods and a choice between the use of grounded-theory or multiple case studies, or an integrated approach.

A case study route (Yin, 1994) could be appropriate for identifying cause-and-effect relationships within a specific context, but it would confine the study to a limited number of projects agreed upon at the outset by either clients or main contractors. Also, it can be extremely difficult for researchers to gain access to contractual information in live projects, for reasons of commercial sensitivity. Even, if access was possible, it can be notoriously difficult to determine truth from commercial studies, especially if attempted through direct observation of live procurement processes. People tend to be sensitive about the issues they disclose and the implications for their immediate or future commercial positions.

A grounded theory (GT) approach (Strauss and Corbin, 1998) can help to overcome many of these methodological challenges by allowing the coverage of a wider variety of cases, while at same time putting participants on ease and ensuring that they remain anonymous. It is important to stress that in GT, the unit of analysis is not the individuals themselves, but actual incidents reported or observed in the data (Glaser and Strauss 1967). In addition, GT is of particular value when the research challenge is to interpret complex social processes where holistic explanations are lacking (Hinton and Hamilton, 2015). Furthermore, the inductive focus of GT makes it suitable for exploring a topic of interest or a substantive problem area that little is known about (Strauss and Corbin, 1998). As incidents used for data analysis will come from disparate projects and contexts, it may be difficult to accurately detail cause-and-effect relationships. A GT approach would lead to the development of 'abstract' conceptual model or theories.

For these reasons it was decided to use a Straussian GT approach in conjunction with case study research, under interpretivist epistemological assumptions, as an integrated methodology. In simple terms, the study used a deductive-inductive GT methodology using Strauss and Corbin's (1998) rigorous coding procedures to analyse data collected from a case-study. Similar research approaches for integrating GT and case-study have been used in the fields of information technology and systems (for e.g. see Halaweh *et al.*, 2008 and Halaweh, 2012). Few, if any, studies have adopted this integrated approach for conducting empirical construction management research.

EXPLORATORY CASE STUDY

This paper presents findings from an investigation into a major UK public-sector infrastructure project, worth around £174 million. This case-study was explored in 2015-16, while the first author was conducting a wider-study (Sarhan, 2018) "*seeking evidence for practical examples of waste or value-loss arising from construction procurement and commercial practices"*. The project-team involved in the afore-mentioned infrastructure project found the research topic of relevance and significance to their needs. They were willing to collaborate and engage in a shared-learning exercise, in order to identify the root-causes of the problems they generally experience in UK public-sector construction projects. This openness and desire to 'learn as a team' has helped the study to overcome the methodological challenges previously explained. All participants were assured that all identities and collected information will remain anonymous and be treated confidentially. In this paper, a gender-neutral language will be used when referring to participants.

DATA COLLECTION AND ANALYSIS

This study relied on the use of qualitative semi-structured interviews, as part of an integrated grounded theory case study methodology. All interviews were conducted over the telephone rather than face-to-face. Telephone was more time and cost effective, but also, when the interviewer is not physically present it can help interviewees to feel less threatened or distressed when answering sensitive questions (Bryman, 2012, p. 488). The first interview was conducted with a representative of the Main Contactor in Nov 2015 when the project had been running for just over a year. The aim of this study was to ask about the typical problems experienced in their current project. The terms 'problem' or 'examples of value-loss' were both used instead of 'waste', based on feed-back obtained from industry practitioners during pilot studies of a semi-structured interview guide prepared for this study.

After initial data collection and analysis of this interview was completed, the study employed *theoretical sampling* to determine who to sample next and what questions to ask during interviews, until theoretical saturation was achieved. Glaser and Strauss (1967, p. 45) define *theoretical sampling* as a "*process of data collection for generating theory whereby the analyst jointly collects, codes, and analyses his data and decides what data to collect next and where to find them, in order to develop his theory as it emerges*". Table 1 provides an overview of the sample characteristics of this study. So, data was not collected from a pre-determined sample; instead it was subject to an evolving and iterative processes and controlled by theoretical categories emerging from analysis of data already collected.

The participants were also asked to provide supporting evidence whenever possible. Examples of supporting documents received and analysed in this study include:

- Form of agreement and contract data (268 pages)
- Samples of planning sheets related to resource quantities and scheduling
- Samples of weekly work plans and consolidated as-built Percentage Plan
- Charts and diagrams of Percentage of Plans Completed (PPC), including analysis of reasons for noncompletion (RNC).
- Template of tool-kit used for measuring supply-chain performance

Table 1: Sample information (in non-corresponding order)

Professional Role / Title	Organisation	Duration (mins)	Data Collection*
Senior Design Coordinator	Main Contractor	45	P+D
Senior QS		39	P
Site Agent (CEng)		40	P+F+D
Sub-Agent		27	(S+E+D)
Project Planner			
Director and Project Manager	Specialist Subcontractor	33	P
Principal Design Engineer	Designer	40	P
ECC Project Manager (CEng, MICE)	Employed by the Client	36	P
Deputy Project Manager (CEng, MICE)		33	P+E
Senior Consultant	Financial Governance Consultancy	35	P+D

* S= skype, P= phone, E= follow-up questions by e-mail, F= follow-up by phone, D= supporting docs sent

CONTRACTUAL AND COMMERCIAL ARRANGEMENTS

The main documents forming the contract between the owner and the main contractor were as follows:

- A Form of Agreement duly executed by the Parties as a deed;
- The Framework Contract;
- Option Z - the additional conditions of contract (Z-clauses) contained in the Contract, which include amendments to core, main and secondary option clauses;
- The NEC3 Engineering and Construction Contract June 2005 (with amendments June 2006 and September 2011) (as amended);
    - Main Option C - Target Contract with Activity Schedule. (as amended);
    - Option W2 – Dispute Resolution (as amended);
    - Secondary Option X2 - Changes in the law (as amended);
    - Secondary Option X5 – Sectional Completion (as amended);
    - Secondary Option X7 – Delay Damages (as amended);
    - Secondary Option Y(UK)2 – HGCR Act 1996 (as amended)

- The Works Information;
- The Site Information;
- The activity schedule; and
- The Prices (including any Resource Schedules and the Lump Sum Fee).

MAIN PROBLEMS REPORTED IN THE CASE-STUDY

THE LARGE NUMBER OF REQUESTS FOR INFORMATION (RFI) BEING RAISED

One of the main problems found in this project was the large number of technical queries (Also known as: RFI) that were being raised by the contractor. The Site Agent reported "*883 RFI have been raised to date*. *Majority of these have been raised for design clarification where either insufficient information has been provided or the current design is not very clear".* When the designer was asked about how they were affected by the large number of RFIs raised in such a short period of time, the participant said:

> *"If there are a lot of RFIs being raised and we don't believe they were all warranted, and believe that the contractor should be able to adapt to the design and does not need the level of details which they are requiring. We'll then make a case to the client and ask for additional resources…you'll be looking at any compensation events, so we can increase what could have been our original target cost or give us another additional sum of money to recover the additional work undertaken in responding to the RFIs".*

A recent study, based on data collected from 168 projects, found, that the average cost of processing RFI on a project in Australia and New Zealand is around US$656 and US$243 respectively (Aibinu *et al*., 2018).

CLIENT VARIATIONS AND CHANGE ORDERS

The whole supply-chain suffered from receiving numerous Project Management Instructions during early stages of the project (Also known as: Client Variations or Change Orders). Examples of responses received concerning this problem include:

- Project Manager: *"We are subject to quiet a lot of change post contract and that's not ideal for an NEC type contract".*
- Design Coordinator: "*Well, so far we are probably just over a year into the contract now, so we've had over 350 project management instructions. And we've had 150 odd supervisors' instructions. So, that's five-hundred instructions that we've had on this scheme since we've started… So those instructions all have to be evaluated and obviously tie the QSs up*".
- Specialist Subcontractor: "*Contractors' and clients' change orders cause us lots of risk and pressure due to our commitments and plans of delivery with our manufacturers - we need at least 3 months of notice prior to delivery*".
- Financial Consultant*: "One of the problems on this particular job was that the client was eager to let it before the old framework expired. And consequently, it was you might say less well defined at the time it was let than it ought to be, and that resulted in an awful lot of change in the early days…We have on this particular scheme successfully obtained compensation events for increased resources as a result of the sheer volume of change".*

When the researcher asked the Deputy Project Manager about the reasons for the huge amounts of change orders, the participant simply said: *"They [the contractors] are having a lot of change in the scope of the works...Why?! Hmm, well, it's due to the client really!"*. The researcher then referred to the contractor once again and asked the Site Agent for explanations; the participant said:

> *"To start off, the project has been live for nearly a year now. And it has been a very slow process of getting responses back for RFIs. And this has been highlighted to the client in our meetings with the client, and with the designer: 'You know your response time to our RFIs is very slow.' And they will say that we don't have the resources. And one said, they were accusing us of raising too many RFIs. And we conquered that argument saying: 'well the reason we are raising so many RFIs is because the design is not clear'. So, which has a sort of indirect impact on the number of PMIs getting raised".*

Further investigation revealed that there were commercial misalignments, onerous contractual clauses and other procurement processes, which contributed to the generation of these wasteful behaviours, conflicts and arguments.

SUB-OPTIMISATION AND COMMERCIAL MISALIGNMENTS

The client used procurement mechanisms which focused on optimising the target fees of each main project party (e.g. Main Contractor and Designer), while overlooking how this may influence overall project performance and target cost. This led to self-interest as the main contractor and designer found no incentive to collaborate together to reduce overall project costs; instead each party focused on finding ways to reduce their own costs, even if this came at the expense of overall project performance. Of interest, the Deputy Project Manager was not aware himself or herself of how this commercial misalignment might impact on project performance. For instance, the participant said:

> *"I see, yes, but everyone is not affecting the other. Like they both have, hmm, the target cost. Hmm, there is one target cost for the whole project, then within this overall target cost, we have separate items for the contractor's cost, and separate items for the designers and the QSs and others – these are part of the auxiliary costs. So, although the total target cost will be increased by each party, but they both have to manage their own. So, really at the end, each one is not affecting the other"*

Further, the client had a predetermined choice and preferred the use of a 'collaborative' form of contract (NEC option D – Target Cost Contract with Activity Schedule) regardless of the procurement approach adopted for the project. This has been described by the Financial Governance Consultant as follows:

> *"The principle with the Client's Schemes was that the designs are relatively generic. So, the client keeps that design in-house. Unfortunately, it then uses a form of contract which pre-supposes, you know the NEC, that it's a contractor design. So, it's an uneasy alliance there which leads to a lot of variations".*

EXCESSIVE NON-VALUE ADDING REPORTING AND CONTRACT ADMIN WORK

The project participants raised concerns about the excessive and, in some cases duplicated, reports required by the client from the supply-chain for monitoring and measuring the

accuracy of monthly financial projections on spend. These prevailing non-value-adding performance monitoring and reporting arrangements contribute to the generation and entrenchment of process waste in construction projects. Obviously, they led to an unnecessary increase in client's transactional costs. They also led to an adversarial environment which can lead to feelings of mistrust that, in turn, hinder collaboration and encourage opportunistic behaviours. Interestingly, these inefficient cost control practices also led to hidden costs that the client may not be aware of as highlighted by the Contractor's Quantity Surveyor:

> *"We have a Commercial Manager who deals with the reporting of this project. And we all feed him our information into him. He has to collate it and prepare it into several different formats basically for the client's requirements. So, it is excessive. It does take a long time and it is not necessarily a value to the client to have all this information, because we are paying for this person to provide all this work...It's just not efficient…it is a waste! So, reports that are duplicated is the answer".*

It can be argued that these inefficient practices are more likely to exist in a contract exercise that tries to compensate for failing to spend enough time creating certainty before procuring a contract. Further, these excessive non-value-adding reporting and admin requirements lead to waste of human potential and value-loss. For example, the QSs spent most of their time in this project evaluating client's change orders, collecting information required for reports, administering subcontracts, early warning notices and requests for compensation, rather than finding means for maximising value delivery. Similarly, the NEC Project manager's effort was mainly focused on administering the contract rather than managing production flow. The whole supply-chain, in general, spent considerable time and resources providing evidence for claims and compensation events, in comparison to what they spent on managing production.

INEFFICIENT SAFEGUARDING AND ONEROUS CONTRACTUAL ARRANGEMENT

The project contract included a Z-clause that implies that if a fatality occurred on the site of the scheme, the contractor loses his share in any savings gained for delivering the project below the target cost. As a fatality occurred during the beginning of the project, the contractor lost commercial incentive to collaborate with others to beat the scheme's target price. The commercial misalignments mentioned above made the problem worse.

> 'If the Scheme Outturn Cost is greater than the Scheme Target Price, the Contractor pays his share of the excess. If the Scheme Outturn Cost is less than the Scheme Target Price, two-thirds of the Contractor's share of the saving is retained and contributed to the Programme Level Incentive Fund and the remaining one third (the "remaining Contractor's share") is paid to the Contractor, provided that the remaining Contractor's share is paid to the Employer if there is a fatality on the site of the Scheme as a result of a reportable incident, is paid to the Employer in the event of termination for any of reasons R1-R15 or R18 and is reduced for late Completion in accordance with the table below' **(Z-Clause, NEC3, 2016).**

Additionally, during the review of the contract documents, the following disclaimer clause was found. These disclaimer clauses, which unfairly push risks to others, have been reported by various studies (e.g. see Zaghloul and Hartman, 2003; Sarhan *et al*., 2017) as

a major reason for increasing the total cost of a project - in the form of insurance or contingencies, adversarial relationships and potential claims and disputes.

> 'The Contractor's total liability to the Employer for all matters arising under or in connection with this contract is unlimited' **(Disclaimer Clause, NEC3, 2016).**

PREVAILING INEFFICIENT PROCUREMENT PRACTICES

The inductive bottom-up coding and analytical procedures adapted in this study led to the conceptualisation of various inefficient procurement practices (Figure 1), which, evidence from the data has shown, contributed to the generation of wasteful behaviours, performances and outcomes in the project.

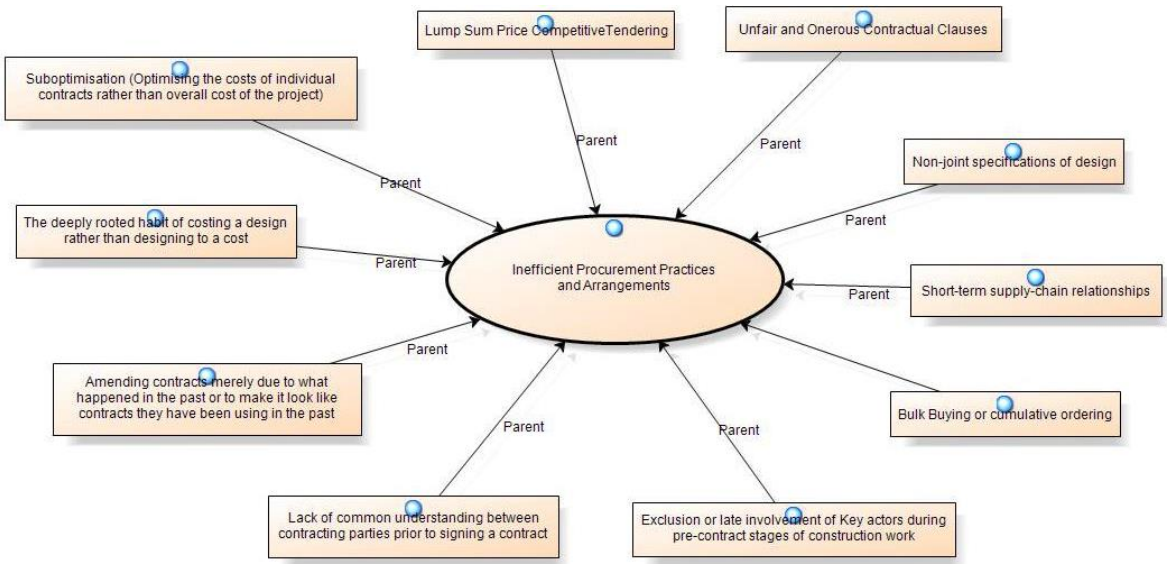

Figure 1: Coding structure for 'inefficient procurement practices and arrangements'

It was found in the study that these prevailing procurement arrangements have a negative influence on the way that project-parties behave and perform throughout the project, leading to consequential wastes. The following section illustrates the impact of these inefficient procurement practices on project team performance and behaviour and reveals the nature of waste that exists at the procurement and supply-chain levels of analysis.

THE COMPLEX AND DYNAMIC NATURE OF WASTE AT THE PROCUREMENT LEVEL

Construction processes are non-linear, interrelated and take place within a dynamic environment that includes lots of variables. Thus, relationships between different kinds of waste are very complex (Formoso *et al*., 2015). Figure 2 shows the interconnectedness and dependencies between different causes of waste, which result from the prevailing procurement practices and mindsets (Figure 1). This diagram was developed using NVivo matrix-coding query (in association with a careful data-verification of the resulting patterns)

and sketched using Insights Maker (a web-based modelling tool) to reveal the complexity and interactive nature of waste existing at the procurement and supply-chain level. It was also found that this dynamic 'causal network of wastes' (Figure 2) leads to consequential wastes (at the production level), which are conceptualised in this study into four main categories: (1) financial losses and cost overruns; (2) time waste; (3) quality or value loss in design, and (4) waste of human potential.

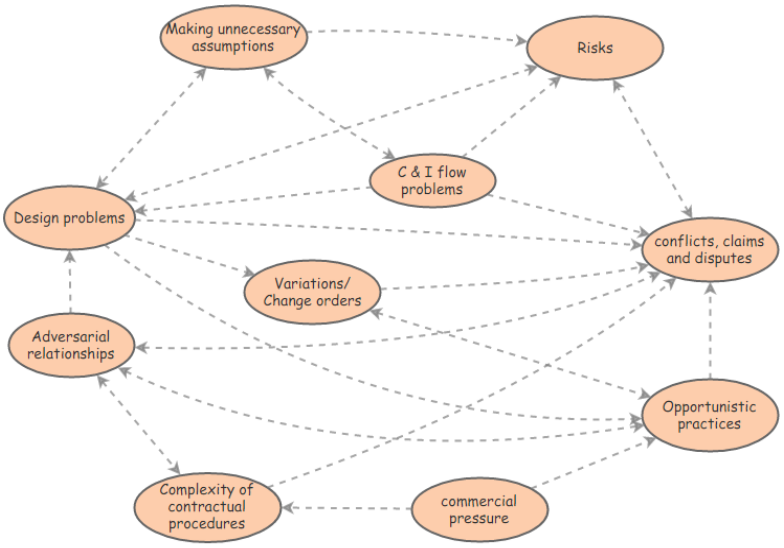

Figure 2: The nature of waste at the procurement / supply-chain level

This phenomenon is relatively similar to what Koskela *et al.* (2013) referred to as a 'chain of wastes', with one waste acting as a 'core' or 'lead' waste. In their study they argued, 'Making-do', in particular, is a core waste in construction (at the production-level of analysis) with substantial negative impact on the production system. Subsequently, Formoso *et al.* (2015) suggested that by attacking this core, one can also eliminate the wastes caused by it. According to them, the causal connections between wastes are not necessarily uni-directional; they can also be reciprocal (A leads to B while at the same time B leads to A). Thus, devising operational strategies focusing on the reduction of the effects would still be useful, as it can help to generate a root-cause analysis leading to the core wastes in the system (for example, this could be achieved using Last Planner System for production control). They concluded their study by offering a preliminary causal analysis of waste generated on site, with a focus on the production (design and construction) stage. They reflected on their reasoning approach, as follows:

> *"Our line of reasoning has taken us from the conceptualization of a linear chain with clear causes and effects to a complex network with both uni-directional and interactive connections between the nodes. In such a complex network we may not be able to identify and analyse all the connections. We see a pattern, but are not able to decompose or decode the network in all its components and interconnections"* (Formoso *et al.*, 2015, p. 457)

The conceptual model of waste developed in this study (Figure 2) is relatively consistent with the conceptualisations offered by Koskela *et al.* (2013) and Formoso *et al.*

(2015). However, this study adds to their work by offering different perspectives and explanations; hence this study is based on a different level of analysis (i.e. procurement and supply-chain level) and is approached using a reflexive grounded-theory methodology. In line with their arguments, it makes sense to propose that if clients stopped adhering to prevailing inefficient procurement practices, they could eliminate or reduce the substantial negative impacts of these procurement arrangements on the production system; thereby enhancing process-flow, eliminating or reducing the consequential wastes and minimising total project costs (both transactional & production). That said, it is arguably more crucial to address the institutional factors and underlying fundamental paradigms which influence construction procurement choices and lead to the persistence of waste in construction. In other words, it would be unwise to tackle procurement processes alone, without first investigating the institutional factors and underlying paradigms that influence early-project decisions and condition project procurement & governance strategies (Sarhan *et al*., 2018).

CONCLUSIONS AND RECOMMENDATIONS

The nature of waste within the construction procurement context is complex, dynamic, interrelated and reciprocal. This study has shown how prevailing procurement practices can lead to a complex 'causal network of wastes' at the procurement/supply-chain level, leading to the generation of consequential wastes.

This study has identified various prevailing project procurement practices, which are taken-for-granted yet impede efficiency and improvement efforts in construction. The study also revealed some of the unnecessary waste that clients and decision-makers embed into their projects by adhering to counterproductive contractual governance arrangements.

The findings of this study suggest that much of the waste generated in construction projects stems from prevailing project procurement practices and governance arrangements. These construction procurement practices are shaped by institutional structures, beliefs and attitudes as well as project characteristics (Sarhan *et al*., 2016, 2017, 2018). For this reason, it has been stressed in this study that tackling inefficient procurement processes, without examining the wider institutional forces and underlying paradigms influencing procurement choices, may lead to some productivity improvements but won't address the root-cause(s) of the problem. The prevailing procurement system is not necessary the villain; it is only a malformed messenger of an inevitable outcome due to poor pre-procurement processes. Future studies are therefore recommended to investigate the institutional factors influencing buyers' approaches to construction project procurement.

The methodology used in this study can be useful for future studies seeking to understand and identify the causes and effects of process waste within construction procurement and supply-chains. The original and empirical findings that emerged from this study provide some evidence of the effectiveness of the methodology.

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