

CRC Construction Innovation

Report: Literature Review

Research Project No: 2004-016-A-1

The research described in this report was carried out by:

Project Leader

Kerry London

Jessica Chen

Researchers

Project Affiliates

Harry Copeland Michelle Jeppessen John Spathonis Allan Carse Wayne Roberts Don Allan Wendy May-Taylor Stuart Rayner Steve Rowlinson

Research Program: A Business and Industry Development

Project: 2004-016-A Supply Chain Sustainability

Date: 10 November 2005

Leaders in Construction and Property Research

Distribution List

Cooperative Research Centre for Construction Innovation Authors

Disclaimer

The Client makes use of this Report or any information provided by the Cooperative Research Centre for **Construction Innovation** in relation to the Consultancy Services at its own risk. Construction Innovation will not be responsible for the results of any actions taken by the Client or third parties on the basis of the information in this Report or other information provided by Construction Innovation nor for any errors or omissions that may be contained in this Report. Construction Innovation expressly disclaims any liability or responsibility to any person in respect of any thing done or omitted to be done by any person in reliance on this Report or any information provided.

© 2005 Icon.Net Pty Ltd

To the extent permitted by law, all rights are reserved and no part of this publication covered by copyright may be reproduced or copied in any form or by any means except with the written permission of Icon.Net Pty Ltd.

Please direct all enquiries to:

Chief Executive Officer Cooperative Research Centre for Construction Innovation 9th Floor, L Block, QUT, 2 George St Brisbane Qld 4000 AUSTRALIA T: 61 7 3138 9291 F: 61 7 3138 9151 E: <u>enquiries@construction-innovation.info</u> W: <u>www.construction-innovation.info</u>

Table of Contents

Tab	ble of Contents	i
List	t of Figures	ii
PR	EFACE	
EX	ECUTIVE SUMMARY	4
1.	INTRODUCTION	6
2.	CONSTRUCTION & DEMOLITION WASTE SECTOR	8
3.	 2.1 Overview of C&D Waste sector	
4.	 3.1 Overview of Precast Concrete sector	
5.	4.1 Supply Chain Management defined PUBLIC POLICY: THEORY	16
6.	 5.1 Public policy defined 5.2 The Australian system of government 5.3 Public policy process	
7.	REFERENCES	

List of Figures

Figure 1.0	Key Initiatives and policies related to C&D waste sector in Australia	10
Figure 2.0	Key Initiatives and policies related to C&D waste sector worldwide	10
Figure 3.0 construct	Strategies/initiatives performed in response to the skill shortage in t ion industry	:he 14
Figure 4.0	Policy process model by Burch and Wood (1989: 15)	20
Figure 5.0	The Australian Policy Cycle	21
Figure 6.0	The agenda-setting process	22
Figure 7.0	The rational comprehensive model	23
Figure 8.0	Consultation continuum	24
Figure 9.0	The different evaluation types	26

PREFACE

The research project is an academic and industry collaboration combining the following partners: Queensland Department of Main Roads, Brisbane City Council, Queensland Department of Public Works, Ryder Hunt, the University of Newcastle and Queensland University of Technology. The project is lead by the University of Newcastle.

The industry partners, Brisbane City Council and Queensland Department of Main Roads are particularly motivated to explore the difficulties in developing supply chain strategies from a government perspective to achieve economic and environmental sustainability in the construction and demolition waste and precast concrete sectors.

EXECUTIVE SUMMARY

This research aims to improve the economic and environmental sustainability of the construction & demolition waste and precast concrete supply chains through the development, trial and evaluation of an innovative public sector supply chain management strategy. The long-term goals are to improve competitive behaviour and market sector performance and improve business process efficiency and effectiveness of public sector program delivery by influencing policy development, changing organisational behaviour and implementation development to achieve more economic and environmental sustainable markets.

The general research question that will be addressed is "How do public sector clients develop sustainable supplier group strategy maps?".

The research objectives are to:

- investigate the productivity and performance problems and the associated actions or changes of two supply chains (precast concrete and construction & demolition waste) to indicate to industry and government what can be achieved,
- develop, trial and evaluate a Supplier Group Strategy Map for the two chains,
- document the development, trial and evaluation *process* to develop a Supplier Strategy Map (practice),
- develop a benchmarking guide to monitor market performance post implementation (monitor policy and practice) to inform decision-making to monitor business environmental changes triggered by federal, state and local government policy,
- develop a best practice guideline for government supply chain management (policy and practice)

The study will promote business process efficiency improvement in program delivery by Brisbane City Council and Queensland Department of Main Roads through policy and implementation development and also promote improved competitive behaviour.

The study seeks to address the Brisbane City Council (BCC)'s strategic objective of increased recycled materials content of construction projects through the expansion of the construction and demolition waste sector through market diversification. The study will also investigate strategies for economic sustainability of the pre-cast concrete sector through a state-wide smoothing of Queensland Department of Main Road (QDMR)'s market investment strategy with the long term benefits of stabilisation of employment levels, reduction in high staff turnover and flow on improvements in skill levels and occupational health and safety. Short term benefits will include improved product quality and reduction in remedial work and wasted government resources to monitor a poor performing sector.

This literature review is the first report for the study and it includes:

- an overview to the two sectors (C&D waste and precast concrete), identification of broad issues within the sectors and a map of a selection of key initiatives that have been implemented to improve the performance of the two sectors;
- a brief discussion of the supply chain management theoretical framework and the role of public sector client in the implementation of supply chain policy for the improvement of the performance of the two sectors; and

 a review of theory related to the field of public policy and identification of issues related to policy implementation towards constructing a process model for the development of a Supplier Group Strategy Map.

The next report that follows will describe the theoretical model.

1. INTRODUCTION

The improvement of the performance of the construction industry through the improved performance of the supply chains that make up the various sectors is a difficult task and one that has had considerable international debate (London, 2005). The idea of using the supply chain concept as a normative model to improve firm behaviour and thus ultimately improve industry performance through the development of supply chain clusters or integrated supply chains has been discussed in many public sector policy documents and in the academic research community since the late 1990s (London, 2005). However it has been difficult to see any real examples where this concept has had any major impact – or where the improvements have been measured and monitored.

Governments have always understood their role as a key purchaser and the impact that they can have on firm behaviour in an industry. Procurement and purchasing policies have been developed however; one of the greatest difficulties is the lack of implementation of these policies in the construction industry. Many of these policies focus particularly on supplier management which is a very useful first step; however, there is still a lack of understanding of the interdependency between firms and the role that the interrelationships between firms has on the overall performance of the industry. To achieve sector wide changes in performance levels we have to think about groups of firms and not simply the first tier of suppliers who supply to government. This report begins to describe the theoretical framework which underpins a research project that is currently being undertaken which is designed to explore the difficulties involved in turning policy into practice and making changes in sectors through the supply chain concept.

One of the greatest concerns of the construction industry is the lack of cohesion and coordination between firms along their supply chains during project contracts. The low productivity and poor performance of the industry has long been associated with the lack of integration between firms. To this end various strategies such as project alliancing contracts have been sought by governments to create environments of trust and longer term business relationships to help achieve higher productivity. Unfortunately, this has had limited success in altering the performance of the industry because these contractual relationships are only between four or five top tier firms. Major infrastructure projects can have well over 1000 firms involved and therefore their supply chains and the relationships between these firms will never be influenced significantly by an alliance contract.

Governments can play a significant role in changing the structural and behavioural characteristics of industries. This raises three key issues to consider in relation to industry performance and productivity, namely:

- How do we develop sector performance through existing structural and behavioural characteristics in an industry with a large number of interdependent firms?;
- What role does government play in improving sectoral performance as both a large client and a regulatory or policy maker?; and
- What are the difficulties related to public sector policy development and implementation?

One of the greatest difficulties is this problem of policy versus practice and for this reason actual examples of markets and the various supply chains is the focus of this research. Two potentially significant market sectors within the construction industry are the construction and demolition waste (C&DW) and precast concrete (PCC) sectors.

This study aims to explore the relationship that two key government agencies have with respect to their activities and interactions with these sectors. Although seemingly different

sectors, they each represent examples of how the agencies are taking the supply chain concept and examining how to respond to the problems that they have identified in relation to performance and productivity. The next two sections; Section 2: Construction & Demolition Waste Sector and Section 3: Precast Concrete Sector will discuss the current behaviour of the two market sectors to highlight the key characteristics, problems and strategies associated with each of the markets in relation to productivity and performance.

A supply chain management approach was considered relevant for the improvement of sector performance through existing structural and behavioural industry of a large number of interdependent firms. *Section 4: Supply Chain Management* will discuss the supply chain theoretical framework and identify key problems associated with its practical application in the construction industry. Its relevance to achieving economic and environmental sustainability for the two specific sectors within the construction industry; construction & demolition waste and precast concrete is also discussed in the section.

As noted previously public sector clients have the opportunity to create improvements in productivity and performance in various markets, including C&DW and PCC sectors through supply chain management. There are numerous activities that asset owners can and do undertake to achieve strategic alignment of their objectives to selected supply chain management strategies. A wider supply chain management approach can lead to:

- 1) greater diffusion of effective environmental practices within the C&DW sector to achieve environmental sustainability; and
- 2) smoothing of the PCC sector through improvements in efficiency and productivity hence ultimately achieving economic sustainability.

Supply chain management has long been considered an important strategy for public sector governance, however it has proven difficult for all governments globally to implement. This project is aimed at investigating the two specific market sectors related to achieve economic and environmental sustainable performance; C&DW and PCC through working with government agencies to assist in the development and implementation of supply chain management policy to achieve economic and environmental sustainability. It will specifically identify the difficulties related to implementation of public sector supply chain management policy within the two sectors to improve practice.

The final section of this report, *Section 5: Public Policy:Theory* is devoted to a review of literature surrounding the field of public policy to provide a broad contextual background to the policy process and to develop a greater understanding of the difficulties related to the development, implementation and evaluation of public sector policy process. More specifically, key issues related to policy implementation will be identified in this section.

2. CONSTRUCTION & DEMOLITION WASTE SECTOR

This section is divided into four parts including:

- a brief outline of the current characteristics of the construction & demolition waste sector globally, particularly in relation to the issues that the sector is facing;
- a discussion of the key barriers and drivers to effective waste management identified in the literature;
- a description of some of the most significant waste minimisation strategies and techniques that are currently being utilised in the construction industry globally; and
- a summary of the issues related to existing strategies to effective waste management and suggestions as to how to improve the performance of the sector

2.1 Overview of C&D Waste sector

The construction industry generates a large amount of waste, which has major impacts on the environment. In Australia, the construction industry contributes 20-30 per cent of overall landfill volumes (EPA, 1998). Typical wastage rates within the industry are as high as 10-15 per cent (Mc Grath, 2000), making the industry the second largest producer of controlled waste (CIRIA, 1995) with the vast majority of which is lost to landfill sites, the industry's most common waste disposal technique (Mills, 1999).

A wide range of waste minimisation techniques has been developed however, after initial adoption by large innovative organisations environmentally friendly practices have not been highly embraced by the wider construction community. Despite the initiatives and measures undertaken by various parties, C&D Waste is still a large problem particularly for local governments. A supply chain management approach has been identified as the way for improved sector performance through greater diffusion of effective environmental practices (Ofori, 2000; Dainty, 2004) rather than relying on individual large firms.

2.2 Barriers & Drivers to effective waste management

There has been a great deal of literature related to construction & demolition waste management and much of it has been focussed on barriers and drivers to effective waste management in the construction industry. The barriers and drivers to effective waste management, which have been identified in the literature, will now be discussed.

The literature has revealed the following drivers, which have been suggested to assist in the adoption of environmentally friendly practices including (Johnston, 1995; Graham, 1996; Lingard, 2000; Zhu, 2005):

- Pressure from regulators (legislation), supply chain partners, competitors and the market (consumers and customers)
- Better quality products and services through more efficient work practices, safer sites and cost savings
- Improvement of corporate image hence better public relations
- Support from senior management

Contrary to the traditionally held perception that the introduction of environmentally friendly practices involves high costs, studies have revealed that effective waste management does in fact offer cost savings amongst other benefits as listed above (Graham, 1996; Lingard, 2000; Teo, 2001; Zhu, 2005). However, the adoption of environmentally friendly practices by the wider construction industry has remained largely minimal despite its potential in offering numerous benefits as identified in the literature. This can perhaps be linked to the barriers to effective waste management, which are caused by the characteristics of the construction industry which include:

- Its culture and resistance to change (Federle, 1993; Lingard, 2000)
- Conflicting goals of the different participants within the construction environment in relation to perceived importance of waste reduction (Teo, 2001; Hampson, year)
- Unique nature of each project, hostility and unpredictability of the production environment, fragmented nature of the project organisations used to procure buildings (Teo and Loosemore, 2001).
- Lack of awareness, interest or commitment to environmental issues (Ofori, 2000)
- Perception that waste management is not cost-effective (Bossink, 1996; Graham, 1996)

As indicated by the literature, most of the barriers to effective waste management revolve around the structural and behavioural characteristics of firms within the construction industry whereby firms are highly resistant in their behaviour and attitude towards new work practices and are therefore not embracing the potential benefits of effective waste management. Much waste management research in the past has focused on the implementation of new work practices, processes and technologies to encourage the adoption of environmental friendly practices within construction industry firms (Formoso, 1993; Bossink et al, 1996; Poon, 1997). Although this research has been useful, the industry remains highly resistant to change. A large part of this is caused by the neglect of the significant role that human behaviour and perceptions can play in initiating change.

Perceptions play a key role in the diffusion of new practices. However, human behaviour and perceptions are changed by work practices. One of the greatest influences on firm work practices is the cluster of firms that they deal with on a daily basis; that is their clients, collaborators and suppliers. Firm practices are also constantly being shaped by their competitors whereby firms can sometimes be lead to change work practices when competitors are embracing change by adopting new practices. Firms are of the perception that it can be too risky not to change when working within such a competitive work environment that is the construction industry.

Lingard et al's (2000) work has provided some general insights into people's attitudes towards waste in the construction industry. Lingard et al (2000) highlighted the significance of the perceptions held by individuals in the successful implementation of waste management strategies within construction firms. Building on to Lingard et al's work (2000), Teo and Loosemore (2001) identified top management supportiveness and availability of local infrastructure as two of the most critical factors for waste reduction behaviour. Whilst these findings serve to reveal the significance of human behaviour and perceptions in the adoption of new practices and programs, there is still limited research performed into the critical role the different players including competitors, suppliers, collaborators/partners; within the supply chain play in influencing the perceptions towards waste minimisation. Even less understood are the characteristics of the relationships between the different players within the supply chain, which can have a significant impact on the way perceptions and attitudes are formed towards new innovations such as environmentally friendly practices.

Contrary to the traditional view that the construction industry is fragmented, unstructured and unpredictable, London (2005) has identified that the project-based industry has a deeper level of complexity in that there is an underlying structure to the activities of the supply chains, supplier firms and procurement relationships, which can be classified based upon specific patterns of attributes. Firms may not work on every project with the same customer and supplier connections; however, firms are typically located within a cluster of business networks, which develop and are maintained over numerous years (London, 2002). There is thus an indication that there are indeed longer term relationships between the different players within the supply chain whereby different players within the chain have a degree of influence over each in other in their behaviour and attitudes towards the adoption of environmentally friendly practices. As such, it is important to gain a deeper understanding of how this takes place within the supply chain that is specific to the C&D waste sector. The next section will identify some key strategies that have been implemented to improve the environmental performance of the C&D waste sector.

2.3 Waste management strategies

Worldwide there have been many policies, initiatives or programs developed in the past two decades to increase the diffusion of effective waste management practices to the wider construction community in the past two decades. Figure 1.0 below maps a selection of key initiatives implemented by various players within the construction industry internationally and nationally in their attempt to improve the environmental performance of the construction industry particularly through effective waste management practices.





Key Initiatives and policies related to C&D waste sector in Australia



Figure 2.0 Key Initiatives and policies related to C&D waste sector worldwide

Within the academic literature, much research has been focussed on strategies to effective waste management and the underlying principles to waste reduction as revealed in the literature (Teo and Loosemore, 2001; Dainty and Brooke, 2004) include:

- Reduce quantity of waste generated (input into the design process)
- Adopt an effective system for managing the unavoidable waste produced

In a study to explore the waste minimisation strategies utilised in high profile construction projects in the UK (Dainty and Brooke, 2004), it was identified that a wide range of waste minimisation techniques are currently being utilised by large construction organisations. The study revealed that the three most effective waste management solutions utilised by construction firms include the:

- the development of alliances with suppliers and recycling companies by forming relationships with suppliers and secondary users of waste materials
- increased use of off-site fabrication to control waste and damage
- use of standardisation to improve buildability and reduce the quantity of off-cuts

2.4 Summary

As shown in figures 1.0 and 2.0, many programs, initiatives, programs and best practice guideline documents have been introduced and implemented both internationally and locally within the C&D waste sector. It should be noted however, that whilst there is no doubting the merits of the strategies suggested and/or implemented by these initiatives/policies/programs, there is no assurance that these strategies would translate into firm practice adoption, let alone into improvements in the performance of the construction industry through

environmental sustainability. It should also be noted that different countries (or states within a country) may have different regulatory requirements, needs and culture; and therefore individual site/market needs, local regulations and issues will need to be addressed through a site/market-specific, performance-based approach.

Despite the utilisation of a wide range of waste minimisation techniques by large construction firms the diffusion of environmentally friendly practices has not trickled down to the wider construction community. Efforts to encourage effective waste management through implementation of various initiatives, programs and policies by numerous governments and interest groups globally appears to have had minimal success. There is thus merit in evaluating the problems associated with the existing policies to identify the difficulties of implementation and further to that lead to a more successful translation of policy to practice within the C&D waste sector. A public sector supply chain management approach is proposed for greater diffusion of waste minimisation techniques and for the improvement of environmental performance in the C&D waste sector. This is discussed in section 4.2 of this report. The next section will now discuss the key issues related to the precast concrete sector.

3. PRE CAST CONCRETE SECTOR

This section is divided into four parts including:

- a brief overview of the current characteristics of the precast concrete sector in Australia, particularly in relation to the issues that the sector is facing;
- a brief discussion of the key barriers to economic sustainability in the sector as indicated by anecdotal evidence;
- a description of some of the most significant strategies that are currently being utilised in response to the skill shortage issue in the construction industry globally; and
- a summary of the issues related to existing strategies to reduce skill shortage and suggestions as to how to improve the performance of the sector.

3.1 Overview of Precast Concrete sector

Anecdotal evidence suggests that the precast concrete (PCC) sector is particularly affected by industry cycles in terms of low productivity and high levels of remedial work. Downturns in the industry also equates with a high level of staff turnover leading to the loss of skilled employees. This then has a major impact on occupational health and safety issues within the industry. The low productivity and high levels of remedial work in the PCC sector is highly problematic, particularly for state and local governments as much resources are spent on stabilising employment levels and monitoring the poor performing sector. It is suggested that a wider supply chain management approach can lead to smoothing of the PCC sector through improvements in efficiency and productivity hence ultimately achieving economic sustainability.

3.2 Barriers to economic sustainability in the PCC sector

A sector's economic sustainability is highly influenced by its productivity and performance. Within the precast concrete sector, anecdotal evidence suggests that the issue of skill shortage is particularly linked to the sector's extreme fluctuations in construction output, employment and training levels. The high industry cycles equates to a high level of staff turnover, which further leads to a loss of skilled employees. This in turn has a major impact on the sector's economic performance through two key areas, namely:

- occupational health and safety issues caused by a high level of worker compensation claims
- high levels of rework

Firstly, occupational health and safety is an important factor that impacts upon the construction sector including the precast concrete sector. The health of employees in relation to physical wellbeing will be affected by a skill and work level stabilization. A reduction in skill shortage would influence the sector in two main ways; firstly it is suspected that workers would have fewer injuries and further to that it is suspected that this would ultimately lead to a reduction in the number of worker compensation claims hence an improvement in the sector's economic performance.

Secondly, rework is also another important factor that impacts upon the economic performance of the precast concrete sector. Rework is the unnecessary process of redoing work that has been performed incorrectly the first time (Love et al, year). Direct costs related to rework in construction projects have been identified to contribute to 10-15% of total

contract value of projects (CIDA, 1994; Burati et al, 1992). Rework in construction projects can be caused by numerous factors including design errors, changes and omissions and skill shortage. The industry's acute shortage of skilled labour and high industry cycles leading to the loss of skilled employees has resulted in the employment of unskilled employees in many areas within the industry including the precast concrete sector. Many unskilled employees do not possess the capacity to perform duties to produce work on construction projects that are of the required standard or quality. Consequently, much economic resources are spent on the high levels of remedial work.

Therefore it is speculated that the skill shortage issue is a key barrier to the economic sustainability of the construction industry including the precast concrete sector and is a particularly pressing area that requires the attention of key industry players including governments. The Australian workforce is already experiencing a considerable skill shortage whereby vacancies in traditional trades have increased by 86%, with acute shortages in chefs, construction, metal, wood, electrical and electronics. According to the Department of Employment and Workplace Relations (2005), the vacancies in building and construction in March 2005 accounted for 23% of all trade vacancies and 14% of all skilled vacancies. These skills shortages are not short-term and are expected to be ongoing due to the continual growth of the Australian construction industry (DEWR, 2005). This problem is not just particular to the Australian construction industry and it appears to be a worldwide trend.

The different factors that have led to the skill shortage in the construction industry worldwide have been well documented and can be attributed to various factors including (Mackenzie, 2000; DEWR, 2005):

- A decline in apprenticeship: less young people entering the workforce to replace the older generation of employees due to demographic decline and also the undervalued nature of technical jobs
- The changing nature of construction markets
- Emerging demands of new technology
- Cyclical nature of the construction market
- Fragmentation of the industry
- Decline in construction training and training resources

3.3 Skill Shortage Strategies

Worldwide there have been many policies, initiatives or programs developed in the past two decades to reduce the shortage of skills in the construction industry. Initiatives specific to the precast concrete sector appears to have been limited and therefore figure 3.0 below has been widened to map a selection of the key initiatives implemented by various players within the construction industry in response to skill shortage in the past decade.



Figure 3.0 Strategies/initiatives performed in response to the skill shortage in the construction industry

3.4 Summary

Despite numerous initiatives and programs that have been implemented in response to the skill shortage issue within the construction industry worldwide as shown in figure 3.0, the industry continues to experience an acute skill shortage, which impacts negatively upon the economic performance of the industry.

More specifically, there is a dearth of literature and industry comment about the state of the precast concrete sector in Australia and yet it poses a highly significant barrier to achieving economic sustainability of the sector. Existing literature related to the precast concrete sector have largely concentrated on specialized and technical issues related to product performance such as strength, etc. Consequently, other important areas related to the economic performance of the sector including occupational health and safety and rework issues caused by the skill shortage within the industry have remained unexplored. A public sector supply chain management approach can lead to smoothing of the PCC sector through improvements in efficiency and productivity hence ultimately achieving economic sustainability. This will be discussed further in section 4.2 of this report. The next section will now discuss the concept of supply chain management and its relevance for the improvement of sector performance.

4. SUPPLY CHAIN MANAGEMENT

This section is quite brief and is intended to provide an introduction to supply chain management. In following reports, we shall provide more theory in relation to supply chain management and merge with the next section on public policy. This will then provide a strong theoretical framework for the development of the conceptual model for this study.

4.1 Supply Chain Management defined

There are numerous interpretations of what the supply chain is and at what level a supply chain is considered (London, 2001). For the purposes of this study an industrial organisation economics perspective has been developed. Industrial organization economics is an economic theory used to describe the economic structure of markets, the economic behaviour and performance of firms in those markets and the performance of the markets as a whole. These three elements of market structure, firm conduct and market performance are the cornerstone elements in the theory. Industrial organization economics is profoundly and fundamentally concerned with policy questions. One of the most interesting discourses that takes place in this theory is the role of governments and the extent to which governments intervene in the market through various mechanisms to change market structure and firm behaviour. There are two schools of thought: the Chicago School and the structure-conductperformance School. The Chicago School suggest do not advocate market intervention and the structure-conduct-performance School suggest that governments should intervene to alter market structure to alter performance. Of course in reality the world does not really divide into these two categories and there is a range of combinations and governments tend to act on a spectrum of intervention.

Therefore the supply chain concept is very much concerned with firm behaviour within markets. The supply chain is the firms that are involved through upstream and downstream contractual relationships who deliver a commodity (product and/or service) related to the core business of a construction project. The supply chain once formed creates a flow of commodities, cash and information. The creation of the supply chain is impacted by the location of the individual firm within its competitive market; which has unique economic, structural and behavioural characteristics. The upstream and downstream linkages are affected by the nature of these markets and then the countervailing power, which occurs between subsequent markets at adjacent levels in the chain (London, 2005). Changing market structure and firm behaviour relies upon:

- the individual firms economic pressures as a result of market competition (the behaviour of their immediate competitors),
- the upstream and downstream linkages that they typically find themselves located within and then the business environment of their upstream and downstream suppliers and/or clients, and
- government policy.

The supply chain management concept has gained the interest of the construction research community and policymakers through its successful implementation by manufacturing sectors to resolve firm performance problems. The general approach to supply chain management to improve industry performance has been through either of the following two types (London, 2005):

 normative models: based on the assumption of a homogenous industry, but one which is fragmented and composed of numerous small to medium sized firms positive models: accepts that the industry is specialised and heterogenous with varied structural and behavioural characteristics across individual markets

Whilst many policymakers worldwide are seeking positive economic models, existing policies are not based upon an explicit understanding of the nature of the varied structural and behavioural characteristics of the industry. According to London (2005),

"The greatest difficulty with supply chain management in terms of construction research theory and practical application is that currently too little is known about the structural and behavioural characteristics and how to describe them".

London (2005) developed a positive economic model to aid mapping industry structural and behavioural characteristics and this will be used for this study. The model was tested through seven major sectors of which precast concrete and C&D waste were not included. Whilst it served to highlight the structural and behavioural characteristics it did not explicitly align this with performance measurement across entire sectors. The present study builds upon this previous study to describe and map the underlying structure and behaviour specific to the two market sectors; C&DW and PCC to develop an innovative supply chain management strategy for government.

Governments can impact the construction industry through three key ways (London, 2005):

- through direct intervention: the development and monitoring of policy and regulations to encourage competition or restrict practices in certain areas;
- by virtue of their demand patterns: the allocation of budgets and capital works programs through their role as a large client of infrastructure projects; and
- through their purchasing power: to induce certain types of behaviour from firms that they contract with.

The development of policy is key to this study and the next *Section 5: Public Policy: Theory* reviews key academic texts in relation to public policy theory.

5. PUBLIC POLICY: THEORY

This section reviews theory related to public policy and is divided into four parts including:

- a review of some of the key definitions provided in the academic literature in relation to public policy;
- a brief overview of the Australian system of government;
- a description of various approaches/models to the policy process including a description of the different stages related to the policy process; and
- a summary that discusses the key issues involved in policy implementation.

5.1 Public policy defined

There have been many interpretations as to the definition of public policy. According to Fenna (2004):

'Public policy is about what governments do, why, and with what consequences' (Fenna, 1998, p3).

The following is a synthesis of the key characteristics/attributes that define public policy (Fenna, 1998; Bridgman and Davis, 2004):

- a conscious choice taken with an end goal in mind
- an intentional course of action by government that contains a purposive element
- authoritative made by a public body with legitimate power in the system of government
- occurs at national, state and local levels
- it is clear that there is intent to make it work clear measures at implementation is an essential component of policy-making
- a dynamic and continual process

The implementation of public policy is ultimately aimed at achieving government's objectives. It is therefore the government's means to an end involving the appropriate selection of both means and ends. In some instances, governments may decide not to do anything in regard to a specific issue. However, that is not to say that the government's inaction is not a policy – the deliberate choice of inaction over action in a consistent manner makes the course of action, which is not to do anything, a policy (Hedidenheimer, 1990; Dye, 1998; Fenna, 2004).

Public policy involves a wide range of issue areas. Fenna (2004) identifies four general issue areas of policy:

- Production concerns the creation of wealth (economic),
- Distribution concerns the way wealth is distributed (social),
- Consumption concerns the way wealth is utilised (environmental), and
- Identity concerns how the people are defined.

In an economic market, governments do not always have full control of the market's economy – the role of the government only extends to their power to exercise indirect influence through 'levers' (for eg. tax structures, spending priorities and official interest rates). It is not known however, the extent to which these levers would work. Consequently, many policies are developed and implemented through hard decisions, which often generate considerable political debate and conflict. These concerns lead governments to implement a

range of policies aimed at influencing the structure of the economy including regulating/deregulating markets, raising/lowering tariffs, providing/denying subsidies.

There are two dimensions to economic policy:

- Macro-economic concerns the performance of a country's economy as a whole (measured by the rate of economic growth and levels of unemployment and inflation)
- Micro-economic concerns the specific nature of the economic activity (the performance of industries and firms within industries)

What is of higher relevance to the present study is the second dimension of micro-economic, which concerns the performance of industries, etc. ('why are some industries or firms prospering while others are not'?). Within the construction industry, it has been suggested that the government, at local, state and federal levels, can affect or influence the market to an extent by being a large construction sector client as well as industry regulator. The government can therefore directly affect the performance of the construction industry by influencing consumer demand and more indirectly through manipulation of its fiscal and monetary policies (Hampson and Manley, 2001).

Public policy is dependent upon its institutional context – it is essentially an expression of the political priorities of the government. Therefore an understanding of the nature of government and the political dynamic is central to the study of the policy process. The next section will review the Australian system of government to explain the operations of the government and the institutional context of policy making.

5.2 The Australian system of government

Very briefly, the Australian government, given national expression in the Commonwealth Constitution of 1900 is a unique system combining parliamentary government with federal institutions. It draws upon the British notions of responsible government and American models of federalism resulting in a system encompassing the following key features (Republican Advisory Committee):

- federal division of powers
- a strong parliament
- a separate Australian judiciary which reviews the constitutional validity of legislation
- an Australian representative of the monarch who exercises nearly all of his or her functions on the advice of the executive and who performs the national ceremonial role normally associated with a head of state

There are three levels of governance in the Australian system of government, including the federal, state and local. The activities of all levels of government impact upon the construction sector (Hampson and Manley, 2001). The responsibilities of the different levels of government include (ISR, 1999, p11):

- Federal: workplace relations, environmental and other standards, education and training, trade-related matters and financial and corporations law
- State: building regulation and the planning approvals system at the state level, although elements of the system are delegated to local government, registration of builders and some trades, and accrediting and registering professionals
- Local: local building regulation and planning approvals system, monitoring of construction

The next section discusses some of the more significant approached or models of the policy process in the public sector.

5.3 Public policy process

Policy-making in the public sector involves deciding what problems to address or what objectives to achieve and how to achieve it. It is made up of a chain of iterative decision-making processes involving the coordination of interactions and consultations between individuals and/or groups at different levels of governance. It can therefore be a highly complex process, which is continual and dynamic and should not be seen as a single event.

Many researchers and practitioners in the field of public policy have developed numerous models and maps to describe and illustrate the different stages involved in the policy process. Three of the more significant models of the policy process and the key aspects of the models include:

- Burch and Wood's policy process model: centres around supply/demand conditions
- Simeon's 'funnel model': centres around key variables/matters of priority
- Sabatier and Jenkin-Smith's 'advocacy coalition framework': centres around consultation

Each of these will now be discussed in turn.

The first model developed by Burch and Wood (1989) as shown in Figure 3.0 below views the government acting almost like a manager coordinating the supply and demand of the market by firstly making use of the public and private resources on the supply side of the manufacturing process to produce goods and services, rules and regulations and then transfer payments as policy outputs. Finally, response from the citizenry thus creates demands, which then impacts upon the future supply side choices. This model highlights the cyclical nature of the policy process whereby responses from one side of the market may influence the conditions of another and vice versa.



Figure 4.0 Policy process model by Burch and Wood (1989: 15)

The second model developed by Simeon (1976) looks at the policy process as one that addresses a wide range of issues and goals from different levels. On the first level at the wider end of the funnel, policies are viewed as responses to broader social and economic settings in an attempt to move closer towards goals. On a more advanced level as it gets closer towards the narrow end of the funnel, the more immediate factors are of the focus whereby only those matters most relevant to the policy under examination are given priority. The significance of this model is that it tells us that the policy process is highly context-dependent and that it should reflect the dominant thinking, characteristics and behaviour of the day (Bridgman and Davis, 2004).

The third model by Sabatier and Jenkins-Smith (1993) suggests that policy making involves interaction and continual negotiation between different participants who develop a shared understanding of the problem despite having disagreements in regard to solutions to the problem. This 'advocacy coalition framework' is significant because it informs that the policy

process is ongoing and dynamic and it involves other powerful interest groups apart from the government.

There is however, an underlying theme or concept that is similar in most of the models in that central to many of these models is a three-phase sequence. The three-phase sequence can be described as (Bridgman and Davis, 2004):

- ideation,
- realisation and
- evaluation

or less formally as

- thinking,
- doing and
- testing.

The *policy cycle* used in Australia is not dissimilar to the three-phase sequence present in other maps or models of the policy process in that it suggests that policies develop through a standard sequence of tasks, which can be framed as activities. The *policy cycle* is used by the Australian system of government to ensure that the way, in which policies are developed, implemented and evaluated matches the broader objectives of governments. It is aimed at achieving consistency so that new policies that are being developed and implemented are constantly in harmony with the wider goals of government activity.

However, despite the normative values in the policy cycle suggesting a strictly logical pursuit, desired policy outcomes can not always be guaranteed as the practice of policy development and implementation is a complex and multifaceted matrix of politics, policy and administration. The policy cycle offers the analytical tools to assist in making sense of policy making to pursue better practices.

"...it is logically impossible to understand any reasonably complicated situation – including almost any policy process – without some theoretical lens ('theory', 'paradigm', or 'conceptual framework') distinguishing between the set of potentially important variables and causal relationships and those that can safely be ignored." (Sabatier and Jenkins-Smith, 1993)



Figure 5.0 illustrates the Australian policy cycle, which suggests that the policy process can be broken down into various activities or elements. The activities/elements of the policy process will now be discussed in turn.

Identification of issues

There is a constant competition between interest groups and parties, parliament and media, departments and private companies to gain the interest of the government. The policy agenda involves the narrowing of this raft of possible policy problems identified by the different players down to those few that are significant enough to command the resources of the government. As pointed out by Anderson (1994),

"...each problem must compete for official attention because of limited time and resources. The demands that policy makers choose or feel compelled to act on at a given time, or at least appear to be acting on, constitute the policy agenda...".

Figure 6.0 illustrates the process of how possible policy problems attracts the attention of the government and becomes part of the policy agenda. As shown in the diagram, the policy agenda is subject to influence from a mix of influential political, economic and bureaucratic elites.

For an issue or problem to make it to the policy agenda, Bridgman and Davis (2004) identify four conditions that need to be met to include:

- An agreement from a coalition of voices of significant interests and individuals from within and outside government agree that a problem is significant enough to require authoritative response
- The problem offers a prospect of a solution where resolution does not seem impossible
- The problem needs to be one that the government considers to be of sufficient consequence to invest time and investment
- The ideological framework of the governing party may influence whether or not a problem will be addressed



Figure 6.0

The agenda-setting process

The agenda-setting process is not without its problems. As indicated in Figure 6.0, the problems that gets into the policy agenda debate and further demands the attention of the government are subjected to the both political and policy elite influence. Therefore the problems that make it to the agenda debate can very well be biased and of relevance or significance only a select group of individuals. There is thus the issue of not knowing if problems being addressed by the government are indeed the most significant public problems.

Policy analysis

After the identification of issues, decisions need to be made in relation to the appropriate approach, relevant time and resources to be spent in addressing the issues. Policy analysis is different from decision making in that it is carried out by staff with detailed policy knowledge for the provision of data and advice for decision makers. Policy analysis assists the appreciation of costs and benefits associated with a range of approaches to policy problems. The key aim of policy analysis is to frame an issue in terms that make it intelligible to others and open to the analytic tools available to policy professionals. To deal with ambiguous / conflicting objectives analysts typically produce a range of options for decision makers, each with its own configuration of problem definition, policy objective and proposed solution. There are two main approaches to policy analysis:

- Rational comprehensive model
- Incremental approach

The rational model follows a logical and ordered sequence and is illustrated in figure 7.0 below.



Figure 7.0

The rational comprehensive model

The rational comprehensive model is based upon the assumption that policy problems are clear and that the policy process is one that is sequential and hierarchical as opposed to the complex process in real world environments. However, the rational approach is a useful sequence that at least forces policy makers to work systematically and provide some justification for favoured options (Bridgman and Davis, 2004).

The incremental approach began as a critique of the rational comprehensive model through observations in real world environments that ends and means in the policy process are rarely clear. It is based upon the premise that each new problem is not addressed by starting from first principles in that policy proceeds through small experiments or pilot programs. The incremental approach views the policy process as one that develops and grows whereby knowledge and information related to a policy area are built up with matching programs. As such, programs/policies/initiatives are implemented in a piece-meal fashion.

Consultation

Consultation is the government's main tool for testing options to policy problems. Consultation assists in government's decision making process and takes place throughout the policy cycle. A consultative process in policy development may help to develop solutions that better reflect the realities of problems and the competing interests of those involved (Bridgman and Davis, 2004).

There is continual pressure on governments to consult about public policy. The OECD suggests that governments use consultation for one or more of the following objectives (OECD, 1994: 6-9):

supporting democratic values

- building consensus and political support
- improving regulatory quality through information collection
- reducing regulatory costs on enterprises, citizens and administrations
- quickening responsiveness
- carrying out strategic agendas

Public involvement in the public policy process can be placed on a continuum whereby public participation ranges from high to low. This is illustrated in figure 8.0 below.



Figure 8.0 Consultation continuum

At the lower end of the spectrum of minimum participation is *information*, which involves a one-way process of the government educating or informing the public about policy decisions and objectives (for eg. public information/advertising campaigns, surveys, focus groups). *Consultation* involves the government seeking input from individuals and groups in relation to a policy decision with the aim of enhancing acceptability through a greater understanding of the interests of those likely to be affected by the decision or outcome (for eg. key contacts, public hearings, interest group meetings, circulation of proposals). *Partnership* allows the public a degree of control over policy content whereby the public work in cooperation with decision makers to influence the policy process (for eg. advisory boards/committees, policy). *Delegation* hands over control of the policy agenda to an outside group (for eg. public inquiries, impact assessment studies). Control – (for eg. referenda, privatisation).

Coordination

Coordination in the policy process involves the process of ensuring the highest level of consistency across different activities and issues including policies and decisions, behaviour by officials, equal treatment of citizens and adherence to due process and official procedures. The coordination process is, however, a highly complex one as it seeks to achieve compatibility across multiple and sometimes conflicting goals. Different government departments and agencies have individual specialisation and focus alongside their own mission, culture and resources. Therefore the government is somewhat divided into different programs, often with contradictory rules and processes. The role of central agencies is to provide a balance to this fragmentation to achieve a 'whole of government' consistency across the different departments/agencies.

Implementation and Policy instruments

Governments utilise a wide variety of policy instruments to implement policies, ranging from those that are very broad to those highly specific. Policy instruments are methods or ways used by governments to achieve goals and objectives whereby policy instruments are government's means to an end. Governments can achieve objectives through various ways depending on the choice of policy instrument utilised. Often the outcomes of a particular piece of policy, program or initiative may differ from the intended outcome (Palfrey et al, 1992). Therefore knowledge and understanding about the range of policy instruments available is central to achieving policy objectives as the selection of a policy instrument may impact upon the success or failure of policies. As Bridgman and Davis (2004) note,

"Great policy ideas are of little use without appropriate means"

Bridgman (2004) drawing on Hood (1983) states that there are four common types of policy instrument used in Australia, which include those that are:

 advocacy-oriented: educating or persuading, using information available to government. Advocacy instruments are those based upon persuasion whereby governments attempt to achieve their goals through the provision of educational information to influence people's behaviour. This form of policy instrument is the government's way of achieving objectives without having to resort to force.

- money-oriented: using spending and taxing powers to shape activity beyond government. Money-oriented instruments involve the attaching of rewards and/or costs to influence behaviour of individuals and organisations.
- action-oriented: delivering services through government agencies
- force-oriented: legislation, regulation and official authority. Force-oriented instruments are those that are based on legislation whereby laws are enforced and are impose specific and unique obligations on individuals.

Evaluation

Interest in evaluating the policy process is fairly recent and therefore not yet systematic (Bridgman 2004). The Australian National Audit Office (1999: Part Two, 1-2) defines program evaluation as "the systematic and objective assessment of a government program, or parts of a program, to assist the government and other decisions makers" to:

- assess the appropriateness of a program in light of current circumstances,
- test its effectiveness in achieving the stated objectives, and
- evaluate its efficiency by determining if there are other ways of achieving the stated objectives.

Policy evaluation is ultimately aimed at increasing the rationality of the policy process (Weiss, 1972). It has been argued that although the theoretical content involved in policy generation implies a highly rational approach, it is not necessarily the case in reality. In real world environments, policies may be derived from illogical prejudices and even ungrounded assumptions (Palfrey, 1992). "Policy making is a process of successive approximation to some desired objective in which what is desired itself continues to change under reconsideration" (Lindblom, 1959, p86). Therefore the process of evaluation is important to continually assess the appropriateness, effectiveness and efficiency of different policies and programs. There are 4 key types of evaluation (refer to Figure 8.0 below):

- appropriateness: this type of evaluation assesses the extent to which a program is needed whereby the outcomes of the program are evaluated to determine for alignment with government priorities
- efficiency: this type of evaluation measures the extent to which the resources used to deliver the policy (inputs) are used to achieve its purpose.
- Effectiveness: this type of evaluation seeks justifications for the resources that are used to deliver the outcomes – it asks if the program is producing worthwhile outcomes.
- meta-evaluations: this type of evaluation measures the success of the evaluation process itself.



Figure 9.0 T

The different evaluation types

The selection of evaluation type is dependent upon the issue at hand whereby some programs require all four evaluation types while others only require specific focussed types.

The main instrument for policy evaluation has been through a set of performance indicators (PI). PI's offer qualified rather than absolute judgements.

"When goals are stated as absolutes...anything less than complete success tends to be construed as failure. This reading masks the real accomplishments of many public policies" (Anderson, 1994, p266).

Whilst the policy cycle suggests that there is scope for evaluation to take place at many points throughout the policy process, most evaluation work has focussed on the implementation stage. The process of evaluation is essential for existing programs to improve, however, have been identified to be a difficult task caused by numerous obstacles including (Bridgman 2004):

- Uncertainty over policy goals/objectives
- Difficulties in data acquisition
- Resistance
- Limited time perspective

As a result, many existing public policies do not always undergo the process of evaluation to measure effectiveness, appropriateness or efficiency.

5.4 Summary: Key barriers to policy implementation

Most existing literature surrounding the field of public policy has focussed on the theory related to the policy process. However, less research has been performed to determine the factors that help or hinder the successful implementation of innovative programs and practices in real world environments (Wilkinson 1997). Most theoretical models of the policy process are largely based on the assumption that the organisations or government agencies responsible for implementing policies have simple machine-like characteristics in that their actions are rational and based on the logic of the organisation's formal goals and that there are simplistic chains of cause and effect (Ryan 1996; Wilkinson 1997). There is a failure within these models to recognise that in actual practice, policy managers or officers within government agencies do not necessarily implement policies based on these strictly rationalised models nor for that matter is implementation of any policy in any organisation that simplistic.

It has been identified that different implementation models demonstrate different strengths and weaknesses in different policy environments or settings (Beer 1990; Winter 1990; Hasenfeld 1991; Mazmanian 1998). This implies that policy processes are highly contextspecific in that the development and implementation of new programs and practices need to be suited to the characteristics of the specific market in question. There is no doubting the merits of generic implementation models developed by some major government agencies. However, that is not to say that such models can be readily applied to or utilised by other government agencies as different organisations or government agencies require 'organisational-specific' implementation models. Furthermore, much of the management theory related to implementation of practice or policy and implementation models are generated from abstract general principles, which have not been tested or evaluated through empirical studies.

The key barriers to the successful implementation of programs/practices in the real world environment that have been identified include (Ryan, 1996; Bridgman and Davis, 2004):

- Conflicting objectives & directives (at different levels of government, different government agencies and between implementing actors)
- Limited competence/lack of capacity
- Insufficient resources (availability & allocation)
- Incomplete specification

Each of this will now be discussed in turn.

Firstly, governments have their own objectives and these may be in conflict with other governments', which could impact upon the successful implementation of policies. Policies developed by one level of government do not necessarily take into account the objectives of other levels. The same applies for agencies whereby implementation in real world environments can vary considerably across different implementing agencies and/or states. Different agencies have respective problems, which seek individual solutions that are specific to their problems. Empirical evidence has shown that some states or agencies do better than others in implementing the same program (Goggin 1987; Goggin 1990). Furthermore, agency administrators who implement policies typically receive instructions from a raft of individuals/groups including the cabinet, clients and governments, who each have their own objectives. This often leads to conflicting instructions given to the agencies responsible for implementation resulting in policies that do not achieve intended outcomes.

Secondly, some policies fail because implementing agencies lack the necessary capacity, expertise or commitment to implement them. Consequently when political objectives do not match their capacity, agency administrators tend to ignore official instructions to pursue personal policy preferences.

"...the objectives people have, the goals they seek to achieve, are a function not merely of their desirability but also of their feasibility. What we try to do depends to some degree on what we can do" (Wildavsky, 1987: 216).

Thirdly, for a policy to be implemented carefully and thoroughly, it needs to be deemed high priority so as to ensure adequate incentives are provided to emphasize the significance of specific tasks. When policy objectives fail to be communicated accurately – inadequate resources (legal an institutional) are provided to enforce program objectives. The decision on which agency is responsible for implementing a policy can also impact upon its success whereby some government agencies are more suited to the implementation of specific policies whilst others less so, based upon their core professional workforce and outlook. Therefore, the poor selection of agency can lead to failure to achieve policy objectives.

Finally, government policy documents set out broad general principles that do not provide sufficient information to inform policy development and implementation in a specialised field. This can lead to unclear policy objectives and/or inadequate information for agencies that are responsible for implementing them. When policy objectives are vague, agencies undergo difficulties as they cannot be certain of what is intended resulting in the implementation of policies that do not necessarily pursue the intended objectives.

6. SUMMARY

This report has examined the key barriers to environmental and economic sustainability within the respective sectors of C&D waste and PCC sectors and identified the relevance of supply chain management in improving the performance of the two sectors. More specifically, it has revealed the significant role the public sector client plays in achieving environmental and economic sustainability through supply chain management. It has also revealed major difficulties related to the successful implementation of public policy whereby there is a clear mismatch between policy and practice.

Further to that, it has been identified that there is the need to test or evaluate public sector supply chain policy through empirical public sector case studies to gain a deeper understanding of the difficulties of policy implementation at the sector level. There is a need to analyse existing policies related to supply chain management that have already been implemented to evaluate their effectiveness, appropriateness and efficiency in achieving intended policy outcomes.

The next report that follows will focus on an analysis of existing government policy documents related to supply chain management. Key themes that will be used for the analysis of existing government policy documents will be developed based upon the theory related to public policy that have been reviewed in this report.

7. **REFERENCES**

Beer, M., Eisentat, R. and Spector, B. (1990). <u>The critical path to corporate renewal</u>. Cambridge, Harvard Business School Press.

Bossink, B. a. B., H. (1996). "Construction waste: quantification and source evaluation." Journal of Construction Engineering and Management **122**(1): 55-60.

Bridgman, P. a. D., G. (2004). <u>The Australian Policy Handbook</u>. Crows nest, NSW, Allen and Unwin.

CIRIA (1995). Waste minimisation and recycling in construction: a review. <u>Construction</u> <u>Industry Research and Information Association</u>. P. a. M. Guthrie, H. London.

Dainty, A. a. B., R. (2004). "Towards improved waste minimisation: a need for improved supply chain integration?" <u>Structural survey</u> **22**(1): 20-29.

Dye, T. (1998). Understanding public policy. Upper Saddle River, Prentice Hall.

EPA (1998). Construction and Demolition Waste Action Plan. NSW, Environment Protection Authority.

Fenna, A. (2004). <u>Australian Public Policy</u>. Frenchs Forest, NSW, Pearson Education.

Formoso, C. F., C. and Soibelman, L. (1993). <u>Developing a method for controlling waste on</u> <u>building sites</u>. CIB: Economic and the Built Environment, Lisbon, Portugal.

Goggin, M., Bowman, A., Lester, J. and O'Toole, Jr., L. (1987). <u>Policy design and the Politics</u> <u>of Implementation: The case of Child health policy in the American States</u>. Knoxville, Tenn, University of Tennessee Press.

Goggin, M., Bowman, A., Lester, J. and O'Toole, Jr., L. (1990). <u>Implementation Theory and</u> <u>Practice: Toward a Third Generation</u>. USA, Scott, Foresman and Company.

Graham, P. a. S., G. (1996). "Construction waste minimisation for Australian residential development." <u>Asia Pacific Construction Management Journal</u> **2**: 14-19.

Hampson, K. a. M., K. (2001). Construction Innovation and public policy in Australia. Innovation in construction. A. a. S. Manseau, G. London, Spon Press.

Hasenfeld, Y. a. B., T. (1991). "Implementation of social policy revisited." <u>Administration and</u> <u>Society</u> **44**(4): 451-479.

Johnston, H. a. M., W. (1995). "Cost-effective waste minimisation for construction managers." <u>Cost Engineering</u> **37**(1): 31-37.

Kenley, R. (2002). <u>Financing construction: cash flows and cash farming</u>. New York, Spon Press.

Lingard, H., Graham, P. and Smithers, G. (2000). "Employee perceptions of the solid waste management system operating in a large Australian contracting organization: implications for company policy implementation." <u>Construction Management and Economics</u> **18**: 383-393.

London, K. (2005). Construction supply chain modelling. <u>Faculty of Architecture, Building and</u> <u>Planning</u>. Melbourne, University of Melbourne. Mackenzie, S., Kilpatrick, A. and Akintoye, A. (2000). "UK construction skills shortage response strategies and an analysis of industry perceptions." <u>Construction Management and Economics</u> **18**: 853-862.

Mazmanian, D. a. S., P. (1998). Implementation and public policy. Lanham, University Press of America.

Mc Grath, C. a. A., M (2000). "Waste minimisation on a construction site." <u>Building Research</u> <u>Establishment Digest</u> **447**.

Mills, T., Showalter, E. and Jarman, D. (1999). "A cost-effective waste management plan." <u>Cost Engineering</u> **41**(3): 35-43.

Ofori, G. (2000). "Greening the construction supply chain in Singapore." <u>European Journal of</u> <u>Purchasing and Supply Management</u> **6**: 195-206.

Poon, C. S. (1997). "Management and recycling of demolition waste in Hong Kong." <u>Waste</u> <u>Management & Research</u> **15**: 561-572.

Ryan, N. (1996). "A comparison of three approaches to programme implementation." International Journal of Public sector management **9**(4): 34-41.

Teo, M. a. L., M. (2001). "A theory of waste behaviour in the construction industry." <u>Construction Management and Economics</u> **19**: 714-751.

Wilkinson, D. (1997). "Whole system development - rethinking public service management." International Journal of Public sector management **10**(7): 505-533.

Winter, S. (1990). Integrating implementatioon research. <u>Implementation and the policy</u> <u>process: opening up the black box</u>. D. a. C. palumbo, D. New York, Greenwood Press: 19-38.

Zhu, Q., Sarkis, J. and Geng, Y. (2005). "Green supply chain management in China: pressure, practices and performance." <u>International Journal of Operations and Production</u> <u>Management</u> **25**(5): 449-468.



Cooperative Research Centre for Construction Innovation 9th Floor, L Block QUT Gardens Point 2 George Street BRISBANE QLD 4001 AUSTRALIA Tel: +61 7 3138 9291 Fax: +61 7 3138 9151 Email: enquiries@construction-innovation.info Web: www.construction-innovation.info

 Established and supported under the Australian
 Government's Cooperative
 Research Centres Program



