

Securing Best Prices for Construction Materials: An Exploratory Study of the New Zealand Construction Industry

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Maintaining an efficient and effective material purchasing system as well as purchasing materials at the right price, quality and time are essential for contractors to remain competitive in today's environment. Construction contractors purchase materials through many sources such as builders' merchants (BMs), direct purchases and consumer clubs. Less well known is the fact that BMs offer multiple tiers of discounts to the trade rather than to the public and some contractors have to pay more than others. In addition, suppliers normally sell non stocked items with added mark-ups to the base prices, consequently final construction often costs more than it should. Nevertheless, material purchasing dynamics in the construction industry have rarely been studied in a systematic manner. As such, this exploratory study is expected to understand how small-to-medium-scale contractors could secure "best" prices for materials. The research will be undertaken in conjunction with contractor's clients and their professional advisors, BMs and other suppliers. It is expected that information will be gathered through questionnaire surveys throughout New Zealand. An extensive literature survey will precede such surveys. Finally, the impact of various behaviours (contractors' buying behaviour, suppliers' supply behaviour and clients' procurement behaviour) will be evaluated in order to understand the impact on pricing, using mathematical models. The major benefit of this study will come from understanding the complexities involved in procurement decisions, thus making it easier for construction firms to adopt suitable strategies to secure best prices for construction materials.

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1. Introduction

Building contractors purchase materials through many sources such as Builders' Merchants (BMs), consumer clubs and direct purchases. Sourcing construction materials from a BM is common practice since they provide good discounts to traders rather than the public (Zavadskas et al., 2005). However, experience shows that not all contractors get good discounts because BMs offer different tiers of discounts to their preferred contractors; total sales volume for construction material increases a real-time discount rate in multi-tier discount schemes (Arbietman et al., 2000).

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Discount tiers are volume discounts with a twist. The twist is that past purchases are added to the current order to determine the volume discount. So far, however, there has been little discussion about why BMs offer multiple tiers of discounts to different contractors. Further, if the item sourced is not a stocked item, the supplier would normally purchase these from another supplier, and re-sell with a mark-up added to the base price. Consequently, final construction costs more than it should. Therefore, this study seeks to find the strategies to get the best discounts from building materials suppliers. This will probably secure better prices for building contractors. Past literature shows that material purchasing dynamics of small-to-medium-scale construction contractors have rarely been studied in a systematic matter. Moreover, the New Zealand context seems different to many other developed countries in relation to the composition of BMs (few with large volumes), finished product manufactures (again few but large for specific cost-heavy materials/products such as concrete), and many local suppliers of imported construction materials. Embarking on a study of these market structures and determining different mix strategies that will secure contractors and clients' best prices for their materials is therefore beneficial.

An examination of cost structures of construction projects reveal that a larger portion of the total construction cost is constituted by construction materials which is usually between 40-50% of the total construction cost for many types of projects (Agapiou et al., 1998b). This view is supported by the Construction Industry Institute (1988) which suggests that materials and equipment comprise more than half of the project cost. This further highlights the importance of construction materials' cost and the extent to which the construction cost can be minimised by focusing on materials. Hillebrandt (1988) while also agreeing that construction materials account for a significant percentage of total construction cost, also show that there is a strong relationship between various project types and their main input contributions. Considering the importance of construction materials, the selection of appropriate procurement strategies for this key resource input deserve attention. There appears to be opportunities to minimise costs through purchasing strategies particularly with respect to price. Construction management literature shows that far too little attention has been paid to cost minimisation strategies in terms of construction materials prices. Accordingly, there are benefits to be derived from material and consequently project cost minimisations.

2. Literature Review

2.1 Background

The construction industry typically utilises a large quantity of construction materials. Van Wyk and Lazarus's study (as cited in Shakantu et al., 2007) reveals that the Earth's resources are highly consumed by the construction industry, utilising about 50% of all materials extracted from the Earth's crust (Lazarus, 2003). In fact, materials in construction make up over half of all resources (by weight) used in production. This significant material usage can be further highlighted from the United States, as it has been the largest consumer of materials by weight for almost a century (Horvath, 2004). Every building facility incorporates hundreds of different material items. Therefore, the construction of buildings and structures relies on having a careful understanding of construction materials in terms of their properties (e.g. strength, stiffness, toughness, durability, etc.), availability, fabrication and the energy required to both produce the structure and consumed during its lifetime, the required maintenance, the end-of-life properties and especially the cost of the materials (Domone and Illston, 2010).

Tooley, Murray, Hardcastle, and Langford (2001) explain that management and procurement systems in the construction industry have improved noticeably with the developing nature of the whole industry. Building material purchasing strategies should not be an exception and should show positive developments considering the centrality of materials in construction activities. Because materials represent a major expense in construction, minimizing their purchase costs presents important opportunities for reducing overall construction costs. Thus, there are significant opportunities to improve the procurement process by achieving the best prices for construction materials. Therefore, wise management practices in the purchasing of and paying for such materials are essential to accomplish successful construction at the best price (Abdul-Malak et al., 2000, Zavadskas et al., 2008, Hadikusumo et al., 2005).

2.2 Construction Materials and their Categorisations

Any material consumed or used in a construction project and incorporated in the constructed building or structure is referred to as a construction material. There are three main categories of materials incorporated in the building construction industry (Dobler & Lee, 1984). Table 1 shows the main categories of materials in the construction industry.

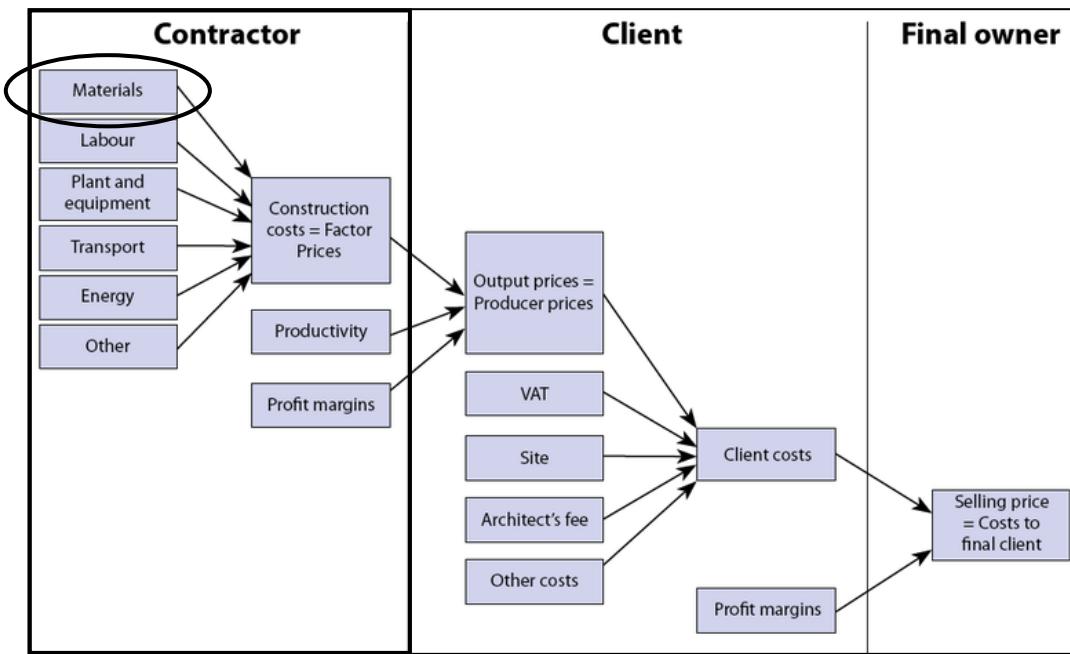
Table 1: Main categories of construction materials
(Source: CII, 1999)

| Material category | Description |
|----------------------|--|
| Raw materials | These are bulk materials that are inputs to processes and activities that take place on construction sites (e.g. sand, aggregates). |
| Finished products | These are referred to off-the-shelf materials that are readily purchased from suppliers with minimal lead-time. They do not require excessive fabrication on site, and can be installed or applied directly (e.g. electrical and mechanical components). |
| Fabricated materials | Refers to those materials that require extensive fabrication before or after they are brought to site. Such materials are especially fabricated in line with project drawings and specifications. |

2.3 Materials Contribution to Total Construction Cost

The ultimate price of a constructed building or a structure is an end result of various cost components mostly associated with contractors and clients of the particular project. For a client the total cost includes output prices, value added tax (VAT), site cost, architecture fee and other costs. Altogether, these components are called the client's cost. In addition, there can be profit margins if the client is not the final owner of the building. Contractors' main cost components consist of construction costs of which material cost is a major component, productivity costs and profit margins. The general cost distribution among these parties can be represented as shown below:

Figure 1: Cost distribution of a construction project
 (Source: Statistics Explained, 2011)



Although the overall building construction cost is distributed over materials, labour, plant and equipment, transport, energy and other components, construction materials comprise a significant part of a construction value, approximating 50% of the cost of all construction work (Zavadskas et al., 2005, Agapiou et al., 1998a, Abdul-Malak et al., 2000, The Business Roundtable, 1982). Further, Bernold and Treseler (1991) commented that the contribution of materials to total construction cost could become even greater in the future due to the increasing cost of materials and increasing usage of materials input in building production. Therefore, any opportunity to minimise materials cost could significantly increase the value of the contractor's profit. Fellows, Langford, Newcombe, and Urry (2002) confirm that a small percentage reduction in materials costs could bring about a sizable increase in profits. However, questions have been raised about the manageability of construction materials prices since they are affected both by trade deals between merchants and contractors, and by factors external to construction (e.g. political, social, etc.) as well (Vidalakis and Tookey, 2005). Thus, when selecting construction materials, it is essential that careful decisions are made. This decision-making includes the selection of necessary construction materials, relevant suppliers, and booking and delivery terms. Project participants (clients, contractors, architects and designers) should be involved in the materials selection process in order to accomplish the best value for a particular project. Their intentions would be associated with economic, technical and aesthetic requirements as well as comfort and prestige. Therefore, for the construction material selection, the methods that should be selected are those that are suitable to perform tasks with several functional purposes, and which can satisfy all project participants. Because of this complexity, the buyers may face many problems when construction materials are chosen from different sources. However, insufficient attention is being paid to construction materials selection process considering that it is the largest single element of project cost (Zavadskas et al., 2005, The Business Roundtable, 1982). Therefore, there can be some opportunities to reduce construction costs by looking at the construction materials selection aspect.

2.4 Materials Cost Categories

The purchase of construction materials may involve a variety of cost types, which could arise at different stages of the construction procurement process. These cost types can be categorised into three main types, namely purchase cost, holding cost and shortage cost (Barrie and Paulson, 1992, Pilcher, 1967). A brief outline of each cost component with their types with some examples is given below:

Table 2: Cost types associated with construction materials purchasing process
(Source: Abdul-Malak et al., 2000)

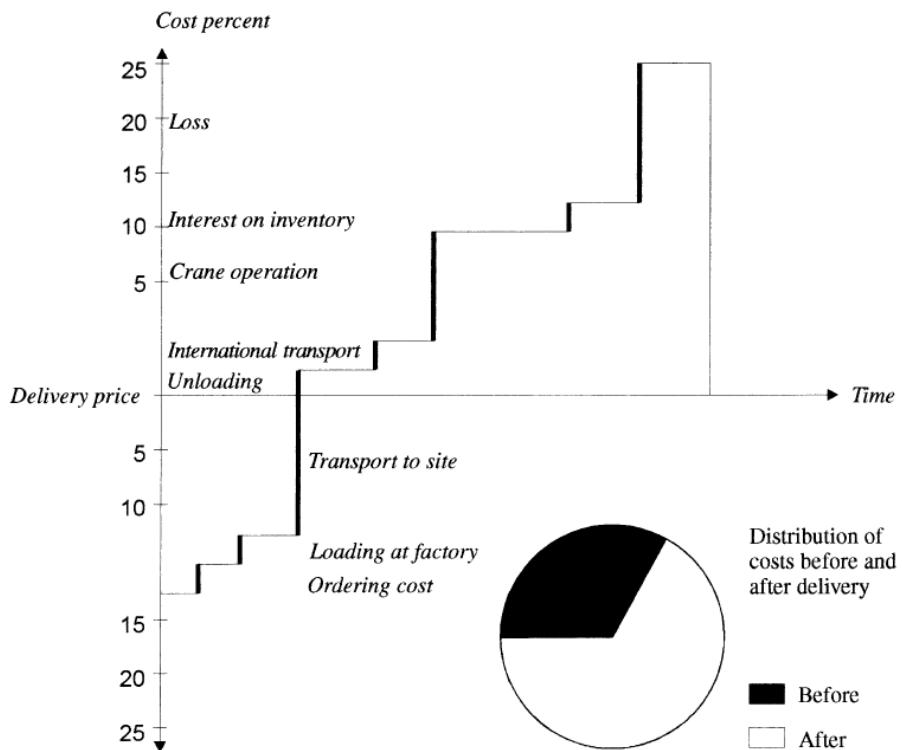
| Type of cost | Sub types | Examples |
|--|------------------------------|--|
| Purchase cost | Material price | Effective negotiation |
| | Overhead incurred | Solicitation and evaluation of quotation Issuance and expedition of purchase orders |
| | Transportation cost | Shipping materials to site Insurance during shipping Custom fees for imported materials |
| Holding costs | Not applicable | Financing Storage Protection and Maintenance Misplacement Handing Obsolescence |
| Shortage costs (Less production compared to demand) | Direct cost Indirect cost | Liquidated damages Activity crashing costs Increased overhead costs Loss in productivity Loss of flexibility in project schedule Premium resulting from remedial action |

Out of the above, the purchase cost is the largest part, and a substantial amount of the purchase cost is compromised by transportation costs. The purchase and delivery stage seems to have potential for improvements in the construction materials delivery process. Therefore, there can be a substantial opportunity to reduce the construction materials cost by considering transportation and delivery aspects. Generally (for whole truck loads), material purchasing cost consists of the transportation cost and therefore, the purchasing organisation is in a position to save the cost of inappropriate forms of delivery (Bertelsen and Nielsen, 1997). Transportation cost is mainly affected by manufacturers and traders as they generally include transportation cost in to the final construction material prices.

2.4.1 Influence of Transportation Costs

The final cost of construction materials purchased by a construction contractor is accumulated until they are used on site. This cost variation can be identified during two main phases before and after delivery of materials in different stages of the construction materials procurement process. The increase of construction material price during the time they are ordered by the contractor until the materials are incorporated in the project is graphically illustrated by the “cost staircase” as shown below:

Figure 2: The cost staircase
(Source: Bertelsen and Nielsen, 1997)



As can be seen from the figure (“cost staircase”) above, the two main activities onsite handling and transportation seem to result in a remarkable increase in material price. Therefore, contractors have opportunities to secure better prices for materials by closely considering transportation and onsite handling activities. It seems that there are opportunities for contractors to shrink the materials cost further, by selecting the best builders’ merchant/material supplier based on the key cost aspects specified by the “cost staircase”. Interestingly, data from the figure shows approximately 33.33% of materials’ indirect costs arise before their onsite delivery. This further strengthens the possibilities of reducing construction material prices.

2.4.2 Logistics Costs

Managing logistics is a multifaceted task in both the manufacturing and construction industries (Shakantu et al., 2000). In construction projects, mobilisation of various resources (labour, material and machines) is considered as logistics management and it includes ensuring that these resources are in the right place, at the right quantity and at the right time to ensure the enhanced quality, safety and efficiency of the project

considered. Further, sourcing, subcontracting, equipment, storage, stocks management, transport of materials, process control, communication and information and infrastructure management are the key logistic activities involving in the construction industry (Nuno and Vitor, 2002). Clausen's study (as cited in Agapiou et al., 1998a) explains that logistic costs apply to different stages, from the extraction of raw materials, until the building is constructed. As this study seeks to find the best value for construction materials, the logistic cost in terms of construction materials is an important issue to consider. Wegelius-Lehtonen (2001a) pointed out that logistic costs related to construction materials are significant and they are highly varied among different material groups as displayed below:

Figure 3: Logistics costs (percentage of the purchase price)
(Source: Wegelius-Lehtonen, 2001b)

| Material group | Average logistic cost (approximate values) |
|---|--|
| Major, Windows, Concrete elements, Kitchen cabinets and doors | 5-15% |
| Plaster board and Mortar | 25% |
| Timber | 50% |

This data confirms that construction material costs can be intensely affected by the indirect costs associated with intermediaries' logistics costs. Fairs's study (as cited in Asnaashari, 2010) described that enhanced simple logistic techniques can cut down 15% of a construction firm's materials and labour costs. It can be seen that the varying nature of logistic costs should be considered to minimise the costs associated with construction materials.

2.5 The Material Purchase Process

Initiation for the purchase of construction materials starts at the tender stage (when design is completed) in a traditional contractual environment. Once the tender document is received, contractors consistently start estimating and send enquires to their selected suppliers. Afterwards, contractors evaluate and select the best-received quote and complete the tender document. The role of material purchasing is performed by three groups, namely the purchasing department/ purchasing agent, the project management team and the field staff. If the contractor wins the tender at the later stage, the validity of the supplier's original quote is reconfirmed by the purchasing department. Sometimes there might be a requirement to negotiate a revised price for materials. The next main step after selecting an appropriate supplier is to raise and issue a purchase order to the supplier. In effect, the order becomes a written commitment to accept and pay for goods under an agreed set of terms and conditions. This becomes a legal contract. In addition, Kong (2001) has reported regularly-encountered trading situations in construction material trading based on the professionals' ideas in the construction industry. Bargaining, bidding, auction and contract are the main existing trading conditions. Bargaining is a trading condition in which the buyer negotiates with the supplier to accomplish a satisfactory deal. In this case a buyer initiates contact with a supplier, researches the product details including price, and negotiates continuously until a better deal is obtained. Bidding involves a buyer and many potential suppliers. The best deal is selected by the buyer out

of the received bids and this follows typical bidding processes. In the case of an auction, a new party called an “agent” who handles the auction comes in to the purchasing process compared to the bidding procedure. The buyers bid sequentially to compete for the materials to be sold. During a contractual trading condition, both buyers and suppliers are controlled by a set of mutually agreed rules.

2.6 Price Determination and Best Buy Concept

Price is a significant factor that should be considered when construction materials are purchased. This study seeks to address the best prices for construction materials and the best price may not necessarily mean the lowest price. Conley argued (as cited in Bernold and Treseler, 1991) that the lowest total evaluated cost should be considered by the material management team. Since this research study is intended to find the best possible price for construction materials from the building contractors’ perspective, the best possible price can be defined as the optimisation of material purchasing or getting the “most for the money”, the “best possible deal” or the “best buy” (Bernold and Treseler, 1991). Bernold and Treseler (1991) discussed the best buy concept for construction materials purchasing strategies and they said that applicable weighted factors should be considered for each item to be purchased. Each weight of the factors considered should reflect comparative importance depending on the requirements and constraints given by the situation of the project specifications and the real construction. As an example, when the delivery time is more significant than the price for particular construction materials, the contractor may end up with a supplier who has a shorter delivery time, but a higher price. This could be the best buy compared to a supplier who offers a cheap price but longer delivery time. Therefore, the best buy concept is dependent on a cost benefit analysis, which normally finds, quantifies, and adds all the positive factors (these are the benefits), and identifies, quantifies, and subtracts all the negatives (the costs). According to this study, positive factors such as quality of the materials, low costs, availability, etc. should be considered, whereas the opposite of the positive factors should be subtracted as negative factors.

2.7 The Construction Sector in the New Zealand Economy

The construction industry is one of the key sectors in the New Zealand economy contributing 5% of its GDP. It is the third largest industry in New Zealand with over 50,000 related business enterprises (Statistics New Zealand, 2009a). The sector plays an essential function in the New Zealand economy contributing over \$9 billion per annum to the country’s economy (Building Research Association of New Zealand, 2010). A substantial growth in the construction industry occurred from 2002 to 2006 mainly due to residential building construction. It contributed to the construction industry’s income and flowed into employment growth and gross domestic product (Statistics New Zealand, 2009b). However, recently the Building Research Association of New Zealand (BRANZ) confirmed there has been a drop in the industry’s productivity of about 0.1% per year since 1990, while most of other industries’ productivity has risen by about 0.2% per year. Statistics New Zealand (2008) further stated that the 5% increment of capital goods price index (CGPI) in the March 2008 quarter was mainly influenced by higher construction prices for new houses and residential buildings. One of the reasons for this higher construction cost is due to high building material costs caused by increased manufacturing costs. There are only one or two manufacturers existing for key construction materials in New Zealand, and hence competition in materials manufacturing is low. Page (2008) suggest that this is one of the reasons why construction materials seem to be expensive.

Moreover, Statistics New Zealand (2009b) shows that the CGPI for residential buildings, non-residential buildings and other construction assets groups continued to rise between 2000 and 2008, with residential buildings recording the highest CGPI compared to non-residential buildings and other construction. Therefore, this data indicates that the costs for capital assets in the construction industry tend to increase. This information shows the significance of the construction sector to the New Zealand economy.

2.8 Summary of the Literature Review

The literature reviewed covered construction materials procurement, construction materials purchasing methods and highlighted the significance of materials contribution to total construction cost. Also, it explored different cost types involved with the construction materials purchasing process. As a result of reviewing different materials purchasing processes in the construction industry a knowledge gap identified was the insufficient attention paid to the process of getting best prices for construction materials. This allowed the formulation of research questions that would be addressed by this study. There are a number of issues surrounding the materials purchasing process. The primary issue is the existence of different construction materials purchasing methods (BMs, direct purchases from manufacturers, consumer clubs, etc.) in the construction industry. However, there are no criteria defined for which method to select, the BMs/suppliers to be selected and which of the methods could guarantee a best price within the New Zealand context. Another issue around the material purchasing practice is that there is no rationale behind the discounts provided by BMs/suppliers. In other words, the reason for offering different discounts for preferred contractors is questionable.

Past literature do not show any integrated and holistic approach to understanding material procurement issues with a focus on price. There are also other issues regarding the involvement of clients and consultants in materials purchasing decisions, which are not adequately addressed. Since their involvement could provide opportunities to secure best prices, there should be well defined criteria indicating the roles of clients and consultants in the materials purchasing process. Finally the literature review emphasised the importance of the construction sector in the New Zealand economy and how materials contribute significantly to building costs. These reinforce the need for a study into issues around material purchasing in the New Zealand construction industry. Hence this research would involve detailed assessment of material procurement issues focussing on price using an integrated and holistic approach. This first time holistic study will help to understand the intricacies involved in materials procurement management in the construction industry from an organisational perspective.

3.0 Design of the Study

3.1 Research Objectives

This research aims to determine how small to medium scale (SME) construction contractors can secure “best prices” for their key material inputs. The study will be undertaken in conjunction with building contractors, building material suppliers and clients based in the New Zealand construction industry. This research study is expected to provide opportunities for the New Zealand construction industry to reduce their construction materials costs. The following research objectives are formulated to help achieve the aim of the research study.

1. To review and analyse the nature of the construction materials purchasing process and to identify existing problems in this process by conducting a comprehensive literature review
2. To identify:
 - buying behaviour of contractors
 - supply behaviour of suppliers
 - procurement behaviour of clients
3. To develop a rationalised model/framework to explain construction buying behaviour with a particular focus on prices of building materials
4. To understand the impact of contractor's buying behaviour, suppliers' supply behaviour and clients' procurement behaviour in relation to prices
5. To validate the research findings by subject matter experts in the New Zealand construction industry

3.2 Key Research Questions

1. How do contractors make their material purchasing decisions in choosing and evaluating supply sources?
2. What roles can clients and consultants play in relation to construction materials purchasing decisions?
3. What mix of strategies should a contractor or a subcontractor adopt to ensure they secure best possible prices?
4. What are the costs and benefits of these strategies?

3.3 Research Methods to be Adopted

3.3.1 Stage 1: Research Problem Identification

The nature of the problem of construction material purchasing can be understood from this stage. This is done by conducting a systematic literature review to understand the buying behaviour of contractors and subcontractors, the supply behaviour of BMs/suppliers, and the procurement behaviour of clients and their professional advisers. The existing parameters, which influence contractors, suppliers and clients, are then identified. Primary data that will be collected from semi-structured interviews and research output from the preliminary literature review will be analysed using qualitative methods. The primary data results could be further supported by extended literature reviews.

3.3.2 Stage 2: Formulation of Research Questions

The research questions have been formulated from information obtained from a comprehensive literature review and the analyses of preliminary data collected.

3.3.3 Stage 3: Data Collection and Synthesis

The research participants for the questionnaire surveys will be building contractors, building material suppliers, and clients in the New Zealand construction industry. As a main step of the data collection, a pilot survey with a small sample population will be conducted as a preliminary piece of research prior to the actual survey in order to address any problems with the sampling plan or the survey questions. Thereafter, the questionnaires will be adjusted in relation to the results obtained from the pilot survey.

This will be followed by three questionnaire surveys directed to contractors, suppliers, and clients to understand the buying behaviour of contractors, supply behaviour of suppliers, and procurement behaviour of clients.

3.3.4 Stage 4: Data Analysis

Upon the completion of the questionnaires, the researcher will analyse the data with the aid of Statistical Package for Social Sciences (SPSS). All the responses given will be checked for errors such as double answers to a question, or incompleteness such as blank responses. Quantitative data analysis will take place parallel with data collection to enable the researcher to generate an emerging understanding about research questions, which in turn informs both the sampling and the questions being asked (DiCicco-Bloom and Crabtree, 2006). The data collection and analysis will be carried out repeatedly and ceases when a saturation point is reached where no new categories or themes emerge. Finally, conclusions drawn from the quantitative analysis will be validated through information drawn from the qualitative analysis to provide a clearer and better understanding of securing best prices for construction materials in New Zealand construction industry.

Qualitative data will be obtained from a focus group interview. Qualitative data collected will be analysed using a phenomenological approach that can encourage the investigation of important statements, meaning units, textural and structural description and description of the essence (Creswell, 2007). The analysis will be carried out using computer aided qualitative data analysis software such as NVivo which is capable of enhancing the rigour in qualitative social research. Thereafter, the qualitative data will be presented in the form of narrative text and the data display reflects the emergence of descriptive themes. The last step in the analysis will involve drawing meaningful conclusions from the processed data.

3.3.5 Stage 5: Validation of Research Findings

Research findings will be validated using the data gathered from focus group interview. Research participants for the focus group meeting consists of 7 personnel in high rank, from a recognized building contractor, a recognized building materials supplier, a recognized client, New Zealand Contractors' Federation (NZCF), Department of Building and Housing (DBH), Construction Clients' Group (CCG), and Building Research Association of New Zealand (BRANZ). Throughout the qualitative data collection process, a standard practice will be adopted as stated below to ensure validity and reliability of data collection.

3.3.6 Stage 6: Conclusions and Recommendations

Finally, conclusions and recommendations will be given on securing best prices for construction materials in the New Zealand construction industry based on the analysis of the quantitative and qualitative data.

3.4 Benefits of the Study

Improving construction material efficiency can directly influence overall construction supply chain efficiency, which is directly related to the best prices of materials using different

purchasing strategies. It therefore implies that securing best prices for construction materials would improve efficiency of the construction industry and consequently lead to an improved New Zealand GDP (gross domestic product). GDP is a strong measure of the economic growth of a particular country including New Zealand (Mawson, 2002) and in recent years, there has been increasing interest in the construction industry's contribution to GDP. Since the building and construction sector contributes more than 5% (DBH, 2008) to New Zealand GDP, improving material efficiency (by providing best prices for the construction materials) can contribute to the increment of New Zealand GDP. In detail, a 1% increment of GDP can be achieved by 10% efficiency increment in the building and construction processes. Further, this translates to an improvement of GDP over \$1 billion per annum (DBH, 2008).

4.0 Conclusion

From the foregoing it is clear that the current study provides a first time understanding of the intricacies involved in material procurement management in the New Zealand construction industry. This exploratory study will be approached from an organisational perspective. Builders' merchants, consumer clubs and buying groups provide various services to construction and the question of how they could add value to clients and contractors through better prices is a key focus in this study. The study will benefit construction academics and practitioners also, as it cuts across many bodies of knowledge, from organisational buying behaviour to supply chain management and production management to marketing. It should be noted that most theory around the subject matter to date seems to have evolved from non-construction industries where operations took centre stage, apart from projects. As stated above, the project-based nature of construction seems to have gone unnoticed in the development of such bodies of knowledge. The current study will provide new insights on the relevance of such bodies of knowledge to construction and for their refinement. The major benefit of the proposed study will come from a deeper understanding of the complexities involved in procurement decisions so that appropriate strategies could evolve to secure best prices for key material inputs.

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